# Analysis of Food Demand in Assam:

## Evidence and Application from Primary and Secondary Data

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By

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*Dedicated to*

My Parents

*Murali Dhar Chowdhury and Chapala (Baby) Chowdhury*

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# Declaration

This thesis entitled **"Analysis of Food Demand in Assam: Evidence and Application from Primary and Secondary Data"** submitted for the degree of Doctor of Philosophy has not been previously submitted for any other degree of this or any other university and is my original work.

In keeping with the general practice of reporting scientific observations, due acknowledgement has been made wherever the work described is based on the findings of other investigations.

B. Chowdhury.

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Date: 16th August 2021 Research Scholar

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## Certificate

This is to certify that Ms. Bandana Chowdhury has prepared the thesis entitled **"Analysis of Food Demand in Assam: Evidence and Application from Primary and Secondary Data"** for the degree of Doctor of Philosophy at Indian Institute of Technology Guwahati. The work was carried out under my supervision and in strict conformity with the rules laid down for the purpose. The thesis is the result of her investigations and has not been submitted either in whole or in part to any other university/institution for a research degree.

Place: IIT Guwahati (Dr. Bodhisattva Sengupta)

Date: **17 August 2021** Supervisor

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*B. Chowdhury.*

*Date: 16th August, 2021* *Bandana Chowdhury*

*Place: Guwahati*

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# Abbreviation

| Abbreviation | Explanation |
|---|---|
| AIC | Akaike's Information Criteria |
| AIDADS | An Implicitly Directly Addictive Demand System |
| AIDS | Almost Ideal Demand System |
| ANOVA | Analysis of Variance |
| BIC | Bayesian Information Criteria |
| BTL | Basic Translog |
| CBS | Constant Budget Share |
| EFM | Egg, Fish, Meat |
| FNGLS | feasible non-linear Generalized Least Square |
| FSU | First Stage Unit |
| GLS | Generalized Least Square |
| HH | Household |
| HS | Higher Secondary/ Class $12^{th}$ |
| IMR | Inverse Mill's Ratio |
| LA-AIDS | Linearly Approximate Almost Ideal Demand System |
| LES | Linear Expenditure System |
| LTL | Linear Translog |
| MPCE | Monthly Per Capita Expenditure |
| NLS | Non-linear-least-square |
| NSSO | National Sample Survey Organization |
| PG | Post Graduation |
| PIGLOG | Price Independent Generalized Logarithm |
| PTI | Pan, Tobacco and Intoxicants |
| QES | Quadratic Expenditure System |
| QUAIDS | Quadratic Almost Ideal Demand System |
| RNLPS | Restricted Non-Linear Preference System |
| SC | Scheduled Caste |
| SD | Standard Deviation |
| SRS | Simple Random Sampling |
| SRSWOR | Simple Random Sampling Without Replacement |
| ST | Scheduled Tribe |
| SUR | Seemingly Unrelated Regression |
| UK | United Kingdom |
| URP | Uniform Reform Period |
| US | United States of America |
| UFS | Urban Frame Survey |
| USU | Ultimate Stage Units |
| INR | Indian Rupee |

# Abstract

The thesis addresses the issues related to food demand estimation for the Indian state of Assam through exploiting both official (NSSO) as well as survey data. Motivation for taking up this research is twofold. First, although there are many types of research related to pan India level concerning computations of various demand elasticities, studies that are based on a single region or a state are somewhat rarer. Such pan-Indian studies do not do justice to the diversities that are natural to a country like India. Thus, there is a motivation for such studies from a positive frame of analysis. Second, such elasticity measures directly contribute to understanding and implementation of various policies, e.g., tax policy in particular and food policy in general. It is our contention that in a country like India, a "one size-fits-all" type of policy may miss its welfare targets altogether. And hence, in order to implement a differential regional policy (or policies), we need to understand regional demand patterns. Hence the research objective also has a normative dimension.

We provide a brief outline of the thesis here. First, a broad range of literature is reviewed to understand the issues involved both at the national and international levels. This non-technical survey allows us to identify the gaps in the present state of knowledge and provides the motivation for the current endeavour. Second, we reviewed the technical methodology of demand estimation and its applications, particularly to tax subsidy issues. These two chapters complement each other. Given this background, Chapter 4 explores the pattern of food consumption in Assam, using secondary data sources (NSSO 68th and 66th rounds). We also analyze the methodology of these rounds and highlight their similarities and differences. Then, using the data, we undertake a comparative study of elasticities across rural and urban sub-samples (within a single round) as well as over the different rounds (over time comparison). We use both the Linear Expenditure System (LES) and LA/AIDS estimation methods to figure out the elasticities. Using the estimates, we show how the data can be used to predict the direction of optimal commodity tax reform. Given the obsolescence of the data (NSSO 68$^{th}$ round was carried out in 2012, and since then there are no other rounds of NSSO detailing consumption expenditure), we carried out a survey data in two contiguous districts of Assam: namely Kamrup Metropolitan (That is, Guwahati city, the state capital) and Kamrup. The sample survey covers both rural and urban parts. The next two chapters are devoted to the analysis of the survey. Chapter 5 presents the details of the primary data.

After providing the details of survey methodology, the rest of the chapter is then devoted to exploratory analysis of household-level consumption expenditures (at various levels) and their link with demographic characteristics. We extensively use paired t-tests and ANOVA analysis to highlight differences in the consumption analysis. Of course, such group comparisons have problems of their own.

Hence, in the next chapter, we use the data for regression analysis and applications. The main aim is to analyse food consumption patterns. In that chapter, we use two different techniques to analyse demand. First, I used multiple equation demand system estimation (using LES and LA/AIDS) where the data permitted. Second, the chapter also discusses a single equation model (with limited data) and highlights the difference between urban/rural as well as poor/rich sub-samples in terms of the effect of demographic variables and expenditure elasticities. The estimates from the complete demand system are used in optimal commodity taxation literature as well.

Based on the findings, one of the major implications is that policymakers should consider context-specific identification of factors affecting food consumption demand. Estimates do differ across samples as well as across the method of estimation. Policy-wise, one must pay attention to the demographic variables. Our analysis provides some limited evidence that the tax rules as prescribed by the current GST regime should be modified.

# Publications

1. Chowdhury, B. (2017) Understanding Two Demand Systems: Theoretical and Empirical Evidences, *Assam Economic Review*, Volume 12, pp 84-95

2. Chowdhury, B. (2016) Optimal Commodity Taxation: Evidences from Assam, *Assam Economic Review*, Volume 11, pp. 264-278

# CHAPTER 1

# INTRODUCTION

## 1.1 Background of the Study

Economists utilize consumption data in multiple ways. At one end, Macroeconomists pay their attention to *the aggregate* consumption behaviour of a country as it constitutes a large part of National Income. Initiated by Keynes (1936), the key intellectual challenge is to understand the determinants of consumption expenditure in an economy (Friedman 1957, Ando and Modigliani 1963, Hall 1978 are among some references). On the other hand, micro economists focus on patterns of household consumption. The reason behind such a focus is the implicit fact that individual levels of material well-being depend crucially on the consumption of goods and services. Hence, the consumption vector of goods and services (both in levels as well as composition) translates into an indicator of the standard of living of an individual or a society (Slesnik, 2000 provides a discussion in the context of the United States of America). The research agenda here has three dimensions. The primary thrust of research is to understand how consumption is affected by various economic and non-economic factors. Once these factors are identified, the second question is how a change in these factors relates to a change in consumption patterns, that is, the sensitivity of consumption (again, both in terms of level and composition) to the exogenous determinants. Finally, since consumption patterns are linked with welfare, the role of economic policies (in which the change in exogenous factors are sought *consciously*) in aiding and abetting the promotion of economic well-being can also be explored. From this perspective, a microeconomic study of consumption patterns applies to numerous and fundamental normative analyses. These include (but are not limited to) projections of future consumption demand, nutritional analysis (adequate intake of calorie and other micronutrients) and promotion of healthy diet patterns (such as reduction in demand for junk foods, see Powell and Chaloupka 2009), construction of cost of living indices, as well as designing commodity taxes.

Food is one of the most fundamental needs for human existence. As Zezza et. al. (2017) have pointed out, expenditure on food contributes to roughly 50% (if not more) of the household budget. Hence food consumption pattern of households is an important barometer of individual welfare and well-being. Such a large share makes the estimation of food expenditure and its principal determinants an integral part of applied welfare economics. Over time and in cross-section, the distribution of consumption patterns across different socio-economic groups is also essential on its own (Vaidyanathan, 1985; Reddy 2004; Pavithra, 2008). Changes in the demand pattern of individuals have serious repercussions in growth, in intra- and international trade as well as in the development prospects of a country.

The current research focuses on the study of the effect of the household budget and other demographic variables (such as family size and composition, household-level educational attainment, socio-demographic variables such as caste, religion, and linguistic identity) on household consumption. Studies in India and elsewhere have indicated that the relationship between consumption decision and demographic variables are likely to be different for different food items (Khan and Khalid, 2012; Dankwa et.al, 1992; Deaton, 1989; Gupta and Mishra, 2014). Further, linking consumption to demographic variables enable policymakers to go beyond economic variables (such as income/expenditure and/or prices) as the only marker of consumption. For example, given the same level of income or prices, if a group of households with certain common demographic characteristics' fall behind' in food consumption; policymakers can go for group/family specific policies. Estimates are also sensitive to the place of residence, i.e. along with urban/rural segments (Deaton and Tarozzi, 2000; Rogers 1988; Deshmukh and Vyavahare, 2018). Thus, such estimates can be used for multiple purposes.

## 1.2 Statement of the Problem

Reviews of the existing literature on these topics show that a few works have been carried out along these lines for India as a whole. But as far as my knowledge goes, only a limited number of studies are devoted to the analysis of regional demand patterns in India. Unless exhaustive research is conducted to understand regional consumption patterns, there is a high possibility that policies aimed at improving the standard of living may miss their welfare targets altogether. Therefore, an academic effort has to be channelized towards the study of consumption patterns in the region. One hopes for a better understanding of regional demand patterns, the characteristics of which often get masked under an all-India study. Such an endeavour may help to predict local demand of food products under different scenarios of prices and income and could prove valuable for the planners for formulating region-specific policy decisions that hinge crucially on spatial characteristics, rather than adopting a "one-size-fits-all" type of policy.

The focus of the present study is Assam in general and Kamrup (Metro) and Kamrup District in specific. The current research focuses on the effects of economic variables like household budget/ prices and other demographic variables (such as family size and composition, household-level educational attainment, socio-demographic variables such as caste, religion, and linguistic identity) on household consumption. As an application, I have shown how the elasticity estimates can be used to judge the direction of commodity tax reform.

## 1.3 Objectives of the Study

As stated above, the main objective of the study is to investigate consumer demand behaviour in Assam.

Based on this broad objective, we propose the following sub-objectives:

1. To explore the consumption patterns of food items.
2. To apply the knowledge of consumption patterns in two areas: demand estimation and optimal taxation.

## 1.4 Data Source and Methodology

The present study uses both primary and secondary sources of data. As far as secondary sources are concerned, data on the research is collected and collated from various reports and publications of government and other organizations, such as the National Sample Survey Organisation (mainly NSSO 66 and 68 Rounds).

But to fill up the gaps of the secondary analysis which includes missing data regarding certain consumption items, the accuracy of NSSO data, obsolescence of relevant data (till 2012 only), I also conducted a primary survey at a much-disaggregated level. The field of the study is two contiguous districts of Assam. I have followed the primary division proposed by the National Sample Survey Organization (NSSO) of India: i.e., rural (villages within the ambit of Guwahati Municipal Area as well as far off villages) and urban (Guwahati city).

I adopted a stratified multi-stage design for the primary survey. Within the two selected districts, two basic strata are formed. The rural stratum comprises all rural areas of the district and the urban stratum includes urban areas of the district. I used both multi-stage random and purposive sampling procedures. The city of Guwahati is divided into six zones by the Guwahati Municipal Corporation namely, East Guwahati, West Guwahati, South Guwahati, Central Guwahati, Dispur and Lokhra. One municipal ward from each zone has been selected randomly. A proportional random sampling technique is used. Thus, the number of sample units of chosen households in each zone is proportional to the number of households in the zones. Chatribari from South, Adabari from West, Gorchuk from Lokhra, Fancy Bazar from Central, Khanapara from Dispur, Ganeshguri from East was randomly selected for the final survey. Also, Dharapur and Garal from the Azara block have been randomly selected. For Kamrup district, Khepnikuchi village from Rangia, Hadala village from Hajo, Bansar village from Sualkuchi, Upar Hali village from Palashbari, Tinigharia from Boko, and Kukur Mara from Chhaygaon have been randomly selected after purposively clubbing villages together with specific characteristics such as the prevalence of particular social or religious groups, religion, etc. within the village.

For both primary and secondary sources, I have analyzed the collected data using multiple estimation strategies. The relevant econometric models mainly come in two groups. The majority of the work is done through multiple equation demand system estimation. The commodities (or groups of commodities) under consideration are such that price-quantity data is available for all. Where such information is limited, a single equation model is adopted to include all categories.

The focus is mainly on estimating various elasticities and doing a comparative analysis across sub-samples and demand models. As an application of elasticity measurements, I show how the data (in a limited way) can hint towards the direction of commodity tax reform. The methodology, in detail, has been discussed in the respective chapters.

## 1.5 Layout of the Chapters

The thesis for the study has been prepared in seven chapters in total, including the present one. Following is a brief overview of those chapters.

Chapter 1, with the title "Introduction," incorporates the background of the study followed by the statement of the problem and objectives of the study. I present the data source and methodology in this chapter. The chapter ends with the chapter plan of the thesis.

Chapter 2 (entitled "Review of Literature") starts with a brief overview of consumption patterns. It discusses the relevant literature on the economic and socio-demographic determinants in the consumption behaviour of food items. It also reviews a few works on the issues of measurement. Moreover, studies on optimal taxation in the global scenario and India have been reviewed. In the end, the gaps in the literature have been identified and discussed. Hence, it provides a motivation for the current research. The discussion of the chapter is non-technical.

Chapter 3 provides a brief technical overview on the methodologies for estimation of multiple equation complete demand systems as well as single equation models. The focus of this chapter is on three things. First, I discuss the assumptions of each model, followed by the (system of) equations generated. Second, I derive elasticity formulas specific to those models. Finally, I show how demand estimates can be adopted for application in commodity tax literature.[1]

Chapter 4 explores the pattern of food consumption in Assam using secondary data sources (NSSO 68th and 66th rounds). In this chapter, first I briefly analyze the methodology of these rounds and highlight their similarities and differences. Then, using the data, I undertake a comparative study of elasticities across rural and urban sub-samples (within a single round) as well as over the different rounds. Using the estimates, I show how the data can be used to predict the direction of optimal commodity tax reform. The problem with secondary sources justifies the necessity of a field visit.

Chapter 5 presents the details of the primary data survey done in two contiguous districts (Guwahati Metropolitan and Kamrup) of Assam. The survey gathered information on certain food items of consumption as well as the relevant demographic features of the respondents. I provide a detailed account of the survey methodology. The rest of the chapter is then devoted

[1] Chapter 2 and 3 are intertwined as the literature and estimation procedure are closely linked.

to exploratory analysis of household-level consumption expenditures (at various levels) and their link with demographic characteristics.

Chapter 6 uses the data collected in the primary survey in regression analysis and applications. The main aim is to analyse food consumption patterns. In that chapter, I use two different techniques to analyse demand. First, I used multiple equation demand system estimation where the data permitted. Second, the chapter also discusses a single equation model (with limited data) and highlights the difference between urban/rural as well as poor/rich sub-samples. The estimates from the complete demand system are used in optimal commodity taxation literature as well.

Chapter 7, entitled "Summary of Findings and Conclusion," records the significant findings of the work. In the end, I make some policy conclusions.

The list of references of books, journals, periodicals, reports, etc., used in the preparation of this thesis is in the Bibliography.

# CHAPTER 2

# REVIEW OF LITERATURE

## 2.1 Introduction

Exploration of consumer behaviour is a cornerstone of modern neoclassical analysis. The theory, as developed by, among others, Marshall (1890)[2], Walras (1874), Hicks (1939, 1956), provide two important strands. First, methodologically speaking, the development of the theory of consumer behaviour parallels the methodology of economics itself: one can see it as a classic case of studying "human behaviour as a relationship between ends and scarce means which have alternative uses" (Robbins, 1932). The theoretical explorations linked consumption to welfare (particularly after Hicks, ibid), and since then has been an important ingredient of welfare economics. On the other hand, to interpret demand data to be consistent with such theoretical predictions, new empirical tools have been developed to bridge the gap between theory and empirics. Thus, demand analysis enjoys a long and fruitful intellectual tradition from both theory and empirical points of view (Deaton, 1980).

Of course, demand has many facets, as the vector of consumption, particularly in modern industrial society, can be very large. For example, one may focus on the demand for energy (Ros, 2017), Mobile phones (Ahn and Park, 2010), for medical care (van Der Gaag and Wolfe, 1991), leisure and associated activities (Njegovan, 2006), or even demand for environmental services provided by, say, national parks (Khan, 2009). However, in this present work, I will focus on the demand for food.

Food is a basic need of human existence and has an enormous economic impact on households. For this reason, it is imperative to gain a thorough knowledge of the determinants of food demand to design comprehensive agricultural, food and social policy options that improve access to food. Expenditure (income) and price elasticities of food demand are exemplified as the key information for this purpose, and econometric analyses are needed to estimate them empirically.

Two main issues are involved. First, one needs to discuss the determinants of consumer demand as predicted by traditional economic theory. An equally important component is the

[2] A stand-alone chapter on "Law of demand" can be found in Cournot (1838).

estimation technique involved. It is possible that different techniques, when applied to the same data set, yield completely different results regarding the key elasticities. Accordingly, we have devoted two sections in order to survey the literature on determinants of demand and various estimation techniques (for a technical discussion of the latter, please refer to Chapter 3). Further, as an application of elasticity calculations, I explore the literature on commodity taxation which uses such elasticity measures.

The chapter is divided into the following sections. In section 2.2, we discuss the consumption pattern of food. Section 2.3 discusses the relevant literature on determinants of consumer demand. Section 2.4 devotes itself specifically to estimation techniques. Section 2.5 includes a discussion on the literature on optimal taxation. Section 2.6 concludes and indicates the research gap.

## 2.2 Consumption Patterns: An Overview

Regmi (2001) provides non-technical evidence that the food budget share and income elasticity of food decrease with the increase in income. The staple food of low value (such as cereals) accounts for a larger food budget share in developing countries whereas food of high value (such as dairy and meat) accounts for a larger food budget share in developed countries. There is a change in the consumption pattern of food and people are shifting from cereals to high-calorie commodities such as milk, meat, fish, etc., that is, from low value to high-value commodities (Kumar and Kumar, 2004; Meenakshi, 1996). But, in rural areas, the shift in consumption pattern is more than those with greater improvement in infrastructure (Rao, 2000). The changing consumption pattern has resulted in a decline in per capita household demand for foodgrains (Radhakrishna and Ravi, 1992; Kumar and Mathur, 1996; Murty, 1999; Kumar and Kumar, 2003). An analysis of state-level demand (in which only major states are involved) suggested that consumers are switching away from cereals toward the more expensive milk, poultry and meat products (Meenakshi 1996). In recent years, an important issue is the so-called “calorie consumption puzzle” (see Basole and Basu, 2015, Deaton and Dreze 2009), where an increase in consumption expenditure is associated with a decline in calorie intake. Law et. al (2019) provide some evidence that over time, cereal demand in India is becoming less (resp. more) income (resp. price) sensitive. Change in consumption pattern indicates changes in preferences. Hence, an understanding of such changing consumption patterns would have implications not only for food grains demand projection but also for development policies. In an age of lifestyle diseases, diets have become important from a public health point of view. Third, for agricultural marketing and associated policies, understanding of (present and future) demand patterns becomes a key issue (majority of articles regarding food demand appear in various `Agricultural Economics' journals). It is, therefore, pertinent to understand the consumption pattern of households in society.

Food demand in India has been characterized by changing preferences. Bhattacharya (1966) had attempted to re-examine the Rudra (1964) and Paul (1964) estimates of elasticities. It was observed that owing to the limitations of the data, the estimates have very wide margins of error. Point estimates seemed to be closer to cross-section elasticities than Rudra-Paul's suggestions that income elasticities were different from the NSSO and the elasticities of necessities and luxuries were much closer to one.

There exists an extensive explanation of studies relating to own and cross-price elasticity in international trade and also, "median" price elasticities segregated by the commodity group and country (Stern et. al. 1976). Armington (1969) used an efficient design of estimation or derivation of the own and cross-price elasticities to imports which were disaggregated by commodity types (and/or by the source country).

## 2.3 Determinants of Consumption

According to the theory, the main determinants of consumption are income (or, when data on income is not available, the total budget or expenditure), prices as well as tastes and preferences. Income/expenditure and price data are observed variables (and, at least theoretically, readily available), while tastes and preferences are not. Researchers have tried to capture the unobserved taste and preference patterns by looking at household level socio-demographic characteristics.

### 2.3.1 Income/Expenditure as Determinant of Consumption

At the very basic level, the main determinant of food demand is household income/expenditure (apart from prices). In many counties where income data is not readily available, expenditure is taken as a proxy of income. Income determines both the level and composition of food demand. According to Engels Law[3], subsistence expenditure makes up a high proportion of income for people with low per-capita income, thus leaving little room for saving (Chai and Moneta, 2008). This, at one level, immediately suggests that poor and rich consumption behaviors are different.

As far as demand components are considered, the key variable is the expenditure/income elasticity of various food items. It gives a ready reference to, say, with economic growth, which commodities have higher (or lower) consumption. It was also observed by Gupta and Mishra (2014) that people belonging to a higher income level have a healthier dietary regime which included fruits, vegetables, meat and oil consumption. Higher income led to a higher economic status which subsequently resulted in better knowledge and understanding regarding healthy eating. This view was supported by Davis et. al (1983) who analyzed that with higher income, consumption on basic needs decreased but expenditure on luxurious and semi-luxurious items increased. There is another contradictory view that pointed that a household may have lower income but higher consumption through dis-savings or with the hope that their future income may increase (Houthakker, 1957; Basumatary, 2015). A study by Mathew (2003) revealed a higher Engel's ratio in food in rural households and with an increase in both food and non-food expenditure due to an increase in the income of urban households (Pradhan et.al, 2000).

### 2.3.2 Prices as Determinant of Consumption

Economic theory predicts own-price elasticities to be negative and cross-price elasticities may be positive or negative depending on whether the commodities are substitutes or complements. The elasticities have both. Differences in magnitudes of own-price elasticity (compared to corresponding expenditure/ income elasticity), indicate whether the policymaker (concerned for food policy designed for vulnerable sections of society) should stress on price support or income support policies. Similarly, positive cross-price elasticity between the goods x and y indicates that a subsidy/cut in the price of x will boost the consumption of y. With respect to prices, such cross-price elasticities may be non-symmetric (Kao et. al, 2001). Andreyava et. al (2010) have conducted a meta-analysis of 160 studies in the context of the US to get an idea of the mean range of elasticities by food category as well as variations in estimates. According to their analysis, among 16 food

[3] Refers to the law postulated by Ernst Engel in 1857 that states that the proportion of income spent on food tends to decline as income increases, with given tastes and preferences.

categories, Food Away From Home shows the highest (own) price elasticity and eggs rank the last. Meng et. al (2014) conducted a study (using a pseudo panel procedure) solely focused on the own and cross-price elasticities of various alcoholic beverages in the context of the UK.

A major issue is which price is to use. Time series analysis is often carried out using wholesale price indices (Viswanathan, 2001) of respective years. Cross-section analysis (in which many times, no price data is included) is carried out using "unit prices" (dividing total expenditure by total consumption). However, quality effects of food items become an issue, and elasticities reflect "quality indices" rather than prices (see appendix 2A to this chapter).

In addition to the described elasticities and consumption patterns, some other demographic features like the possible effects of income changes on patterns of per capita expenditure in both rural and urban areas; and no doubt, the simultaneous effect of total expenditure, location, and household size on food expenditure patterns of a country is also mandatory to design wide-ranging agricultural, food and social policy options that build up the strength of the households towards the healthier food access. A review of few works relating to the effect of socio-demographic characteristics on food consumption behaviour is incorporated in the next section.

### 2.3.3 Socio-Demographic Characteristics

The focus is the effects of the household budget and other demographic variables (such as family size and composition, household-level educational attainment, socio-demographic variables such as caste, religion and linguistic identity) on household consumption, as summarized in budget share. As said earlier, such socio-demographic variables capture the hidden "taste and preference" parameter in a positive sense. In terms of policy, the study of demographic variables and expenditure/price elasticities can be used in figuring out income supplements (at least for the commodities which have a high calorie/other nutritional benefits). Further, linking consumption to demographic variables enable policymakers to go beyond income as the only marker of consumption. Given the same level of income, if a group of households with certain common demographic characteristics 'fall behind' in food consumption; policymakers can go for group/family specific in-kind transfers than cash transfers.

Empirical evidence indicates that household characteristics such as household size, education, ethnicity of the household head, and residential location of the household are important factors in determining household consumption behaviour; hence, a review of a few studies on the impact of socio-demographic characteristics on consumption has been carried out with the following sub-heads.

***Gender of the Head:*** Consumption was not homogeneous across the male-headed households and female-headed households. Khan and Khalid (2012) have demonstrated that Female-headed households seemed to have higher budget shares for housing, fuel and lighting, education and footwear with lower expenditure on food, transport and communication as compared to their male counterpart.

***Region/Urban/Rural Area:*** In India, the rural-urban disparities of per-capita expenditure have been increasing with the increase in per capita expenditure (Deshmukh and Vyavahare, 2018). Poor Indian states have different consumption patterns than those of the richer states. Myers (2007) tries to give a proper distinction between the demand behaviour across rural and urban households and various income groups using the KwaZulu-Natal Income Dynamics Study data. This was important as a study because size structural change, demographic effects and seasonality effects were taken into account. Results revealed them to be significantly different between rural and urban households across various income groups. This implied that an accurate analysis of expenditure patterns required a disaggregated analysis that takes into account these differences in demand behaviour. Rogers (1988) focused on the socio-economic aspect of the urban and rural populations and the expenditure pattern of the two populations. The income and expenditure patterns in terms of transportation, food and housing were compared with rural and urban populations. The urban counterparts had a higher level of expenditures on food, housing and apparel whereas the rural population's average income was spent on transportation, health care, tobacco and other personal insurance. Therefore, there are differences in the way that urban and rural consumers allocate their expenditures budgets as regard socio-economic changes. In a Chinese survey, expenditure in urban areas was mostly done on luxury items and education, whereas in rural areas expenditure was on fundamental needs and basic amenities (Ha, 2006). Moreover, Rogers and Green (1978) found food expenditures to be lower in non-metropolitan areas than within metropolitan areas both away from home and at home. Rural households had a higher Engels ratio in food (Mathew, 2003) and both food and non-food expenditure increased with an increase in income of the household urban areas of India (Pradhan et.al, 2000). Redman (1980), in an analysis of the 1972-73 and 1973-74 United States Consumer Expenditure Survey Data, revealed that households residing in the urban areas spent more on prepared foods than did households residing in rural areas and fewer meals were eaten at home by urban households than their rural counterparts. Aziz and Malik (2010, Pakistani data), show that the partial food demand systems as a basis for the future choice of Pakistani food policies in their study. The expenditures on vegetables and meats increase with higher income in rural areas weigh against the urban areas. However, the expenditures on fruits, and milk and milk products are more likely to increase with higher income both in urban areas than in rural areas. Bhalla et. al. (1999) worked with NSSO 50$^{th}$ Round data using log inverse expenditure function for cereal, milk and milk products and meat and eggs. At the national level, both urban and rural estimated the expenditure elasticity of cereal for rural households to be 0.29 and for urban households to be 0.18. This indicated that an increase in household income will result in a proportionally greater increase in expenditure for both rural and urban households.

***Household size and Composition:*** Expenditure Elasticity of household size is positive for necessities and negative for luxuries with respect to income (Jain, 1983). Also, economies of household size seemed to be more effective for non-food consumption (Davis et.al, 1992). In a study by Dankwa et.al (1992),[4] two household size effects were identified. First is the *specific effect* which resulted from the increase in the need for various commodities when family size increases. But the increase was found to be less than proportional to the increase in household size due to the presence of economies of scale in households with a larger number of consumers. Second is the *income effect* which indicates that an increase in family size makes the household relatively poorer. It was observed that with the increase in family size, the need for every commodity does not increase in the same proportion but may reduce the need for some specific items.

When a household bears a child,[5] it cuts down the consumption of adult goods such as clothing, tobacco, intoxicants, etc., which may be regarded as the cost of the child (Deaton, 1989). Adults, mostly elders spend most of their expenditure on medical and health care in the USA (Moehrle, 1990). A concept of demographic separability was proposed by Deaton

[4] See also Young and Hamdok (1994, data from Zimbabwe)

[5] Barten (1964, op cit) pioneered the choice theoretic analysis of the household size and demographic considerations. As Gorman (1978) noted "When you have a wife and baby, a penny bun costs three pence" (quoted in Myles, 1996, pp 68)

et.al (1989) that formalizes the notion that there are groups of goods (adult goods) that have little or no relationship to specific classes of household demographics (the numbers or ages of children). Pollak and Wales (1981) analysed that the number of children does affect consumption patterns. Studies conducted by Heiem *et. al*. (1989, in the context of Mexico), Lahiri (1990, in the context of Egypt), Raper *et. al.* (2002, in context of USA) demonstrate that household size, employment and marital status, household composition, etc. are important determinants of consumption patterns. Grewe (1998) analysed Indonesian data to evaluate the impact of extended families on food demand.

***Religion:*** Expenditure on consumption varies significantly among different religions of the consumers. There are religious barriers like *forbidden* and *permitted* food among consumers belonging to the Islamic religion and preference for vegetarian food seemed to be more prevalent among certain Jain and Hindu consumers (Gupta and Mishra, 2014). A larger portion of cereals (e.g., rice) was consumed by Hindu and Christian households, whereas, pulses was the staple diet among Jain, Buddhist and Sikh religious groups.

***Social Group/Ethnicity*:** The effect of ethnicity, with income controlled, on household consumption has been investigated in studies by Redman (1980) and Capps et. al. (1985). Redman (1980) found that black households spent significantly less on prepared foods than did non-black households. Similarly, Capps et. al.(1985) also found that black households allocated smaller budget shares of total food expenditures to all convenience foods but larger budget shares of total food expenditures on non-convenience foods than did white households. Raper et *al ibid*, Charles *et al* 2009 find evidence that race and ethnicity matter both in the level and composition of consumption. Charron-Chennier et. al (2016) have argued that in the context of the US, racial disparities in consumption occur independently of economic disparities matters both in level and composition of consumption. Abdulai et. al (1999, in the context of India) show that effects of demographic variables such as region, household size, education are significant in consumption patterns.

***Education:*** The educational level of the household head has also been found to influence household expenditure patterns (e.g., Lazear & Michael, 1988; Rikhana, 1991; Smallwood & Blaylock, 1981). In their study of food expenditure patterns in the United States, Smallwood and Blaylock found that female household heads with higher levels of education spent less on food away from home than did female household heads with lower levels of education.

Lazaer and Michael and Rikhana also found that the effect of the education level of the household head had a positive and significant effect on total household expenditures. In a study by Sekhampu, T.J. and Niyimbanira (2013) the number of people employed, employment status, and the educational attainment of the household head were also associated with a positive influence on household expenditure. This suggests that households, where the head has more education, have higher household expenditures than their less-educated counterparts. A percentage increase in the educational attainment of the head of the household was associated with a 15% increase in household expenditure. Individuals with different levels of education may have other knowledge and different perceptions about diet and health, and consequently may have a different consumption basket. Highly educated people were seen to consume less meat indicating them to be more nutrition-conscious by Vega and Gracia (2000, Mexico). Yusuf and Brooks (2010, urban Chinese data) found differences in consumption patterns with regard to the education level of the head of the household. Hasyim et al. (2018) also found household heads' education level to have significant effects on household consumption patterns of small businesses partially. This view was shared by Yueh (2006) and Omori (2010) where they observed that the education level of the household head has an additional effect on personal and household expenses. It was further mentioned that household income and parental education are the main factors influencing expenditures on children's education, entertainment, and books (Omori, ibid)

## 2.4 Measurement Issues

The section is devoted to studies that are important from a "methodological" viewpoint.[6] The key thrust is to estimate various elasticities and then use the elasticities as a guide to policy and welfare implications. Initial attempts of obtaining the elasticity focussed on estimating single-equation models (each good is treated separately). The analysis was pioneered by Praise and Houthakker (1955, 1971), Working (1943) and Laser (1963). The advantage of single-equation models such as above is the fact that they can be used even if there is a paucity of some data (say, price). On the other hand, the method is not consistent with utility maximization (Muelbauer, 1980).

Since Stone's (1954) seminar article, many studies (see the bibliography of Deaton and Muelbauer *op cit*) have adopted a linear expenditure system as a convenient starting point.

[6] The analysis here is as non-technical as possible.

The main problems with LES are (a) for certain values of prices and income, predicted expenditure is negative. Although it is not satisfactory from the theoretical aspect, this system may be still being used for other price-income points. (b) LES seems to be limited due to a lack of long time series data or continuous cross-section data. They are unduly restrictive as a result of arbitrary assumptions used in the derivation of parameters (Chang 1994). (c) LES is price relative and requires few independent parameters (2k-1; k = number of commodities). Although this makes its applicability an easy task, it is sometimes not free from limitations such as goods are Hicksian substitutes and cross-price derivatives are proportional to expenditure derivatives, expenditure elasticities are always positive, etc. Murty and Ray (1989) argued that estimation of optimal commodity taxes that are based solely on LES (e.g. Harris and Mackinnon 1979) distort the price and expenditure responses.

Despite these criticisms, LES (among all other demand models) exhibits a very close consistency with consumer choice theory (having well-defined expenditure and indirect utility functions). More recent examples include Clements et al (2020, Australian data), Lahiri (ibid), Berges and Casellas (2002, Argentina), Raper ( ibid). Arar and Verme (2016) have used LES (among other systems), to compute consumption and welfare changes implied by price changes. Chang and Fawson (1994) discussed certain systematic estimation trends in consumer behaviour during 1951-1990. A higher $R^2$ value along with significant t statistics of the relevant estimates revealed that the LES system was a useful tool in characterising the wide tendencies in the allocation of expenditure behaviour of individuals. Although somewhat dated, Howe (1977) demonstrated how to incorporate demographic variables in a LES framework.

Now we discuss a few studies that are focused on estimation methodologies of LES are in order. Chipman and Tian (1989) deal with problems relating to the stochastic specification and MLE of LES with attached restrictions of the assumption that minimum required quantities for the commodities have a three parameters multivariate lognormal distribution. Ham (1978) estimated the LES with the help of maximum likelihood whereas Parks (1971) proposed two procedures for estimating the LES by maximum likelihood: a Gauss-Newton routine and a modification of Stone's (1954) original proposal. Here, LES has been compared to the more conventional method of estimation and is found to use significantly less computer time than the conventional method.[7]

The basic LES model has been extended to many directions, for example, Lluch (1973)[8] introduced Extended LES (ELES) model to obtain an estimate of savings propensity. The main difference is to change the expenditure, M, by income, Y. Houthakker (1960, see also Deaton and Wigley 1971) proposed a non-linear extension of LES. [9]

One of the most popular methods is the **A**lmost **I**deal demand system (AI demand system) proposed by Deaton and Muelbauer (1980) and its various extensions. AIDS and its various extensions give an arbitrary first-order approximation to any demand system without forcing linearity on the Engel curve. Satisfying the axioms of choice exactly, it gives a functional form that is consistent with known household-budget data. It is easy to calculate, simple to estimate, and largely avoids the need for nonlinear estimation and it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters.

The application of (LA/)AIDS and its various extensions are many. Here, I pick a subset of key and literature. Molina (1994) used AIDS in Spain, using the annual time series of 1964-89 for six food categories. Fulponi (1989) and Margos and Donatos(1989) used AIDS to estimate Food and meat demand in France, and food demand in Greece, respectively. Blanciforti and Green (1983) modified the AIDS model with habit persistence and used it to estimate a time series model of US data for 1948-78. Ulubasoglu et al (2016) used the AIDS model to compute demand for food elasticities for 15 disaggregated food categories in Australia. Ivanova (2005) has used the model to examine the demand for domestic and imported commodities in Russia.

In the context of developing economies, Taljaard et. al (2003) estimated demand for four categories of meat (beef, chicken, pork and mutton) for South Africa using the data for 1970-2000. Abdulai and Aubert (2004) have used QU-AIDS on Tanzanian food expenditure data, Wu et al (1995) examined urban consumption of six broad food categories (rice, pork, vegetables, fish, eggs and fruits) using Chinese household survey data. Huang and David (1993s, used a time series version of LA/AIDS in order to study the impact of urbanization

[7] My methodology is discussed in chapter 3.
[8] Also, see Lluch and Wiliams (1975)
[9] Houthakker (ibid) terms it as Addilog demand system.

on cereal demand in nine Asian countries. Dey et al (2011) used QU-AIDS to investigate demand for fish in Bangladesh, using a consumer survey that covered four non-coastal districts. Using data from household income and expenditure survey 2006-2007, Nirmali and Edirisinghe (2015) estimated the changes in price and expenditure in Sri Lanka's western province with the usage of LA/AIDS.

In the context of India, Mazumder (1986) compared the outcomes of LES and AIDS demand systems using NSSO 7-28$^{th}$ rounds and for nine food groups. She concludes that AIDS performs better than LES in explaining the data. Viswanathan (2001) used data during 1952-1991 to test for structural breaks in consumption patterns. Although there are multiple breakpoints, such breakpoints can be generated by changing of data collection methodology. Kumar et al (2011) have used data from 1983-2004 to estimate food elasticity with QU/AIDS specification (and contrast the results with another approach known as Food Characteristics Demand System (FCDS)). Mittal (2010) computed elasticity for the demand of major food groups (cereal, pulses, vegetables and fruits, milk, oil, sugar and egg-fish-meat). Meenakshi and Ray (1999) explored the regional demand pattern in India using a generalized quadratic form of AIDS attributed to Banks (1992).

Along with LES and AI-Demand system, The Rotterdam model has been applied widely.[10] For example, Seale and Regmi (2006) in terms of cross-country comparison, Wetherspoon (2013, 2015, using US data) have used the Rotterdam model to estimate demand for fresh food. Barten and Bettendorf (1989, Belgium fish demand) have used the inverse form of the Rotterdam model with prices on the left-hand side and quantities on the right-hand side. In the context of India, Murty (1980) used the Rotterdam model to see if the observed data is consistent with neoclassical theory.

## 2.5 Demand Estimation and Commodity Taxation

Commodity taxation occupies a central place in the study of Public Finance. As late as 2015-16, the share of commodity (indirect) tax revenue to total tax revenue for India's central government stood as high as 76.4%.[11] The corresponding figure for OECD countries is 32.7%

[10] For a recent comprehensive summary, refer to Clements and Gao, 2015.

[11] The figure is taken from Indian Public Finance Statistics, 2017-18, accesses from https://dea.gov.in/indian-public-finance-statistics. 2016-17 and 2017-18 estimates are revised and budget estimates (yet to be updated). Hence these data are less reliable.

in 2018. Given this, commodity taxes are an important tool for governments to increase revenue as well as secure redistributive justice. For economists, the quest is to obtain a set of taxes that raises adequate revenue, distorts the economy the least, as well as serves redistributive justice. The question becomes important in the context of developing economies since a large section of the population lives outside the direct tax net.

The study of optimal commodity taxation was initiated by Ramsey (1927). In that paper, Ramsey asked the following question: *"On which goods should the government impose higher rates of commodity tax so as to raise a certain amount of tax revenue?"* One of the several rules that Ramsey had formulated on commodity tax rates stated that commodities with low price elasticity should be taxed heavily. This is a special case of the Ramsey rule which is better known as the *Inverse Elasticity Rule*. It is assumed here that there is zero cross-price elasticity of demand for commodities that are taxed. However, it had very little significance in practical terms due to its simplistic assumptions and non-incorporation of the equity issues.[12] The modern treatment of Ramsey rule came from Samuelson (1986),[13] which states that taxes should be imposed in such a way that proportionate reduction in compensated demand is the same across commodities. However, as one cannot observe compensated demands in real life, the rule cannot be immediately operationalize.

Corlett and Hague (1953) took the first step towards a Ramsey rule which can be implemented. There is another exceptional case for the Ramsey rule which is given by Corlett and Hague (1953) using only two taxed commodities in addition to leisure. The Corlett and Hague "rule" stated that the commodity which is more complementary to leisure needs to carry a relatively high tax rate so as to counteract the tendency of the tax system for encouraging substitution towards leisure.[14] Uniform taxation is optimal only in the special case where both commodities are equally substitutable for (complementary to) leisure. In a similar study (Homburg 2006), in order to characterize optimal commodity taxes, when a heavy tax is imposed on a commodity, its index of encouragement[15] reduces. The

[12] Commodities with more inelastic demands should be taxed more heavily to lower the excess burden of taxation; but if such goods are consumed predominantly by those with lower incomes, then equity concerns argue for lower tax rates. Again, the equity rule states that those goods that are consumed in greater proportion by the people with lower income should be taxed at a lower rate.

[13] Although a mimeo, which he prepared for US Government, has been circulating since 1951.

[14] See Sandmo (1976)

[15] Index of encouragement indicates the response of earnings to an increase in the respective expenditure. It may be positive, negative or zero.

commodities which do not induce a consumer to work hard are referred to as time-consuming activities (e.g. alcoholic beverages). Such commodities should be heavily taxed whereas a commodity that motivates the consumers to work firmly should be reasonably taxed. This was different from the Corlett-Hague rule since the rule given by Homburg holds for many commodities unlike just two commodities as given by Corlett-Hague. Moreover, tax rates are characterized as observable variables and not compensated elasticities like in the case of Corlett – Hague.

Cast in a world of a representative consumer, Ramsey-type results thus states that an optimal pattern of taxes should more heavily tax those goods with more inelastic (compensated) demand. Thus, necessities are to be taxed heavily and luxuries must be taxed at a lower rate. Ramsey's rule thus reflects efficiency, but not equity. Diamond (1975) extended the rule to many commodities, many household models (where households differ by income), thus bringing in an element of redistribution (as reflected in a Social Welfare Function). Optimal indirect tax design explores minimizing the tax distortions to labour supply that necessarily occur when commodities (excluding leisure) can be taxed.

### 2.5.1 From Theory to Empirics

Feldstein (1977) noted that existing literature on optimal taxation focuses too much on the optimality features and very little on the process of how to obtain them. Successful tax reform is a dynamic process and considers an individual's responses to change. But the existing literature on optimal taxation focuses too much on the optimality features and very little on the process of how to obtain them. In another similar study,

The current empirical literature is heavily influenced by Ahmad and Stern (1984). Such studies[16] ask three broad questions

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$$e_i = \frac{\partial y}{\partial x_i} \frac{1}{q_i}$$

Here, the derivative represents the responses of income to changes in demands and $q_i$ is the price of the i-th commodity

[16] Alm (1996) posits that methods of deriving optimal tax systems were irrelevant to practical design. This was so because social institutions and fiscal considerations (e.g. administrative and enforcement costs etc.) had been ignored and it became a complex procedure. Most literature has dealt with determining the set of sufficient conditions whether optimal commodity taxes ought to be uniform instead of discovering what they ought to be i.e., by assessing them from expenditure data and actual tax.

a) Is the existing tax structure Pareto optimal in a many-household many-commodity economy, or is there room for Pareto improvement?
b) If the structure is not optimal, what should be the direction of tax reform (this is the question of optimal tax reform): i.e. on which commodities should we (marginally) raise (or decrease) the taxes?[17] If the taxes are "small enough" then we are dealing with issues of marginal tax reform.
c) What should be the levels of such optimal taxes, starting from a hypothetical situation of no taxes (this relates to the question of computation of optimal taxes)?

The "theory" behind the optimality of taxes is presented (see chapter 3). It is readily observed that the answer to all these questions depends heavily on the demand structure of the economy. Therefore, commodity taxation remains one fruitful area of application for empirical demand analysis.

Although marginal commodity tax reforms investigate the direction of tax reform which is considered to be "good", it does not ensure that an optimal position will be reached following such a reform. Also, other reforms may be preferred over the considered optimum ones. Hence, external criteria e.g. administrative convenience, political acceptability and the reliability of estimated parameters gains importance (Ahmad and Stern 1991).

According to Ahmad and Stern (ibid, 1984),[18] through the comparison of the marginal cost in terms of the welfare of raising an additional unit of revenue through a tax increase on each good, the optimality of an indirect tax structure may be assessed. Optimality necessitates that the marginal social welfare cost must be the same for all the pertinent goods. Or else, a Pareto improvement may well be easily implemented by increasing the tax on the good with the lower marginal cost and by lowering the excise tax on the good with a higher marginal cost. An advantage of using the above model is that it is not necessary to estimate a full demand system and only the following data is required: the relevant *observed* consumption levels and aggregate demand responses (represented by cross-price elasticities). On the other hand, to calculate the level of optimal taxes, the knowledge of the individual's complete demand functions (and its response to situations that are different from the current one) is required. In

[17] Thus, not all tax reforms are Pareto improving. See Guesnerie (1977).
[18] There is an alternate version of tax reform known as Daltonian reform (see, for example, Mayshar and Yitzhaki, 1995 and Santoro 2007 )

a developing country like India, the availability of databases is poor and their marginal tax reforms may be easier to predict and implement than optimal commodity tax rates (Ray 1997).

### 2.5.2 Optimal Taxes and Tax Reform: Relevant Literature

Using Irish data, Madden (1995, 1996) estimated the direction of Irish tax reform (elasticity calculation done by LES in 1995 paper and through AIDS in 1996). He concluded that taxes on tobacco should be reduced and that services should be increased and that demand specifications do not matter much as far as ranking of marginal social costs is concerned. Using a twelve commodity classification of the Belgian indirect tax system, Decoster and Schokkaert (1990) provide a comprehensive comparative treatment of marginal tax reforms using different specifications for demand (LES, Rotterdam, AIDS and CBS[19]) observe that the rankings of marginal costs are more or less robust to the choice of demand system,[20] but not to the imposition of the Slutsky symmetry condition. However, the latter sensitivity diminishes with increasing inequality aversion. Crag (1991) analysed the structure of Canadian indirect taxes using a quadratic expenditure system. Schobb (1995, relying on the estimates by Pashardes, 1993) used AIDS estimate to investigate green tax reform in UK. Ray (1989)[21] initiated optimal commodity taxes (and subsidies) in presence of children within households. Blacklow and Ray (2002) explored optimal tax rules in Australia using demographic data. They found that optimal commodity tax rates must be non-uniform and with increasing inequality aversion, such non-uniformity tends to increase. At zero inequality aversion, optimal tax rates as calculated by LES approaches zero. However, when the elasticities are measured through an alternate demand system (RNLPS: Restricted Non-Linear Preference System)[22] the results are different. Using data from household surveys from Japan and Korea, Urakawa and Oshio (2010) made a comparative study of marginal tax reforms. They based their study on the estimation of two demand systems (AIDS and LES) and compared the marginal cost of taxing major commodity groups and examined the distributive gains from tax reforms. The main conclusion that they derived was that revenue-

[19] CBS demand system is a variant of the Rotterdam model, allowing for non-constant marginal budget shares. The acronym stands for "Central Bureau Voor de Statistiek", the Dutch for Statistics *Netherlands*. See Keller and Van Driel (1985).
[20] Ray (1999) also provides limited support to such arguments.
[21] Drawing on Ray(1988), which is a pioneering study.
[22] See Blundell and Ray (1984). RNLPS is a generalization of LES in the sense that it allows for non-additive preferences.

neutral marginal tax reforms that include a reduced tax on food and beverages have a higher probability of facing efficiency, equity trade-offs in Korea than in Japan.

As far as relevant literature using Indian data is concerned, Ahmad and Stern (ibid)[23] complemented the theory with an empirical illustration of the possibilities of tax reforms in India, demonstrating how welfare-improving reforms can be found when a social welfare function and data on taxes and expenditure is given. They have also investigated whether the present (observed) state is optimal or not. Murty and Ray (1987) investigated the sensitivity of optimal tax design to the assumption of separability of commodities and leisure. Majumder (1988) uses PIGLOG demand system estimation to calculate optimal commodity tax rates. Ray (1986a, 1986b) investigated optimal tax design in India under various assumptions about demand structure (namely, LES and RNPLS). Murty and Ray (1989) proposed an alternate computational procedure for designing optimal taxes and also suggest that the optimal commodity taxes are quite sensitive to departure from the linearity/separability assumptions of LES They also took rural/urban differences in Indian expenditure patterns into account. They found that the rankings of the cost do not depend so much on the inequality aversion parameter for the rural sample, but the urban behaviour is different. Moreover, the results are sensitive to the choice of demand specification. They conclude that there cannot be a "one size fits all" type of tax reform, but such reforms must be different for urban and rural sectors. Ray (1995) investigated design issues in presence of commodity tax evasion.

## 2.6 Literature Gap and Proposed Study

The present thesis has two objectives: analysis of consumption using various Statistical/Econometric tools and application of the analysis, where possible, to optimal commodity tax reform. To this extent, I summarize, in a limited way, the state of current research (as this has been presented extensively elsewhere) and point out the gap in the literature that the present thesis will try to close.

In the context of India, Mazumdar (1986, op cit) Kumar et.al (ibid) used five NSSO rounds data to arrive at an estimation of elasticities related to various food groups. Pan et al (2008)

[23] Ahmad and Stern (1991) apply the same framework to Pakistan. However, as Ray (1997) has pointed out, in the 1984 paper, they have used the assumption of linear Engel curves e.g. as dictated by LES. Thus, those studies are restrictive in nature.

did a similar exercise for edible oil consumption, after taking care of the demographic variables. However, due to data limitations, in their study, only two regions were considered: North and South India (as dummies). Mittal's (ibid) is similarly a pan India study. Murty (2005) used all India NSSO data from 1972-1994 (five quinquennial rounds), to estimate demand elasticities for major food groups incorporating household size and changing consumer preferences (represented by a time trend). In a series of papers, Ray (1997, op cit), as well as Murty and Ray 1989, op cit) used demand estimates with demographic variables for optimal tax computation.[24]

It is our contention that such pan-Indian studies may not be a suitable guide for a positive or normative understanding of consumption patterns. India is one of the most diverse countries in the world.[25] As examples of pan Indian studies that have investigated demand patterns of regions and major states, we cite Meenakshi (1996, op cit) as well as Ray and Meenakshi (1999, op cit). However, their analysis includes only selected states.

Thasnimol et. al (2016) used 66th round NSSO data to analyse the consumption of high-value agricultural commodities in Northern Karnataka. Felix and Kumar (2020) have used NSSO 68th round data to compute elasticities of food consumption in rural and urban areas of Tamil Nadu. Roy and Malhotra (2018) conducted and analysed a survey (a reference to dairy products) based on Kolkata metropolitan area. In a recent attempt, Barman et. al (2020) worked with 68th round NSSO data and estimated expenditure elasticity of various types of pulse demand in Assam. However, their analysis does not extend to other food grains, nor do they check if urban and rural elasticities differ. As can be seen, the state-level consumption patterns are somewhat rarer, compared to national-level studies. Second, there is no exhaustive study based on Assam.

The analysis suggests two things. First, there is some evidence that considerable regional variation exists in demand patterns across India. As food policy (and possibly other social security policies) is tied up with elasticity measures, any such initiative should show flexibility for differential implementation across states. For that, comprehensive regional analysis is imperative. Secondly, India has embarked on major tax reform as nationwide GST

[24] For an exhaustive (but somewhat dated) survey regarding India, refer to Radhakrishna and Murty (1997).
[25] Fearon (2003) has ranked 215 countries in terms of ethnic, religious and linguistic fractionalization. India ranks 117 in terms of ethnic heterogeneity, 197 in terms of linguistic heterogeneity, and 74th in terms of religious heterogeneity. A higher rank implies less homogenous society.

has been introduced during 2018-19. The taxes are similar across nations. Using local demand patterns, it is also possible to comment on the optimality of such taxes. Yet, to the best of my knowledge, there has not been any analytical study for Assam.

To fill the gap, I undertake a comprehensive study of demand patterns pertaining to Assam.

## Appendix 2A: Unit Values as Prices

In many cross-sectional household surveys, typically price data is not available. Prices are approximated by household-specific unit values of commodities. That is

$$p_{ih} = \frac{E_{ih}}{q_{ih}}$$

Here, $E_{ih}$ ($q_{ih}$) is the expenditure (quantity purchased) on (of) commodity i by household h. The problem is, if data is collected from a wide region (a country or many regions), the prices will show wide dispersion due to quality effects that may reflect certain regional characteristics. To overcome this, Cox and Wohlgenant (1986) have proposed the following procedure. Let $\overline{p}_R$ be the region (community) specific mean of prices. The quality effects are encapsulated in the difference between household price and the communal mean unit value. Quality depends on certain household characteristics. The quality difference is regressed on such characteristics (h) i.e.

$$p_{ih} - \overline{p}_R = \phi(d_h) + \varepsilon_i$$

The equation is linear and can be estimated by the OLS technique. The "quality" adjusted prices are $p_i = \overline{p}_R + \hat{\varepsilon}_i$ . In a study on Vietnam, Vu (2009, 2020) criticised the method, because the above procedure means different households in the same community will face different prices (as $\hat{\varepsilon}_i$ are different). To rectify this, he has proposed using $p_i = \overline{p}$, where $\overline{\text{p}} = (\overline{p}_R + \hat{\varepsilon}_i)$. In the context of India, Majumder et al (2012) have used community-specific median value in order to create rural-urban price differential. Law et al *(ibid)* have used a similar methodology.

A comparative procedure was proposed by Deaton (1988, 1990), Deaton and Grimard (1992). The approach is to Deaton (1987, 1988 and 1990) in his studies revealed a methodology that had permitted the assessment of own and cross-price elasticities of domestic demands using household budget surveys. He assumed that households sharing similar clusters are confronted with similar market prices. Within-cluster variation in unit values and expenditures can be used to estimate the effects of household income and characteristics on quantities and qualities of purchased goods, and correct the measurement errors. Based on such corrected quantities and unit values, it is then possible to remove the impacts of both quality effects as well as measurement errors. Stavrev and Kambourov (1999) used this approach of Deaton to estimate price elasticities using the data of Bulgarian household budget surveys.

However, Huang and Lin (2000), Niimi (2002), Gibson and Rozelle (2002) have criticized Deaton's procedure.[26] Hence the jury is still out on which method best rectifies the quality errors. To some extent, as Deaton himself recognized (1990), that data should be cross-checked with actual prices whenever possible.[27] The difference of prices and unit values (which reflects the hidden quality effects) are more exacerbated if the data is temporal and collected across the regions (implying very high variations in quality).

[26] See also McKelvy (2011)

# CHAPTER 3

# DEMAND SYSTEM ESTIMATION AND APPLICATION: A METHODOLOGICAL OVERVIEW

## 3.1 Introduction

As already noted in the previous chapter, the role of consumer behaviour is crucial in the formulation of economic policy. Changes in the demand pattern of individuals have serious repercussions on the growth, trade and development of any country. The roles of prices along with appropriate pricing (including taxation) policies are the need of the hour. Also, proper weights regarding the commodities that are taxed need to be assigned in the process of strategy making. The composition of the commodity of the consumer's basket varies with their income and prices and as a result, the need for calculating the price and expenditure elasticity becomes a necessity. Governments of all countries are pursuing various programs in the form of price and income policies to promote the welfare of their consumers.

Demand models play an important role in evaluating the indirect tax policy reform. The first prominent demand system was Linear Expenditure System (LES) by Stone (1954) after which many other systems have been developed. These new demand systems such as AIDS, BTL, QES, NGLES, LTL, QUAIDS, AIDADS, etc. use income elasticities and price elasticities and have been applied for analyzing empirical data. Translog (LTL, HTL, BTL, etc.) and AIDS are flexible functional forms and do not require too many strong prior restrictions. On the other hand, QES, AIDADS, QUAIDS have more Engel-flexibility[28] which allows greater flexibility in the treatment of Engel effects. In this chapter; my objective is to provide a short introduction to relevant themes. Some of these will be applied in later ones.

The current chapter is organized as follows. In section 3.2, I provide a summary of the theory behind estimation issues. Sections 3.3 and 3.4 discuss the main workhorse models of demand estimation. Section 3.5 reviews additional issues that crop up during estimation. Section 3.6 shows how demand estimation can be applied to optimal commodity tax literature.

[28] Presence of non-monotonic responses of budget shares with increasing income.

## 3.2 Demand and Demand Elasticities: A Theoretical Overview

A textbook version of demand theory[29] is presented here to motivate the analysis in later sections. Suppose $\mathbf{x} = [x_1, x_2, .. x_n]$ is the consumption vector and **p** is the corresponding price vector. The consumer maximizes utility $u(\mathbf{x})$ subject to a budget constraint $\mathbf{p}^{\mathbf{T}}\mathbf{x} \le M$, where M is the budget allocated to consumer. The primal problem of the consumer is

$$\left.\begin{array}{l} \max_{x_1, x_2, .. x_n} u(\mathbf{x}) \\ \text{such that } \mathbf{p}^{\mathbf{T}}\mathbf{x} \le M \end{array}\right\} ...(3.1)$$

The corresponding Lagrangian is $u(\mathbf{x}) + \lambda\left[M - \mathbf{p}^{\mathbf{T}}\mathbf{x}\right]$. First-order conditions are[30]

$$\left.\begin{array}{l} \dfrac{\partial u}{\partial x_i} - \lambda p_i = 0 \\ M - p^T x = 0 \end{array}\right\} ...(3.2)$$

Here, λ is Lagrange multiplier. Solving the first-order conditions, we get the Marshallian demand functions $x_i^M = x_i^M(\mathbf{p}, M)$. Of particular interest is how the demand function changes as prices or income alter. The own price, cross-price and income elasticities are, respectively $\eta_{ij}^m = \dfrac{\partial x_i(.)}{\partial p_j}\dfrac{p_j}{x_i}$ (if i=j we have own price elasticity) and $\eta_{iM} = \dfrac{\partial x_i}{\partial M}\dfrac{M}{x_i}$. Plugging the Marshallian demand functions in the utility function, we get the indirect utility function $v(\mathbf{p}, M)$, which expresses the maximum utility given any price income situation.

In a similar fashion, we solve the dual program of minimizing cost with subject to a certain level of utility constraint, i.e.

$$\left.\begin{array}{l} \min_{x_1, x_2, .. x_n} \mathbf{p}^{\mathbf{T}}\mathbf{x} \\ \text{such that } u(\mathbf{x}) \le \bar{u} \end{array}\right\} ...(3.3)$$

yields the Hicksian demand functions $x_i^h = x_i^h(\mathbf{p}, \bar{u})$, and corresponding price derivatives are Hicksian elasticities. Hicksian and Marshallian elasticities are related by Slutsky equation

$$\eta_{ij}^m = \eta_{ij}^h - \alpha_j \eta_{iM}$$

For j=1,2,…n. Here, $\alpha_j$ is the share of j-th commodity in the consumers' budget. Plugging the Hicksian demand functions in the objective functions gives rise to expenditure function (or

[29] See Varian (1992) or Mas-Collel, Whinston and Green (1996)

[30] I abstract away from the problems of corner solutions and second order conditions.

cost functions): the minimum expenditure to achieve the lifestyle given the prices. This is usually expressed as $E = E(\mathbf{p}, u)$.

The primary objective of empirical demand analysis is to estimate the elasticities.

### 3.3 Empirical Demand Analysis: Single Equation Methods

Since Engel (1857), Economists and Statisticians have spent considerable time specifying relation between demand (in form of budget share, commodity purchase, or total expenditure on a particular commodity) and associated variables such as income, prices as well as taste and preferences. In their seminal studies, Prais and Houthakker (1955, 1971) investigated equations of the forms

$$\left.\begin{aligned} x_i &= \alpha_i + \beta_i \ln(M) \\ \ln(x_i) &= \alpha_i + \beta_i \ln(M) \\ \ln(x_i) &= \alpha_i - \frac{\beta_i}{M} \end{aligned}\right\} \ldots(3.4)$$

Here $x_i$ is the purchase of commodity i and M is the family budget (or food budget). In their analysis, they found that different functional forms are applicable for different commodities as well as different expenditure levels.

One key variant of the Prais-Houthakker model was first explored by Working (1943) and Laser (1963). The model is given by

$$w_i^h = \alpha_i + \beta_i \ln(M^h) \ldots(3.5)$$

Here, $w_i^h$ is the budget share of commodity i (e.g. a particular food item) for household h and $M^h$ is family income (or expenditure on a particular group (such as food). Since budget shares must add up to 1, one has to impose the following restrictions on the parameters

$$\sum_i \alpha_i = 1; \sum_i \beta_i = 0 \ldots..(3.6)$$

Depending on the sign of $\beta_i$, the commodity under consideration can be either a luxury ($\beta_i>0$) or necessities and/or inferior goods ($\beta_i<0$). The income elasticity is given by the following equation

$$\eta_{iM} = 1 + \frac{\beta_i}{w_i} \ldots(3.7)$$

Conventionally, the estimate is evaluated at the sample average, $\bar{w}_i = \frac{\sum_h w_i^h}{H}$ , where H is the total number of households (or observations). The estimation is usually done through conventional Ordinary Least Square method.

The Working-Leser model has been applied successfully over many years. The model is the genesis of single-equation estimates of consumer demand. For a typical example, we refer to Chern et. al (2002), which can be thought of as an extension of the Working-Leser model

$$w_i^h = \alpha + \beta \ln(M^h) + \sum_j \gamma_{ij} \ln\left(p_j\right) + \sum_k \delta_k D_k^h + \varepsilon_i \ldots(3.8)$$

Here, $p_j$ is the price and $D_k$ is the k-th demographic characteristics,[31] provided such data is available.[32] The Marshallian own price, cross-price and expenditure elasticities (evaluated at sample mean) are, respectively,

$$\left.\begin{aligned} \eta_{ii} &= -1 + \frac{\gamma_{ii}}{\bar{w}_i} \\ \eta_{ij} &= \frac{\gamma_{ij}}{\bar{w}_i} \\ \eta_{iM} &= 1 + \frac{\beta_i}{\bar{w}_i} \end{aligned}\right\} \ldots..(3.9)$$

## 3.4 Empirical Demand Analysis: Demand System Estimation

Single equation models are easy to estimate and are widely used when there are certain data limitations (such data limitations are endemic features of Household surveys). Nonetheless, as Pollak (1990) and Pollak and Wales (1995) have argued, if the data permits, one should employ estimation of complete demand systems (involving simultaneous demand estimation of many commodities) because it is consistent with the economic theory of preference maximization. For that reason, starting from the pioneering work of Stone (1954), demand systems, in various forms, have been constantly employed to get accurate estimates of important statistics.[33] With these words, we turn towards the estimation of demand systems.

[31] This is a particular way of adding the demographics. I will present the details later (pp 40)

[32] Holcombe et al (1995), for example, in their study of food away from home (FAFH), did not employ price data but used demographic variables

[33] However, Pollak (ibid) points out that although individual behavior is consistent with utility maximization behavior, it cannot be said true for households (unless and until we impose some constraints). Further, even if

### 3.4.1 Linear Expenditure System (LES)

LES begins with the algebraic form of the consumer's utility function and then derives the corresponding demand functions. The utility function is given by

$$U=\prod\left(x_i - a_i\right)^{b_i} \text{...(3.10)}$$

Where $a_i$ is minimum (subsistence) consumption for commodity i. Maximising utility subject to the budget constraint $\sum p_i x_i = M$ yields the following set of equations,

$$p_i x_i = p_i a_i + b_i\left(M - \sum_{j=1}^{n} p_j a_j\right) \text{....(3.11)}$$

Where $M - \sum_{j=1}^{n} p_j a_j$ = supernumerary expenditure (over and above subsistence expenditure).

The equation has a very straightforward interpretation. Total expenditure on any good consists of committed expenditure on the good, $p_i a_i$, and a fraction ($b_i$) of the income over and above the committed expenditure *on all commodities* ($M - \sum p_i a_i$). In this interpretation, $b_i$ is the 'marginal budget share' of commodity i $\left(b_i = \frac{\partial E_i}{\partial M}\right)$. Of primary importance are the "subsistence consumption" parameters as thy directly reveal the state of poverty. This becomes important when one does a group comparison.

The model must obey $q_i > a_i$ (regularity condition), $b_i > 0$ (for normal goods) and marginal budget shares must add up to 1 $\left(\sum\left(\frac{\partial E_i}{\partial M}\right) = 1 \rightarrow \sum b_i = 1\right)$...(3.12)

This restriction also implies that the utility fictions are homogeneous of degree zero. On the other hand, some of the $a_i$ can be negative (implying elastic demand).

Substituting the estimated values in the formula for Marshallian own price elasticity, Marshallian cross-price elasticity and expenditure elasticity:

Own price elasticity $\eta_{ii} = -1 + \frac{a_i(1-b_i)}{q_i} = -1 + \frac{a_i(1-b_i)}{\bar{q}_i}$...(3.13)

Cross price elasticity[34] $\eta_{ij} = -b_i \frac{p_j a_j}{q_i p_i} = -b_i \frac{p_j a_j}{\bar{E}_i}$...(3.14)

households' behavior is consistent with preference maximization, the aggregate/market behavior need not be so.

[34]Note that $\eta_{ij} \neq \eta_{ji}$. Also, cross-price elasticities are always negative for a normal good (as long as $a_j > 0$). The model predicts that commodities are gross complements in a Marshallian sense if $a_j > 0$.

Expenditure elasticity $\eta_m = \frac{b_i M}{q_i p_i} = \frac{b_i M}{\bar{E}_i}$....(3.15)

Corresponding Hicksian elasticities are

$$\left.\begin{array}{l} \eta_{ii}{}^{h} = (b_i - 1) * \left(1 - \frac{a_i}{x_i}\right) = (b_i - 1) * \left(1 - \frac{a_i}{\bar{x}_i}\right) \\ \eta_{ij}{}^{h} = -\left(\frac{b_i p_j}{p_i x_i}\right)(x_j - a_j) = -\left(\frac{b_i \bar{p}_j}{\bar{E}_i}\right)(\bar{x}_j - a_j) \end{array}\right\} ...(3.16)$$

The norm is to calculate the elasticities at the mean value of price, quantity, expenditure, etc. The model predicts that the Engel curve

$$E_i = p_i q_i = p_i a_i - b_i \sum p_j a_j + b_i * M....(3.17)$$

is linear. This is an added restriction, and is likely to be satisfied only over small ranges of income.

One added complication comes from the fact if the estimated value of $a_i$ is negative. While this does not pose any theoretical problem, the interpretation of $a_i<0$ as the "subsistence purchase" becomes difficult to sustain (Pollack 1971). A negative value of $a_i$ implies elastic demand. However, corresponding cross-price elasticities will be positive as already observed.

#### 3.4.1.2 Estimation

The econometric equation to be estimated is

$$p_i q_i = p_i a_i + b_i (m - \sum_{j=1}^{n} p_j a_j) + \varepsilon_i....(3.18)$$

Or, equivalently, in share form

$$w_i = \frac{p_i a_i}{M} + b_i \left(1 - \frac{\sum_j p_j q_j}{M}\right) + v_i....(3.19)$$

For n goods, we have 2n parameters $(a_1, a_2, ...a_n, b_1, b_2, ..., b_n)$ to estimate. The estimation is usually done by Zellner's (1962) seemingly unrelated regression technique (SUR),[35] since the contemporaneous variance covariance matrix $\mathbf{\Sigma}=E(vv')=\sigma_{ij}$ is likely to be non-diagonal[36]. However, there is one more problem. Since $w_i$ must sum up to 1, the matrix $\mathbf{\Sigma}$ is singular. The problem is overcome by using (n-1) of the equations to estimate 2n-1 variables ($a_1$,

[35] For a textbook treatment, refer to Davidson and Mackinnon, 2004 as well as Cameron and Trivedi (2005)

[36] As opposed to that, OLS regression assumes $\mathbf{\Sigma} = \sigma_{ii} * \mathbf{I_n}$, where $\mathbf{I_n}$ is a diagonal matrix.

$a_2,\ldots,a_n$, $b_1$, $b_2,\ldots,b_{n-1}$) and using the adding up constraint $\sum b_i = 1$ to recover $b_n$, say. Since the model is nonlinear in **a** and **b,** estimation is usually performed by a variant of the Gauss-Newton method of minimizing non-linear least squares

In brief, the nonlinear model can be written as

$$w_i = g(\xi_i, \beta) + v_i \ldots(3.20)$$

Here, $\xi_i$ is the vector of explanatory variables (income, prices, etc.), β is the vector of slope coefficients and $v_i$ is the error term. Then the non-linear-least-square (NLS) estimates are such that the vector of estimates, $\hat{\boldsymbol{\beta}}$ maximises

$$Q_n(\beta) = -\frac{1}{2n}\sum_i \left(w_i - g(\boldsymbol{\xi}, \boldsymbol{\beta})\right)^2 \ldots(3.21)$$

However, as the data is prone to heteroscadasticity, in my later estimates, I use the feasible non-linear GLS (FNGLS) technique to obtain the parameter estimates. I briefly provide the procedure here.[37] Let, **v** be the vector of errors, **g** be the vector of non-linear functions and **w** be the vector of shares. Let $\Omega = \Omega(\gamma)$ be the variance-covariance matrix, where γ is a finite dimensional parameter vector. Let $\hat{\gamma}$ be estimates of $\gamma$. Then, $\hat{\beta}_{FNGLS}$ maximises

$$Q_n(\hat{\beta}) = -\frac{1}{n}(\mathbf{w} - \mathbf{g})^T \left(\Omega(\hat{\gamma})^{-1}\right)(\mathbf{w} - \mathbf{g}) \ldots(3.22)$$

It can be shown that the parameters, thus estimated, asymptotically follow the normal distribution

$$\hat{\beta}_{FNGLS} \sim^a N\left(\beta_0, \left[\frac{\partial g^T}{\partial \beta}|_{\beta_0} \, \Omega(\gamma_0)^{-1} \frac{\partial g}{\partial \beta^T}|_{\hat{v}}\right]\right) \ldots.(3.23)$$

### 3.4.2 Beyond Linear Expenditure System

Although the linear expenditure system is a conventional starting point for demand system estimations, there are theoretical problems with the system. Since Stone's (1954) seminar article, many studies (see the bibliography of DM, *op cit*) have adopted a linear expenditure system as a convenient starting point. The main problems with LES are (a) for certain values of prices and income, predicted expenditure is negative. Although it is not satisfactory from the theoretical aspect, this system may be still being used for other price-income points. (b) LES seems to be limited due to the lack of long time series data or continuous cross-section

[37] See Cameron and Trivedi (ibid)

data. They are unduly restrictive as a result of arbitrary assumptions used in the derivation of parameters (Chang 1994), (c) Hicksian substitutes and cross-price derivatives are proportional to expenditure derivatives, (d) expenditure elasticities are always positive, etc.

The new approach is to derive the demand equations from some expenditure function. The idea is to generate a `flexible functional form' from a general model of preferences (as summarized in an expenditure system)

The AI (**A**lmost-**I**deal) demand model dates back to Deaton and Muelbauer (1980). First, they define an expenditure function (which they termed as cost, i.e. the expenditure function, E (.)) as

$$\ln E(v,\mathbf{p}) = (1-v)\,a(\mathbf{p}) + v * b(\mathbf{p}) \text{...(3.24)}$$

Note that, for E=E(v,p), $\frac{\partial E}{\partial p_i} = E_{p_i} = q_i$, where $q_i$ is the consumption of good i.[38] Dividing and multiplying both sides by $p_i$ and c, we have, $\frac{p_i}{E}\left(\frac{\partial E}{\partial p_i}\right) = \frac{p_i q_i}{E} \rightarrow \frac{\partial \ln E}{\partial \ln p_i} = w_i$, where $w_i$ is the share of good i in budget.

Deaton and Muelbauer (ibid) propose the following forms for a(.) and b(.).

$$\left.\begin{aligned} a(p) &= \alpha_0 + \sum \alpha_i \ln(p_i) + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \ln(p_i)\ln(p_j) \\ b(p) &= \beta_0 \prod_i p_i^{\beta_i} \end{aligned}\right\} \text{...(3.25)}$$

These functional forms are chosen because these forms can define any arbitrary first and/or second-order derivatives of the Expenditure function, ( e.g. $\frac{\partial E}{\partial p_i}, \frac{\partial^2 E}{\partial p_i^2}, \frac{\partial^2 E}{\partial p_i \partial p_j}, \frac{\partial E}{\partial v}, \frac{\partial^2 E}{\partial v^2}$ ) are well defined.

Substituting the functional forms of a(.) and b(.) in the expenditure function, one gets

$$E(v,p) = \alpha_0 + \sum_i \alpha_i \ln(p_i) + \frac{1}{2}\sum_i \sum_i \gamma_{ij} \ln(p_i)\ln(p_j) + v\beta_0 \prod_i p_j^{\beta_j} \text{....(3.26)}$$

and then taking the logarithmic derivative, we get

$$w_i = \alpha_i + \sum_j \gamma^*_{ij} \ln(p_j) + \beta_i \ln\left(\frac{M}{P}\right)_k + \varepsilon_i \text{...(3.27)}$$

In the above equation,

$w_i$ = expenditure share of the i-th commodity

[38]The second equality follows from Shephard's lemma. Note that $q_i$ is Hicksian demand.

$p_j$ = price of the j-th commodity

M = total expenditure on the group of commodities

$\varepsilon_i$ = disturbance/error term

$P$ = aggregate price index

There are many ways to construct the price index P. In general, one uses the translog price index

$$P = a_0 + \sum_i a_i \ln(p_i) + \frac{1}{2}\sum_i\sum_j \gamma_{ij} \ln(p_i)\ln(p_j) ...(3.28)$$

)

The system of equations along with the above (possibly nonlinear in $p_i$,$p_j$) price index is known as the Almost Ideal (AI) demand system..

Deaton and Muelbauer's (1980, pp 316) suggestion was to use the Stone (1953) price index, that is, $\ln(P) = \sum_i w_j \ln(p_j)$. In other words, the suggestion here is to linearize the function a(**p**). Hence this version of the almost ideal demand system is called LA-AI (**L**inearly **A**pproximated **A**lmost **I**deal) demand system.[39] Since $w_i$ appears both on the left and right-hand sides of the equation to be estimated, one suggestion is to replace $w_i$ by average budget share, that is $\overline{w}_i$.[40]

$$\ln(P) = \sum \overline{w}_i \ln(p_i) ...(3.29)$$

The parameter $\gamma_{ij}^*$ is defined by

$$\gamma_{ij}^* = \frac{1}{2}(\gamma_{ij} + \gamma_{ji}) = \gamma_{ji}^* ....(3.30)$$

For this model, adding up requires

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[39] AI Demand systems and their extensions have played an important role in demand estimation. Of particular importance is the so-called Quadratic AIDS (QUAIDS), as proposed by Banks et. al (1997). The estimating equation is given by

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{M}{P}\right) + \frac{\lambda_i}{\left(\prod_i p_i^{\beta_i}\right)}\left[\ln\left(\frac{M}{P}\right)\right]^2$$

It is easily seen that AIDS is a nested form of QU-AIDS with $\lambda_i$= 0. They also point out that, within weakly separable branches of the utility tree, the nonlinear AIDS model may classify substitutes as complements or overestimate the elasticities of substitution among goods

[40] See Moschini (1995).

$$\sum \alpha_i = 1, \sum \beta_i = 0, \sum_i \gamma_{ij}^{\ *} = 0 \text{....(3.31)}$$

Homogeneity (of the expenditure function) is satisfied iff $\sum_i \gamma_{ij}^* = 0$ and symmetry[41] is satisfied if $\gamma_{ij}^{\ *} = \gamma_{ji}^{\ *}$.

### 3.4.2.1 Estimation

Estimation of the LA-AI demand system is computationally less demanding than the LES. Deaton and Muelbauer (ibid) suggested employing OLS.

Note that the system of equations can be written as

$$\begin{bmatrix} \mathbf{w_1} \\ \mathbf{w_2} \\ .. \\ \mathbf{w_n} \end{bmatrix} = \begin{bmatrix} \mathbf{Z_1} & \mathbf{0} & .. & \mathbf{0} \\ \mathbf{0} & \mathbf{Z_2} & ... & \mathbf{0} \\ ... & ... & ... & ... \\ \mathbf{0} & \mathbf{0} & .. & \mathbf{Z_n} \end{bmatrix} \begin{bmatrix} \boldsymbol{\beta_1} \\ \boldsymbol{\beta_2} \\ .. \\ \boldsymbol{\beta_n} \end{bmatrix} + \begin{bmatrix} \mathbf{v_1} \\ \mathbf{v_2} \\ .. \\ \mathbf{v_n} \end{bmatrix} \text{...(3.32)}$$

$$\rightarrow \mathbf{w} = \mathbf{Z}\boldsymbol{\beta} + \mathbf{v}$$

Where, $\mathbf{w_i}$ is the vector of shares for i-th commodity, $\mathbf{Z}$ is the related vector of explanatory variables , and $\boldsymbol{\beta_i}$ is the vector of coefficients (for example, $\gamma_{11}$ is a coefficient in the share equation $w_1$, but not in $w_2$). Here,

$$\left.\begin{aligned} &\mathbf{v_i} = \left[\mathbf{v_1}^{\mathbf{T}}, \mathbf{v_2}^{\mathbf{T}} \mathbf{....v_n}^{\mathbf{T}}\right]^T \\ &E\left(\mathbf{v} \mid \mathbf{Z_1}, \mathbf{Z_2}, \mathbf{...Z_N}\right) = 0 \\ &E\left(\mathbf{vv^T} \mid \mathbf{Z_1}, \mathbf{Z_2}, \mathbf{...Z_N}\right) = \Omega \end{aligned}\right\} \text{...(3.33)}$$

Thus, the system of equations is called a SUR model. It is assumed that disturbances are unrelated across the samples. Hence, one can write

$$E\left(v_{ik} v_{jp} \mid Z_1, Z_2, ...Z_n\right) = \sigma_{ij} \text{if } k = p \text{ and 0 otherwise}$$

Thus, the disturbance term can be written as

$$\boldsymbol{\Omega} = E\left[\mathbf{vv^T} \mid \mathbf{Z_1}, \mathbf{Z_2}, \mathbf{....}, \mathbf{Z_n}\right] = \begin{bmatrix} \sigma_{11}\mathbf{I} & \sigma_{12}\mathbf{I} & ... & \sigma_{1n}\mathbf{I} \\ \sigma_{21}\mathbf{I} & \sigma_{22}\mathbf{I} & ... & \sigma_{2n}\mathbf{I} \\ ... & ... & ... & ... \\ \sigma_{n1}\mathbf{I} & \sigma_{n2}\mathbf{I} & ... & \sigma_{nn}\mathbf{I} \end{bmatrix} \text{....(3.34)}$$

If we denote

[41] Cross price derivatives of Hicksian demand being symmetric. Moschini (*ibid*) also points out that the problem with the Stone price index does not occur with a non-linear version of AI demand system that uses (1.2) directly.

$$\Psi = \begin{bmatrix} \sigma_{11} & \sigma_{12} & .. & \sigma_{1n} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2n} \\ .. & .. & .. & .. \\ \sigma_{n1} & \sigma_{n2} & \cdots & \sigma_{nn} \end{bmatrix} \text{...(3.35)}$$

Then the above equation can be written as

$$\mathbf{\Omega} = \mathbf{\Psi} \otimes \mathbf{I}$$

Where $\otimes$ is Kronecker multiplication. GLS estimator for the parameters is

$$\widehat{\boldsymbol{\beta}}_{\mathbf{GLS}} = \left[\mathbf{Z}^{\mathbf{T}}\left(\mathbf{\Psi}^{-1} \otimes \mathbf{I}\right)\mathbf{Z}\right]^{-1} \mathbf{Z}^{\mathbf{T}}\left(\mathbf{\Psi}^{-1} \otimes \mathbf{I}\right)\mathbf{w} \text{...(3.36)}$$

Note that in this case, we have identical regressors, so the $Z_1=Z_2 = Z$ (say). In that case, GLS is equivalent to OLS. The estimated values of β can be written as, in matrix notation,

$$\widehat{\boldsymbol{\beta}}_{\mathbf{OLS}} = \begin{bmatrix} \sigma_{11}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} & \sigma_{12}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} & \cdots & \sigma_{1n}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} \\ \sigma_{21}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} & \sigma_{22}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} & & \sigma_{2n}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} \\ \cdots & & & \\ \sigma_{n1}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} & \sigma_{n1}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} & \cdots & \sigma_{nn}(\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1} \end{bmatrix} \begin{bmatrix} (\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1}\sum_{k=1}^{n}\sigma_{1k}\boldsymbol{\beta}_k \\ (\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1}\sum_{k=1}^{n}\sigma_{2k}\boldsymbol{\beta}_k \\ \cdots \\ (\mathbf{Z}^{\mathbf{T}}\mathbf{Z})^{-1}\sum_{k=1}^{n}\sigma_{nk}\boldsymbol{\beta}_k \end{bmatrix} \text{...(3.37)}$$

In the later chapters, we have used a constrained (in the sense that restrictions are imposed a priori) SURE model. The asymptotic properties of the parameter estimates are standard.

### 3.4.2.2 Elasticities

Marshallian price elasticities are

$$\begin{aligned} \eta_{ij} &= -\delta_{ij} + \frac{d \ln w_i}{d \ln p_j} \\ &= -\delta_{ij} + \frac{1}{w_i}\frac{dw_i}{d \ln p_j} \\ &= -\delta_{ij} + \frac{1}{w_i}\left(\gamma_{ij} - \beta_i \frac{d \ln P}{d \ln p_j}\right) \\ &= -\delta_{ij} + \frac{1}{w_i}\left(\gamma_{ij} - \beta_i \overline{w}_j\right) \text{....(3.38)} \end{aligned}$$

Here, $\delta_{ij}$ is the Kronecker delta (=1 if i=j, =0 otherwise). Since the values are calculated at the sample mean, we have the following expressions for own and cross-price elasticities.

$$\left.\begin{aligned} \eta_{ii} &= -1 + \frac{\gamma_{ii}}{\overline{w}_i} - \beta_i \\ \eta_{ij} &= \frac{\gamma_{ij}}{\overline{w}_i} - \beta_i * \left( \frac{\overline{w}_j}{\overline{w}_i} \right) \end{aligned}\right\} \text{...(3.39)}$$

Similarly, the expenditure elasticity is

$$\begin{aligned} e_i &= 1 + \frac{d \ln w_i}{d \ln X} \\ &= 1 + \frac{1}{w_i} \frac{dw_i}{d \ln X} \\ &= 1 + \frac{\beta}{\overline{w}_i} \text{....(3.40)} \end{aligned}$$

Corresponding Hicksian elasticities are

$$\begin{aligned} \eta_{ij}{}^h &= \eta_{ij} + e_i w_j \\ &= -\delta_{ij} + \frac{1}{\overline{w}_i} \left( \gamma_{ij} - \beta_i \overline{w}_j \right) + \left( 1 + \frac{\beta_i}{\overline{w}_i} \right) * \overline{w}_j \\ &= -\delta_{ij} + \frac{\gamma_{ij}}{\overline{w}_i} + \overline{w}_j \text{...(3.41)} \end{aligned}$$

And hence,

$$\left.\begin{aligned} \eta_{ii}{}^h &= -1 + \frac{\gamma_{ii}}{\overline{w}_i} + \overline{w}_i \\ \eta_{ij} &= \frac{\gamma_{ij}}{\overline{w}_j} + \overline{w}_j \end{aligned}\right\} \text{...(3.42)}$$

It is evident that the Engel curve implied by AIDS is non-linear (thus it removes one problem associated with LES). We have [42]

$$\left.\begin{aligned} \frac{\partial E_i}{\partial M} &= \left( \alpha_i + \beta_i - \beta_i \ln P + \sum_j \gamma_{ij} \ln\left(p_j\right) \right) + \beta_i \ln M \\ &= A + \beta_i \ln M \end{aligned}\right\} \text{...(3.43)}$$

[42] In terms of budget share, the slope is $\frac{\partial w_i}{\partial M} = \frac{\beta_i}{M}$, another non-linear expression.

## 3.5 Other Issues in Estimation

In this section, we offer a brief technical overview of other issues that may crop up during estimation.

### 3.5.1 Demographic Factors

Although the importance of demographic factors is well recognized, an important question is how the demographic variables should be incorporated in the estimation of equation systems. Three different strands are adopted by the researchers. First, if the data permits, it is possible to divide the pooled sample into various sub-samples across socio-demographic lines, and then one can estimate each equation. The second method is called the so-called "translation" method (Gorman 1970, Pollak and Wales 1980, 1981). To see this formally, assume $x_i = x_i(\mathbf{p}, M)$ is the demand function of commodity i. Let $h_k$ be the household-specific vector of demographic variables. Then translation implies

$$x_i(\mathbf{p}, M) = d_i + \bar{x}_i\left(\mathbf{p}, M - \sum_j \rho_j d_j\right) \ldots(3.44)$$

Here, $d_i$ is the demographic variables (or, are functions of demographic variables, $d_i$=D(**h**)).[43] Translation amounts to adding fixed quantity levels (depending on the demographic parameters) to utility. On the other hand, demographic scaling (the study was pioneered by Barten, 1964) implies that

$$x_i(\mathbf{p}, M) = m_i * \bar{x}_i\left(\mathbf{p}\mathbf{m}^T, M\right) \ldots(3.45)$$

Here, $\mathbf{m} = [m_1, m_2, \ldots\ldots m_n]$ are known as scaling factors and those are posited to be functions of demographic variables, $m_i = M_i(h_1, h_2, ..h_k)$.[44]

There are studies (for example, see Gorman 1976, Ray 1996) which have generalized the procedures by including both.

### 3.5.2 Censoring

In a consumption survey, zero reporting may arise due to many factors. First, these can be a true 'zero', for example, economic, caste and religious restrictions imply many families do not purchase the item. On the other hand, such zero consumptions also may arise due to the fact that either the households did not purchase those items or those items were not available

[43] A popular method is the so called "linear translation procedure", which proposes $d_i = d_0 + \Sigma \gamma_r h_r$, where $h_r$ is the demographic characteristics of the household.

[44] Again, another convenient way is "linear demographic scaling", which proposes $m_i = 1 + \Sigma \gamma_k h_k$.

(although normally the households do purchase such items from time to time) within the time period concerned (see Deaton, 1997).

To mitigate the potential bias arising out of sample selection bias, one employs the Heckman two-step estimation methodology (see, for example, Heien and Wessels, 1990, Saha et al, 1997, Raper *et. al*. (*op cit*) or Ulubasoglu *et al* 2016). We briefly explain the methodology here.

Suppose the consumption equation to be estimated is given by

$$\mathbf{w} = \mathbf{x}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \quad ...(3.46)$$

Here, w is the vector of shares, β is the vector of coefficients to be estimated and x is the vector of explanatory variables. However, the vector w contains many 0 (non-purchase) observations. We assume that the purchase decision (in effect, a zero-one decision) is related to a latent process

$$\mathbf{z}^* = \boldsymbol{\xi}\boldsymbol{\Pi} + \mathbf{u} \quad ...(3.47)$$

Here ξ is the vector of the explanatory variables and Π is the coefficient vector. Probit specification assumes that the vector of errors follows a standard normal distribution, i.e. $\mathbf{u} \sim N(0, \mathbf{I})$. That is

$$\left.\begin{aligned} pr\left(z^* = 1\right) &= \Phi(\boldsymbol{\xi\Pi}) \\ pr\left(z^* = 0\right) &= 1 - \Phi(\boldsymbol{\xi\Pi}) \end{aligned}\right\} ...(3.48)$$

Here, Φ is the CDF of standard normal distribution. The set of variables **x** must be a subset of ξ.[45] We observe $z_i$=1 (positive purchase) if $z^*_i > 0$ and $z_i$=0 otherwise.

The first stage estimation provides the estimates of Π . The inverse-Mill's ratio (IMR) for a typical household is obtained by estimating the above equation

$$IMR_h = \frac{\phi\left(\boldsymbol{\xi\Pi}\right)}{\Phi\left(\boldsymbol{\xi\Pi}\right)} \quad ....(3.49)$$

For households purchasing the item and

$$IMR_h = \frac{\phi\left(\boldsymbol{\xi\pi}\right)}{1 - \Phi\left(\boldsymbol{\xi\pi}\right)} \quad ...(3.50)$$

for households not purchasing the item. Here, φ and Φ are, respectively, the standard normal density function and cumulative density function evaluated at the predicted values.

In the second stage of the procedure, the $IMR_h$ is added as an explanatory variable in the original system of equation, i.e.

[45] Wooldridge (1999).

$$\left.\begin{aligned} w|_{w>0} &= X\beta + \alpha * \frac{\phi(\xi\Pi)}{\Phi(\xi\Pi)} + \varepsilon \\ w|_{w=0} &= X\beta + \alpha * \frac{\phi(\xi\Pi)}{1-\Phi(\xi\Pi)} + \varepsilon \end{aligned}\right\} \ldots(3.51)$$

Here too, a SUR procedure is appropriate because the commodity equations employ the same regressors, but different IMR terms. Further, the disturbance terms may be correlated.

It can be mentioned here that there is a difference with typical single equation methods of, say, commodity-by-commodity Working-Laser type equations. In a single equation model (see, for example, Cheng and Capps (1988) or Jensen et al (1992)), only the non-zero consumption observations are included in the second stage. Moreover, in single-equation models, if the corresponding coefficient of IMR is statistically insignificant (Wooldridge, op cit), then we need not be concerned about the selection bias.

## 3.6 Tax Optimality

A key policy application of elasticity measurements (from demand) is in the optimality of commodity taxes. Since the day of Ramsey (1928), optimal commodity tax literature, seeks to answer the following question: how should taxes be designed such that, to raise a certain amount of revenue, welfare loss and distortions must be minimized. Ramsey's (*ibid*, also see Samuelson ibid) are elegant: for a single household economy, taxes should be imposed in such a fashion that the proportional change in compensated demand should be the same across commodities. If $[x_1, x_2, \ldots x_n]$ be the vector of commodities, then optimality requires that

$$\left(\frac{\Delta x_1}{x_1}\right)_{comp} = \left(\frac{\Delta x_2}{x_2}\right)_{comp} = \ldots\ldots = \left(\frac{\Delta x_n}{x_n}\right)_{comp} = -\Theta \ldots(3.52)$$

Here $\Theta$ is a positive constant. Elegant as the result is, it is of little practical importance for two reasons. First, the result is valid for (unobservable) compensated demand. Second, the result assumes one (representative) household. In reality, consumption demand comes from multiple households with differential access to resources. In what follows, I demonstrate operationalization using a two commodity, two-household model.

### 3.6.1 A Two Household, Two Commodity Model

Let $u_h(\mathbf{x}_h)$ and $v_h(\mathbf{p}, \mathrm{M}_h)$ denote individual households' *(h = 1,2)* direct and indirect utility functions respectively, where $\boldsymbol{x}_h$ denote commodity vector and $\boldsymbol{p}$ = vector of consumer prices. Then, $\mathrm{M}_h = \mathrm{p}^T \mathrm{x}_h$ is the household' aggregate expenditure. Defining the social welfare function V over the individual's indirect utility so that it is specified as a function of prices:

$$V(\mathbf{p},\ M_1, M_2) \ = \ W\left[v_1(\mathbf{p},\ M_1),\ v_2(\mathbf{p},\ M_2)\right] \text{...(3.53)}$$

If $X_i(p)$ denotes aggregate demand of commodity i then

$$X_i(\mathbf{p},\ M_1, M_2) = \sum_h x_{ih}(\mathbf{p}, M_h) \text{...(3.54)}$$

The revenue constraint is given by, $R = R_0 = \sum_{n=1} t_n X_n$ Here, the target revenue $R_0$ is set exogenously by the authorities. Further, let the production technology be CRS, and the market structure is assumed to be competitive. Then, the market price of commodity i is $p_i = c_i + t_i$ (this assumption ensures that $dp_i = dt_i$), where $c_i$ is (exogenously determined) the marginal cost of production.

If a tax $t_i$ is increased, the marginal effect on social welfare is given by

$$\frac{\partial V}{\partial t_i} = \frac{\partial W}{\partial v_1} * \frac{\partial v_1}{\partial t_i} + \frac{\partial W}{\partial v_2} * \frac{\partial v_2}{\partial t_i} \text{....(3.55)}$$

From Roy's identity, we have

$$\left(\frac{\partial v_h}{\partial p_i}\right) \Big/ \left(\frac{\partial v_h}{\partial M_h}\right) = -x_{ih} \text{...(3.56)}$$

Which implies (assuming perturbation in prices is coming from perturbation in taxes)

$$\frac{\partial v_h}{\partial p_i} = -\mu_h x_{ih} \text{....(3.57)}$$

Here, $\mu_h$ is the Lagrange multiplier associated with households' utility maximization. By duality (Varian, 1992), it is equal to the marginal utility of money $\left(\frac{\partial v_h}{\partial M_h}\right)$. Thus, the equation (3.63) can be written as

$$\frac{\partial V}{\partial t_i} = -\mu_1 x_{i1}\left(\frac{\partial W}{\partial v_1}\right) - \mu_2 x_{i2}\left(\frac{\partial W}{\partial v_2}\right) \text{....(3.58)}$$

The expression $\mu_h \frac{\partial W}{\partial v^h} = \beta_h$ is known as the social marginal utility of income for household h and measures the impact of the marginal Rupee (or dollar) to household h on the social welfare. Thus, (3.66) can be written in a compact way

$$\frac{\partial V}{\partial t_i} = -\beta^1 x_{i1} - \beta^2 x_{i2} \text{...(3.59)}$$

Differentiating both sides of the revenue constraint with respect to the tax rate, we obtain:

$$\frac{\partial R}{\partial t_i} = X_i + \sum_{k=1}^{2} t_k \frac{\partial X_k}{\partial p_k} \text{....(3.60)}$$

This is the marginal revenue generated through raising the tax rate on commodity k .
Finally, let us write the programme of the government as

$$\left.\begin{aligned} &\max_{t_k} V\left(\mathbf{p},\ M_1, M_2\right) \\ &\text{s.t } R_0 = R = \sum_{n=1} t_n X_n \end{aligned}\right\} \text{...(3.61)}$$

The associated Lagrangian is

$$V(.) + \lambda\left[R_0 - R(.)\right]$$

The first-order condition yields

$$\lambda = \frac{\left(\partial V / \partial t_i\right)}{\left(\partial R / \partial t_i\right)} \text{....(3.62)}$$

Here, $\lambda$ can be termed as social marginal cost of taxation: how much (social) welfare is lost if we increase tax on good i (in a marginal sense). If for two commodities i and j, we have $\lambda_i \neq \lambda_j$, then one can increase (decrease) the tax on the commodity with lower (higher) $\lambda$ (Ahmad and Stern 1984, op cit). In other words, those goods with the largest values of $\lambda$ should have their taxes reduced since collecting revenue via these goods lead to a larger loss in social welfare for a unit of revenue than would tax on low $\lambda$ goods. The exercise indicates *the direction* of optimal commodity tax reform.
Using the equations 3.67 and 3.68, The first-order condition for an optimal tax is:

$$\lambda = \frac{\beta^1 x_{i1} + \beta^2 x_{i2}}{X_i + \sum_{k=1}^{2} t_k \frac{\partial X_k}{\partial p_k}} \text{....(3.63)}$$

Suppose we want to compute $\lambda_1$. Then, multiplying and dividing by $p_1$, we have

$$\lambda = \frac{\sum_h \beta^h p_1 x_{1h}}{p_1 X_1 + \sum_{k=1}^{2} t_k p_1 \frac{\partial X_k}{\partial p_1}}$$

$$= \frac{\sum_h \beta^h E_{1h}}{E_1 + \sum_{k=1}^{2} t_k X_k \frac{p_1}{X_k} \frac{\partial X_k}{\partial p_1}}$$

$$= \frac{\sum_h \beta^h E_{1h}}{E_1 + \sum_{k=1}^{2} t_k X_k \eta_{k1}}$$

$$= \frac{\sum_h \beta^h E_{1h}}{E_1 + \sum_{k=1}^{2} \left(\frac{t_k}{p_k}\right)(p_k X_k)\eta_{k1}}$$

$$= \frac{\sum_h \beta^h E_{1h}}{E_1 + \sum_{k=1}^{2} \tau_k E_k \eta_{k1}} \quad .........(3.64)$$

Here, $E_{ih}$ is the total expenditure on commodity i by household h, $E_i = \sum_h E_{ih}$ is the total expenditure on commodity i (summed over all households), $\tau_k$ is the ad valorem tax rate and $\eta_{ik}$ are Marshallian elasticities.

Exploration and estimation of demand systems readily give us data on $E_i$, $E_{ih}$, and $\eta_{ik}$. The only issue here is to determine social marginal weights, $\beta_h$. To be consistent with the theory, such values should be consistent with a specified Social Welfare Function and individual or household utility maximization procedure. In reality, the values are obtained by using an Atkinson type individual indirect utility

$$v_h = \frac{K}{1-\varepsilon} M_h^{1-\varepsilon} \quad ...(3.65).$$

Here, ε measures aversion to inequality. For a particular household h, $\beta_h = K\left[M_h\right]^{-\varepsilon}$. The value of K is fixed by setting the value of $\beta_h$ to 1 for the lowest income consumer. Thus, one can write

$$\beta_h = \left[\frac{M_h}{M_0}\right]^{-\varepsilon} \quad ...(3.66)$$

However, note that assuming a utility function such as above is tantamount to putting a strong restriction on the product of (marginal)social preferences and individuals' utilities of income.

Further income/expenditure is treated as exogenous.[46] On the other hand, one advantage of this method is that the welfare weights are determined exogenously. In addition, the concern for equity is clearly expressed in ε and can be varied to reflect the inequality aversion of the social planner (Myles, 1996, chapt 4).

This completes our discussion of how to operationalize marginal income tax reform analysis using observable demand characteristics and (somewhat ad hoc) Social Welfare Function. We will use this in our later chapters.

For the sake of completeness, we briefly show how one can check whether the initial situation is Pareto optimal or not. Dissatisfaction with 'imposed value judgement' indicates that we can ask the following question: assuming that the current set of taxes are optimal, what vector **β**=[$\beta_1$, $\beta_2$,…$\beta_H$] is consistent with the present consumption behaviour? To answer this question, Ahmad and Stern (1984) notes that the first-order condition of the welfare maximization program can be written as , say, for a two good two household economy

$$\left.\begin{aligned} \beta_1 x_{11} + \beta_2 x_{12} &= \lambda\left( X_1 + \sum_{k=1}^{2} t_k \frac{\partial X_k}{\partial p_k} \right) \\ \beta_1 x_{21} + \beta_2 x_{22} &= \lambda\left( X_2 + \sum_{k=1}^{2} t_k \frac{\partial X_k}{\partial p_k} \right) \end{aligned}\right\} \quad \ldots(3.67)$$

Here, $x_{ih}$ is the demand for i-th good from the household h. Multiplying both sides of the equations by respective prices, we have, as before

$$\left.\begin{aligned} \beta_1 E_{11} + \beta_2 E_{12} &= \lambda\left( E_1 + \sum_{k=1}^{2} \tau_k E_k \eta_{k1} \right) \\ \beta_1 E_{21} + \beta_2 E_{22} &= \lambda\left( E_2 + \sum_{k=1}^{2} \tau_k E_k \eta_{k1} \right) \end{aligned}\right\} \quad \ldots(3.68)$$

Of course, $E_{ih}$ is the total expenditure of household h on commodity i and $E_k$ is the total spending on commodity 1. Scaling the SWF appropriately such that λ=1, the above equation yields a matrix equation

[46] "Difficulties are circumvented rather than solved", (Hindriks and Myles, 2007, pp 463)

$$\begin{bmatrix} E_{11} & E_{12} \\ E_{21} & E_{22} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} = \begin{bmatrix} E_1 + \sum_{k=1}^{2} \tau_k E_k \eta_{k1} \\ E_2 + \sum_{k=1}^{2} \tau_k E_k \eta_{k1} \end{bmatrix}$$

$$\rightarrow \mathbf{E\beta} = \mathbf{\Delta R} .....(3.69)$$

Where **E** is the observed matrix of expenditures and **ΔR** is the vector of marginal revenues. Provided that the matrices are invertible,

$$\mathbf{\beta} = \mathbf{E}^{-1}\mathbf{\Delta R} ....(3.70)$$

Ahmad and Stern (ibid) considered Indian tax data of 1979 and consumption data of 1973. Using a 9 commodity 9 household (created according to the expenditure pattern), they show that some of the implied welfare weights are in fact, negative. If some welfare weights are negative, they establish that the taxes are not Pareto optimal.[47]

[47] This is an application of the Minkowski-Farkas lemma. Either a feasible Pareto improvement exists or the β vector should be strictly positive (Ahmad and Stern, *ibid*, pp272).

# Appendix 3A

## Other Methods of Demand Estimation

In this appendix, I briefly mention some other dominant methods of demand estimation as well as an extension of what we have seen before for the sake of completeness.

Along with LES and LA/AIDS, the Rotterdam model (Theil 1964, Barten 1965) is the third workhorse of demand estimation. Apropos to start with a pre-specified utility function, the model begins with a general demand function in differential/difference form, imputes restriction consistent with consumer behaviour (for example, homogeneity and symmetry of Slustky equations) and additional restrictions to make the slope coefficients constant. Finally, it estimates the following equation

$$w_i d(\ln x_i) = \alpha_i d\left(\ln Q\right) + \sum_j \gamma_{ij} d\left(\ln p_j\right) \ldots (A3.1)$$

Here, $w_i$ is budget share of i-th commodity and

$$\left.\begin{aligned} \alpha_i &= p_i \frac{\partial x_i}{\partial M} \\ d\ln Q &= \sum w_i d\ln x_i \\ \gamma_{ij} &= \frac{p_i p_j \eta_{ij}^{\ h}}{M} \end{aligned}\right\} \ldots (A3.2),$$

An incomplete demand system was proposed by Lafrance and Hahneman (1989). Let **x** be vector of n commodities of interest and **p** be the corresponding prices. Let M be the money income, , **y** be the consumption vector of other commodities and **z** be the set of other prices. The researcher has information about **p** and **z**, but not about **y.** The idea here is to estimate the demand for **x** and s, where s=M-$\mathbf{px}^T$ can be thought as a numeraire commodity as functions of **p, z** and M.

# CHAPTER 4

# FOOD DEMAND IN ASSAM: A COMPARATIVE ANALYSIS OF 66th AND 68TH ROUND NSSO DATA

## 4.1 Introduction

The aim of the chapter is to provide a comparative analysis of demand for selected food items for Assam, using secondary data from National Sample Survey (NSSO) 66th and 68th rounds. I also show how the demand estimates provide an approximate guide to the reform of commodity taxation. The motivation of the present chapter is to analyse official data as exhaustively as possible.

The chapter is divided into the following sections. Section 4.2 provides a brief guide to the two rounds of NSSO, an overview of the commodities selected, as well as the summary statistics. Section 4.3 presents the analysis of data as per linear expenditure system (LES) estimation.

The next section presents the analysis as per LA-AIDS estimation. Within each section, the scheme of presentation is the following:

(i) 66th round pooled data: regression, elasticity,[48] tax reform.[49]

(ii) 66th round urban/rural data: regression, elasticity, tax reform and comparison (urban/rural)

(iii) 68th round pooled data: regression, elasticity, tax reform.

(iv) 68th round urban/rural data: regression, elasticity, tax reform and comparison (urban/rural).

(v) Comparison over time: pooled 68/ pooled 66, urban 66/urban 68, rural 66/ rural 68.

The reason behind such a comparison exercise is the following. Regression coefficients and elasticities reflect behavioural patterns, and hence different values indicate a possible transformation of preferences. Such transformations may happen not only over cross-section of data (e.g. urban/rural preferences might be different within a single round of NSSO) but

[48] Marshallian, Hicksian and Expenditure elasticities.

[49] Involves computation of marginal welfare cost of different commodities

over time (e.g. urban/urban preferences are different over two different rounds of NSSO). An exhaustive study is required to investigate these aspects.

## 4.2 Analysis of the data

The 66th round (July 2009-June 2010) of the National Sample Survey (NSS) Organization and the 68th round (July 2011-June 2012) of NSS are allotted for the survey on 'Household Consumer Expenditure' and 'Employment and Unemployment'. The 66th is the 8th quinquennial survey in the series. The previous one was performed during the 61st round (2004-05) of the National Sample Survey. The 68th round is akin to a quinquennial survey as far as issues of design, enquiry, questionnaires and sample sizes are concerned.

'Household Consumer Expenditure' and 'Employment are regarded as the chief and vital source of statistical indicators on social consumption and well-being, level of living and inequality. This helps to estimate a variety of parameters of factor market of labour and activity participation of the people in the country/region. The survey instruments for both these subjects have been stabilized over the years, since their quinquennial inception in the NSS 27th round (October 1972 – June 1973). Besides, there have been annual rounds, alternate modules and occasional methodological studies for updating and refining the survey instruments, especially, for the measurement of Household Consumer Expenditure (HCE).

Implicit prices are used for calculating the prices of goods. In the NSS surveys, for most of the commodities, respondents provide information regarding the amount of money spent on each categorized item and the purchase of its physical quantity. (for example, rupees 10 is spent on 5 kilos of cereals). The ratio of expenditure to volume (that is, value divided by quantity) gives a measure of price (implicit price) or a measure of unit value.

The main advantages of unit-level data are that the size of samples is huge and the unit values relate to genuine transactions, not the price reported or listed by the shops. But all the goods and services do not have already defined quantities (for example, milk and milk products, fruits, vegetables, etc.). Also, unit values are not prices. However, many goods are not perfectly homogenous inspite of the fact that goods are defined at the maximum possible disaggregation level. In such a case the unit values reflect not only prices but also the mix of varieties within the category.

For certain commodities, the questionnaire does not measure quantities as it is not possible to do so. So, such commodities have been dropped from our analysis. Data by NSS is collected separately for commodities purchased in the market, for commodities grown or produced at home, and for commodities obtained as loans or gifts. Thus, the unit values are calculated by dividing the sum of the three kinds of expenditure by the sum of the three kinds of quantity.

Although expenditure is measured in the currency of the nation, viz., rupees where its concept and units are clear, but therein lays a problem of choice of the units; for example, items can be bought, by weight or one by one. There are also local variations in units so that what works in one place may not work as well somewhere else. Sometimes certain goods may be bought by the bunch (fruits or vegetables), box (fruits or vegetables), packet or bag, or will be converted by the enumerator or the respondent, but this conversion may not be accurate. Taking the example of eggs, they are measured in dozens for some households and units for others. In such cases, the unit values are said to have multi-modal distributions, with peaks corresponding to each distinct unit. There is the existence of another problem, which is when two or more distinct goods are included within a single commodity. Taking the example of milk, if milk (liquid) and milk products (expensive sweets) are lumped together, the unit values will cluster around the milk price and the sweet price. (Deaton and Torazzi, 2000)

### 4.2.1 Procedural Differences in 66$^{th}$ and 68th Rounds

The 68$^{th}$ round (July 2011-June 2012) of NSS is earmarked for surveys on 'Household Consumer Expenditure' and 'Employment and Unemployment'. The last survey on these subjects was conducted in the 66$^{th}$ round of NSS (2009-10) which was the eighth quinquennial survey in the series on 'Household consumer expenditure' and 'Employment and Unemployment'. The 68$^{th}$ Round is similar to a quinquennial survey as far as subjects of enquiry, design, questionnaires and sample sizes are concerned.

While comparing 66$^{th}$ and 68$^{th}$ Round NSSO, a new item named 'refined oil (sunflower, soyabean, saffola, etc.)' has been seen as an additional item 184 in the 'edible oil' sub-group. Also, the vegetable sub-block has been reduced from the earlier 30 to 17 items. 'Jeera' and 'dhania' are the two new substances that have been added as items 252 and 253 in the sub-group of ‘spices’. Moreover, a new item sub-group termed as ‘served processed food’ consists of the ‘cooked meals’ items and a new item named ‘cooked snacks purchased’ which covers a variety of cooked snacks usually purchased and consumed away from home. The old item ‘cooked meals received as assistance or payment’ has been split into two items ‘cooked meals received free in the workplace’ (item 281) and ‘cooked meals received as assistance’ (item 282) in the ‘served processed food’ item sub-group. Besides, the earlier items of prepared sweets, cake, pastry, biscuits, chocolates, pickles, sauce, jam, etc. have been placed in a ‘packaged processed food’ sub-group in Block 5.2.

In the 68th Round NSSO, sugar and salt have been clubbed together. Hence we are using the 66th round questionnaire to delineate sugar and salt. Besides, to check the demand for both the commodities separately and also for consistency of demand estimation between the two rounds, we extracted the sugar and salt sub-sections separately and added them under the group “sugar”[50] and “ salt”[51] respectively. Sugar and salt were clubbed together under the item code “179” in the 68th round, unlike the 66th Round data.

### 4.2.2 Estimation of Prices

Estimation requires prices ($p_i$) to be different across households. Since we are dealing with a cross-section, prices are the same across households. So we use unit values $p_i = \frac{Expenditure_i}{Quantity_i}$ as a proxy of prices (see Deaton 1988). In our case, all data was collected within Kamrup (Metropolitan) and Kamrup District and within a short time-period. In that case, such unit values are good proxies of prices, and may not be biased by quality effects.

The summary statistics of total consumption expenditure are shown in table 4.1.

[50] Item codes of sugar were 171+172+173+174+175.
[51] Salt had the item code 170

**Table 4.1: Total consumption expenditure in deciles (in rupees)**

| DECILE CLASS | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 |
|---|---|---|---|---|---|---|---|---|---|
| Assam Rural 66 Round | 576 | 656 | 741 | 815 | 904 | 1012 | 1121 | 1283 | 1550 |
| India Rural 66 Round | 537 | 631 | 718 | 804 | 895 | 1001 | 1133 | 1322 | 1653 |
| Assam Urban 66 Round | 674 | 835 | 1048 | 1205 | 1426 | 1747 | 1918 | 2311 | 3330 |
| India Urban 66 Round | 733 | 926 | 1101 | 1293 | 1502 | 1773 | 2097 | 2063 | 3665 |
| Assam Rural 68 Round | 584 | 742 | 806 | 880 | 1043 | 1263 | 1420 | 1710 | 2583 |
| India Rural 68 Round | 521 | 905 | 1018 | 1136 | 1266 | 1427 | 1645 | 2007 | 4481 |
| Assam Urban 68 Round | 821 | 976 | 1245 | 1432 | 1645 | 1855 | 2197 | 2664 | 5580 |
| India Urban 68 Round | 701 | 1363 | 1625 | 1888 | 2181 | 2548 | 3063 | 5350 | 7282 |

*Source*: 66 & 68 NSSO data

### 4.2.3 Categories of Consumption Items

Although there are various categories of food and non-food items under consumption expenditure, our study focuses on food expenditure only. The rationale behind such an analysis is because there were many missing values in the NSSO Rounds data[52]. The five items viz., cereals, pulses, sugar, salt and oil only had consistent quantity and value of consumption data (refer to Table 4.2). Also, rural-urban segregation which is the basic division followed by NSSO, India has been followed in our study. In mostly, all empirical demand analyses, such a division are usually maintained (Bhalla et. al, 1999; Aziz and Malik, 2010; Rao, 2000; Myers, 2007)**.** We speculate that both the magnitude and the signs of elasticities may vary across the food items as well as between the urban and rural sub-samples. Thus, as far as a targeted food policy is concerned, they ought to vary between the urban and rural centres in addition to the food items.

[52] the sample units with missing data points were also omitted and dropped

**Table 4.2: Consistent Data (both 66 and 68 Round) (in rupees)**

| Item | Consistent Value of Consumption data Available | Consistent Quantity of Consumption Data Available |
|---|---|---|
| Cereals | Yes | Yes |
| Pulses | Yes | Yes |
| Sugar | Yes | Yes |
| Salt | Yes | Yes |
| Oil | Yes | Yes |
| Milk | Yes | No |
| Fruits | Yes | No |
| Vegetable | Yes | No |
| PTI | Yes | No |
| Spices | Yes | No |
| EFM | Yes | No |
| Beverages | Yes | No |

The commodity disaggregation will be as follows:

1. Cereal: It includes rice, chira, khoi, muri, wheat, maida, maize, bajra, ragi, etc. Household consumption does not include consumption of cereals by livestock belonging to the household. Such expenditure, being part of farm expenditure, is excluded from household consumer expenditure altogether.
2. Pulse: It includes urd, khesari, gram, moong arhar, masur, peas, besan, etc.
3. Sugar: This will include sugar, khandsari, gur, misri, honey, candy, etc.
4. Salt: This will include all edible salt, whether iodised or not.
5. Edible oil: When vanaspati, groundnut oil, mustard oil, coconut oil, etc. is used for cooking they are termed as "edible oil". But the same is not included here when used for toilet purposes.

The Linear Expenditure System (LES) and the Linearly-Approximate Almost Ideal Demand Systems (AIDS) which had been proposed by Deaton and Muelbauer (1980) shall be used for estimating a five-commodity disaggregation of consumer expenditure from National Sample Survey (NSS) data in India (66th NSS Round).

The share of the budget for each household in the surveys for each commodity; has been calculated. The total value of expenditures on the commodity is the sum of home production purchases and gifts and loans, and the other is divided by total household expenditure on all goods and services, which is constructed from the NSS–supplied per capita total household expenditure multiplied by household size.

**Table 4.3: Summary Statistics of Selected Items (both rounds) (in rupees)**

| Value | (66th round) | | (68th round) | |
|---|---|---|---|---|
| | Mean[53] | S.D. | Mean | S.D. |
| **Cereals(Assam)** | 1061.45 | 475.637 | 1025.39 | 566.12 |
| **Cereals (Urban)** | 938.70 | 436.012 | 1021.34 | 555.30 |
| **Cereals (Rural)** | 1096.72 | 480.74 | 1026.64 | 556.47 |
| **Pulses (Assam)** | 134.38 | 25.44 | 194.09 | 116.07 |
| **Pulses (Urban)** | 180.77 | 112.08 | 203.6 | 134.39 |
| **Pulses (Rural)** | 168.97 | 108.4 | 191.17 | 109.68 |
| **Sugar (Assam)** | 71.81 | 46.02 | 84.64 | 47.32 |
| **Sugar (Urban)** | 76.953 | 52.427 | 88.37 | 59.597 |
| **Sugar (Rural)** | 70.33 | 43.91 | 83.50 | 42.79 |
| **Salt (Assam)** | 13.93 | 6.79 | 27.84 | 17.29 |
| **Salt (Urban)** | 13.28 | 6.90 | 31.94 | 21.95 |
| **Salt (Rural)** | 14.123 | 6.74 | 26.58 | 15.373 |
| **Oil (Assam)** | 167.91 | 80.81 | 596.86 | 406.24 |
| **Oil (Urban)** | 178.76 | 89.48 | 609.13 | 455.86 |
| **Oil (Rural)** | 164.79 | 77.88 | 593.08 | 389.71 |
| **Sample size (Pooled)** | 3393 | | 3368 | |
| **Sample size (Urban)** | 752 | | 793 | |
| **Sample size (Rural)** | 2641 | | 2575 | |

*Source*: 66 & 68 NSSO data

**Table 4.4: Mean prices of various commodities (in rupees)**

| Commodities | Mean Price (Assam) 66th Round | Mean Price (Assam) 68th Round |
|---|---|---|
| Cereals | 16.86965 | 16.98403 |
| Pulses | 62.12575 | 56.00154 |
| Sugar | 28.90609 | 21.43286 |
| Salt | 9.586937 | 10.42264 |
| Oil | 68.22255 | 68.8975 |

[53] In rupees

**Table 4.5: Mean prices of various commodities (Urban / Rural) (in rupees)**

| Commodities | Mean Price (Assam) 66th Round-Urban | Mean Price (Assam) 66th Round-Rural | Mean Price (Assam) 68th Round - Urban | Mean Price (Assam) 68th Round-Rural |
|---|---|---|---|---|
| Cereals | 2.81 | 2.78 | 2.32 | 3.45 |
| Pulses | 64.94 | 61.31 | 6.90 | 55.52 |
| Sugar | 31.42 | 28.18 | 7.85 | 20.77 |
| Salt | 10.25 | 9.39 | 4.68 | 10.22 |
| Oil | 69.02 | 67.99 | 6.12 | 68.91 |

With the data in the background, we move towards estimation of data.

## 4.3 Linear Expenditure System

As mentioned in chapter 3, the LES procedure estimates the following equation

$$w_i = \frac{p_i a_i}{M} + b_i \left( 1 - \frac{\sum_j p_j a_j}{M} \right)$$

Here, M is the group budget, $a_i$ is the minimum (subsistence) consumption, $b_i$ is the marginal budget share and $p_i$ is the (unit) price of commodity i. The system aims to estimate $a_i$ and $b_i$. Since I have consistent data only for five categories, we will assume separability[54]. In what follows, the commodities are identified as such

| Commodity id | Commodity |
|---|---|
| 1 | Cereal |
| 2 | Pulse |
| 3 | Sugar |
| 4 | Salt |
| 5 | Oil |

The procedure is as follows. We will first tackle pooled data for the 66th round. We will present the regression estimates, compute the elasticities (Marshallian, Hicksian and Expenditure), and use these elasticities to figure out the direction of tax reform. We will repeat the procedure for urban and rural sub-samples (of 66th round) and compare the estimates to figure out if urban and rural elasticities and tax prescriptions differ qualitatively. Then the above procedure will be repeated for the 68th round, covering pooled, urban and rural sectors.

[54] See Vu (2020)

As a final exercise, we will compare the estimates across time, e.g. pooled(66th) with pooled 68th, urban 66th with urban 68th, etc. This will throw light on whether preferences etc are changing over time.

### 4.3.1 Pooled Data, 66th Round

We begin by reporting and interpreting the regression coefficients and elasticities. Then we will move towards application to tax reform.

#### 4.3.1.1 Regression Result and Elasticities

As per the procedure outlined above, we present the regression estimates first.

**Table 4.6: Regression Coefficients: 66th Round**

| Coefficient | 66 Pooled Sample |
|---|---|
| $a_1$ | -3.7665 |
| | (-1.23) |
| $a_2$ | 1.543778 |
| | (23.09)*** |
| $a_3$ | 1.7584 |
| | (37.20)** |
| $a_4$ | .90717 |
| | (34.84)*** |
| $a_5$ | 1.48564 |
| | (27.90)*** |
| $b_1$ | .86676 |
| | (185.21)*** |
| $b_2$ | .059755 |
| | (18.25)*** |
| $b_3$ | .01656 |
| | (12.75)*** |
| $b_4$ | .004190 |
| | (19.21)*** |
| $b_5$ | .0527334 |
| | (19.21)*** |
| *N* | 3368 |

* $p<0.05$; ** $p<0.01$

z values are reported in parenthesis

The values of the marginal budget shares $b_i$ are shown in the above table. The t-values for all the estimates except a1 are found to be statistically significant. The group with the lowest marginal budget share[55] ($b_i$) is salt.

[55] Fractions of an additional rupee of expenditure spent on each good that is independent of prices and expenditure.

We estimate the Akaike's information criterion[56] and Bayesian information criterion for the equation. The result is summarized below-

**AIC and BIC**

| | |
|---|---|
| AIC | -57198.41 |
| BIC | -57143.31 |

Using the formulae in chapter 3, we compute the Marshallian elasticity for the pooled data. Here, every cell (except in the diagonal) indicates is cross-price elasticity of the price of the horizontal item on the demand of the vertical item.

**Table 4.7: Own and Cross-price Elasticity[57] of Food Groups (Pooled) 66**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | -1.00047*** | -.07831*** | -.041498*** | -.0070967*** | -.082763*** |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | .022125 | -.99154*** | -.01769*** | -.003026*** | -.035292*** |
| P>(\|z\|) | 0.21 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | .01465 | -.022117*** | -.97591*** | -.002004*** | -.023373*** |
| P>(\|z\|) | 0.207 | 0.000 | 0.000 | 0.000 | 0.000 |
| Salt | .019114 | -.02885*** | -.015287*** | -.9351492*** | -.030488*** |
| P>(\|z\|) | 0.20 | 0.000 | 0.000 | 0.000 | 0.000 |
| Oil | .0199548 | -.03011*** | -.01595*** | -.002729 | -.99161 |
| P>(\|z\|) | 0.211 | 0.000 | 0.000 | 0.000 | 0.000 |

** $p<0.05$; *** $p<0.01$

Behavioural characteristics of the consumer demand systems have been measured in the form of elasticity. Thus, consumer response to price change is summarised in terms of cross-price elasticity. This uncompensated elasticity of demand represents changes in the quantity demanded as a result of changes in prices, capturing both the income and price effect.

It can be observed that the own-price elasticity is comparatively lower for salt and higher for cereals, pulses sugar and oil. The estimated own-price elasticities[58] indicate

[56]It is an estimator of prediction error and thereby the relative quality of statistical models for a given set of data. Given a collection of models for the data, AIC estimates the quality of each model, relative to each of the other models. Thus, AIC provides a means for model selection. Suppose that we have a statistical model of some data. Let $k$ be the number of estimated parameters in the model. Let $\tilde{L}$ be the maximum value of the likelihood function for the model. Then the AIC value of the model is the following.

$$\text{AIC} = 2k - 2\ln(\tilde{L})$$

[57] Calculated at the sample mean

that a 1 unit increase in price leads to more than a 1 unit decrease in quantity demanded for cereals. This higher change of cereals indicates this item is very sensitive to price changes. This is an indication that price interventions for cereals can have a significant effect on consumption, at least during the short run. Since these seem to be inelastic goods, thus reducing the prices will not increase the revenue of the government.

The table below computes the expenditure elasticity for the pooled data.

**Table 4.8: Expenditure Elasticity of Food Groups (Pooled) 66**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Expenditure Elasticity | 1.214028 | .5176909 | .3428567 | .4472285 | .4669015 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |

The result of this analysis suggests that cereals are the most preferred items in the consumer's budget (since they have higher expenditure elasticities than other commodities) and their consumption is fairly sensitive to changes in income. It was observed that owing to the limitations of the data, the estimates have very wide margins of error. Point estimates seemed to be closer to cross-section elasticities than Rudra-Paul's suggestions that income elasticities were different from the NSSO and the elasticities of necessities and luxuries were much closer to one. (Rudra 1964 and Paul 1964)

Hicksian elasticities are presented in the next table (table 4.9)

**Table 4.9 Hicksian Elasticities: 66th Round: Pooled Data**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.1411891***** | -.0634629*** | -.0184102*** | -.0044026*** | -.0542534*** |
| P>(\|z\|) | **0.000** | **0.000** | .0.000 | 0.000 | 0.000 |
| Pulse | -.3929872*** | **-.4208671***** | -.0078505*** | -.0018774*** | -.023135*** |
| P>(\|z\|) | .0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | -.2602668 *** | -.0179226*** | **-.3021698** | -.0012433*** | -.0153218*** |
| P>(\|z\|) | 0.000 | 0.000 | **0.000** | 0.000 | 0.000 |
| Salt | -.3393479*** | -.0233684*** | -.006779 | **-.3810814***** | -.0199773*** |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | **0.000** | 0.000 |
| Oil | -.3544322*** | -.0244071*** | -.0070803 | -.012049 | **-.375079***** |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | **0.000** |

** $p<0.05$; *** $p<0.01$

As expected, the own-price elasticities are negative, and all of them exhibit price inelastic behaviour. The cross-price elasticities have similar signs. Unlike the Marshallian elasticities, all Hicksian elasticity measures are significant.

#### 4.3.1.2 Tax Reform

In this section, we apply the Marshallian elasticities to show how the estimates can be used to predict the direction of commodity tax reform.

The tax rates have been taken from the Commissionerate of Sales tax, Government of Assam. It has been found that the goods, cereals, pulses, sugar and salt have been exempted from taxes (First Schedule). Only oils have been taxed at the rate of 6% (Second Schedule) [59]

The next table shows different values of the inequality aversion parameter ε. Unlike Murty and Ray (1989), $\beta_h$ s are not allowed to vary with prices. $\beta_h$ increases for lower-income households. Thus, we take $\varepsilon$ as the inequality aversion parameter[60]. In other words, 'social marginal utility of income' for the poorest household is unity and declines monotonically with an increase in the household affluence at the rate determined by the "inequality aversion" parameter $\varepsilon$. The value of $\varepsilon$ measures the degree of concavity of the function $\beta_h^{(1-\varepsilon)}/(1-\varepsilon)$ and therefore reflects the extent to which the income transfer from a rich to a poorer person improves social welfare.

Now, for optimal taxation, substituting all the variables in the final equation of λ, we find out the value of λ at different levels of ε. Substituting all these calculated values along with the pre-determined tax rates, we obtain the value of λ.

Following Decoster and Schokkaert (1989) whose analysis of Belgian data had a twelve commodity breakdown, it is evident that the marginal social costs (λ) depend upon the chosen value of ε. Thus, λ indicates the effects of tax increase on the i-th good sufficient to raise one rupee of the government revenue on all groups, with the usage of welfare weights that are expressed in terms o units of per-capita expenditure to the poorest group. Thus, λ is an indication of the loss of the household concerning its own expenditure.

[59] Used for both 66th and 68th Rounds, NSSO data
[60] It measures the relative sensitivity to transfers at different income levels.

Thus, λ represents the effects of an increase in the tax on the i-th good sufficient to raise one rupee of the government revenue on all groups, using welfare weights that are expressed in terms of units of per-capita expenditure to the poorest group. Thus, λ is an indication of the loss of the household in terms of its own expenditure. But marginal tax reform is assumed to increase and not decrease welfare since it is believed to move towards a 'good' direction but nothing guarantees that reform will reach an optimal state.

**Table 4.10: Marginal Welfare Cost of Taxation (pooled sample)**

| Item | ε = 0 | ε = .5 | ε = 1 | ε = 1.25 | ε = 1.5 | ε = 2 |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 0.999811 (5) | 0.520996 (5) | 0.276565 (5) | 0.202867(5) | 0.149468 (5) | 0.082214 (5) |
| $\lambda_{pulses}$ | 1.001771 (4) | 0.537557 (3) | 0.294184 (3) | 0.219223(3) | 0.16416(3) | 0.093414(3) |
| $\lambda_{sugar}$ | 1.002243 (2) | 0.537698 (2) | 0.294441(2) | 0.219568(2) | 0.164587(2) | 0.093959(2) |
| $\lambda_{salt}$ | 1.001977 (3) | 0.5358 (4) | 0.292561 (4) | 0.217867(4) | 0.163081(4) | 0.092804(4) |
| $\lambda_{oil}$ | 1.06326 (1) | 0.5681 (1) | 0.309755 (1) | 0.230449 (1) | 0.172306(1) | 0.097792 (1) |

Note: *The number in brackets denotes the rank of λ for each commodity*

The above table shows different values of the inequality aversion parameter[61] ε. In other words, the 'social marginal utility of income' for the poorest household is unity and declines monotonically with an increase in the household affluence at the rate determined by ε.[62] Here, ε > 0, $\beta_h < 1$[63] so that increments of expenditure to the poor are seen as more valuable than those to the rich.

The above table presents that at ε = 0, for cereals, λ = 0.998, which means that there is a 0.998 unit loss in welfare due to a 1 unit increase in taxation. Again, for pulses, λ = 1.1001 means that there is 1.1001 unit loss in welfare due to a 1 unit increase in taxation. Similarly, for sugar, salt and oil, λ = 1.1002,1.1001 and 1.063 respectively which means that there is a

[61] It measures the relative sensitivity to transfers at different income levels.

[62] The value of $\varepsilon$ measures the degree of concavity of the function $\beta_h^{(1-\varepsilon)}/(1-\varepsilon)$ and therefore reflects the extent to which the income transfer from a rich to a poorer person improves social welfare.

[63] With ε > 0, the social marginal utility declines as income increases. It decreases faster as ε rises, so relatively more weight is given to low- income consumers. Thus, in this way, the value of ε can be treated as a measure of concern for equity.

When ε = 0, it implies that the policy-maker values Rs.1 of expenditure for the poorest individual as equivalent to rupee 1 for the richest. Again, a value of ε = 1 indicates that a marginal unit to a household 'h' is worth half as much as a marginal unit to individual 1 if the expenditure of *h* is twice that of individual 1. Besides, ε > 2 gives much greater weight to the poorest.

1.1002,1.1001 and 1.063 units loss in welfare due to a 1 unit increase in taxation for the items of sugar, salt and oil respectively. It decreases with the increase in ε (inequality aversion) for all commodities. The loss in welfare is more in these items per unit increase in tax generation. Hence, it indicates that the commodity taxes on all these food commodities are unequal.

This implies that cereals and pulses should have their taxes increased, sugar, salt and oil may have their taxes decreased for commodity taxes to be optimal[64] Note that the ranking of lambdas are fairly consistent under different assumptions of ε. Here, we say shall say that we reduce the tax on the top 3 commodities, i.e., sugar, salt and oil and increase tax on the bottom two ranking items which are cereals and sugar. But as we move from ε=0 to ε=0.5, we need to reduce taxes on pulses, sugar and oil and increase taxes on cereals and salt. This result is consistent throughout all the εs.

This concludes our discussion of 66th round pooled data with LES estimation.

### 4.3.2 66th Round: Urban and Rural (LES Estimation)

In the next section, we repeat the same exercise for disaggregated data, showing the estimates for urban and rural populations separately. At The same time, we will present the cross-sectional comparison of different estimates and statistics. As we know, the parameter estimates/coefficients capture different aspects of behavioural patterns. We would like to see if there is considerable change over urban and rural sub-samples.

#### 4.3.2.1: Regression Coefficients and Elasticity

Again, repeating the same method separately for urban and rural sub-samples, we get the following regression results (table 4.11).

Looking at the regression table, one can see that the 'minimum consumption' is higher for cereals, pulses, and salt in the rural sector and for oil and sugar in the urban sector. As far as marginal (group budget) shares are concerned, the rural sector shows a higher propensity of spending on pulses, sugar, salt and oil, and urban sector on cereals.

We also estimate the AIC and BIC for the equation for both urban and rural are given as follows:

[64] Note that the results can be indicative only since we are dealing only with a subset of the consumption basket.

**AIC and BIC 66th Round**

| | | |
|---|---|---|
| 66 Urban | AIC | -11750.74 |
| | BIC | -11709.13 |
| 66 Rural | AIC | -45924.59 |
| | BIC | -45871.76 |

**Table 4.11: Urban/Rural: Regression Coefficients 66**

| Coefficient | 66 Urban | 66 Rural |
|---|---|---|
| a1 | -19.484 | 16.504* |
| | (-2.77) | (5.45) |
| a2 | 1.3292 | 1.74824 |
| | (7.94)** | (25.45)** |
| a3 | 1.8989 | 1.8173 |
| | (16.30)** | (37.27)** |
| a4 | .77022 | 1.0663 |
| | (14.41)** | (36.59)** |
| a5 | 1.5827 | 1.5792 |
| | (10.95)** | (29.2)** |
| b1 | .87402 | .8472 |
| | (83.88)** | (153.5)** |
| b2 | .063845 | .066176 |
| | (8.81)** | (16.65)** |
| b3 | .011208 | .020494 |
| | (3.72)** | (12.81)** |
| b4 | .003989 | .00435 |
| | (7.91)** | (15.9)** |
| b5 | .046935 | .06177 |
| | (6.84)*** | (20.00)** |
| *N* | 752 | 2616 |

* *p*<0.05; ** *p*<0.01

The z values are in parenthesis

**Table 4.12: Own and Cross-price Elasticity of Food Groups (Urban) 66**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-1.00261*****| -.08037*** | -.05555*** | -.00735*** | -.10172*** |
| P>(\|z\|) | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | .12676 | **-.9931164***** | -.0210728** | -.002788*** | -.038585*** |
| P>(\|z\|) | 0.004** | **0.000** | 0.030 | 0.000 | 0.000 |
| Sugar | .05227 | -.01257 | **-.975598***** | -.001149*** | -.015913** |
| P>(\|z\|) | 0.015 | 0.001 | **0.000** | 0.000 | 0.001 |
| Salt | .10781*** | -.02593*** | -.0132938*** | **-.942232***** | -.03281*** |
| P>(\|z\|) | 0.002 | 0.000 | 0.000 | **0.000** | 0.000 |
| Oil | .09423*** | -.02266*** | -.01566*** | -.002072 | **-.991561***** |
| P>(\|z\|) | 0.006 | 0.000 | 0.000 | 0.061 | **0.000** |

Looking at the Marshallian elasticities from the urban data, like the pooled counterpart, shows the cereals' demand to be price elastic. Salt is the least elastic. It seems that cereal is the gross substitute for all other commodities. Other commodities are gross complements.

Now we compute the same elasticities for the rural sector.

**Table 4.13: Marshallian Own and Cross-price Elasticity of Food Groups (Rural) 66**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.9977** | -.082805 | -.039566 | -.007738 | -.082947 |
| P>(\|z\|) | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.10615 | **-.99033** | -.020059 | -.003923 | -.042053 |
| P>(\|z\|) | 0.000 | **0.000** | 0.000 | 0.000 | 0.000 |
| Sugar | -.07898 | -.031236 | **-.97468** | -.002919 | -.031289 |
| P>(\|z\|) | 0.005 | 0.000 | **0.000** | 0.000 | 0.000 |
| Salt | -.083548 | -.03303 | -.01578 | **-.92482** | -.03309 |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | **0.000** | 0.000 |
| Oil | -.10160 | -.040180 | -.019199 | -.00375 | **-.99100** |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | **0.000** |

Looking at the Marshallian elasticities from the rural data, all commodities are price inelastic. Salt is the least elastic. All commodities are gross complements.

Our next task is to compare the elasticities across urban and rural sub-samples. To facilitate the discussion, we use the data from the above tables and generate the following one.

### Table 4.14: Cross-Sectional Comparison of Marshallian Elasticities: 66th Round

| | Cereal | | Pulse | | Sugar | | Salt | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| Cereal | **-.9977** | **-1.00261*****| -.082805 | -.08037*** | -.039566 | -.05555 | -.007738 | -.00735 | -.082947 | -.10172 |
| P>(\|z\|) | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.10615 | .12676 | **-.99033** | **-.9931164** | -.020059 | -.0210728 | -.003923 | -.002788 | -.042053 | -.038585 |
| P>(\|z\|) | 0.000 | 0.004 | **0.000** | **0.000** | 0.000 | 0.030 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | -.07898 | .05227 | -.031236 | -.01257 | **-.97468** | **-.975598** | -.002919 | -.001149 | -.031289 | -.015913 |
| P>(\|z\|) | 0.005 | 0.015 | 0.000 | 0.001 | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.001 |
| Salt | -.083548 | .10781*** | -.03303 | -.02593 | -.01578 | -.0132938 | **-.92482** | **-.942232** | -.03309 | -.03281 |
| P>(\|z\|) | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | **0.000** | **0.000** | 0.000 | 0.000 |
| Oil | -.10160 | .09423*** | -.040180 | -.02266 | -.019199 | -.01566 | -.00375 | -.002072 | **-.99100** | **-.991561** |
| P>(\|z\|) | 0.000 | 0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.061 | **0.000** | **0.000** |

For cereal, own-price elasticity at the urban centre is higher. For urban consumption, cereal shows positive cross elasticity, but rural consumption generates negative cross elasticities. For Pulse, own-price elasticity of urban consumption is higher than the rural consumption. The cross-price elasticities are higher in the rural sector compared to the urban sector. For sugar, urban own-price elasticity is higher than that of the rural one. Cross-price elasticities are higher in urban areas for cereal and pulses. For salt, urban own-price elasticity is higher than that of the rural one. Cross-price elasticities are higher in rural areas for all other commodities. For oil, urban own-price elasticity is higher than that of the rural one. Cross-price elasticities are higher in rural areas for pulse, sugar and salt.

From the above discussion, it is evident that, as far as Marshallian elasticities are concerned, consumption in rural and urban areas shows marked disparity, depending on the commodity concerned.

In the next table, we present the cross-sectional comparison of expenditure elasticity.

**Table 4.15: Cross-sectional Comparison of Expenditure Elasticities: 66th Round**

| Sub-sample | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Urban | 1.29280 | .49038 | .202244 | .41710 | .364562 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |
| Rural | 1.1702 | .59331 | .441454 | .46694 | .567869 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |

In both urban and rural sub-samples, cereal is expenditure elastic. In the urban sample, cereal is followed (decreasing order of elasticity) by pulses, salt, oil and sugar, while in the rural sample; the order of commodities is pulses, oil, salt and sugar. Thus the behaviour is more or less consistent across sectors.

In the next table, we provide an analysis of compensated elasticities. As before, we present first the tables, followed by a comparative analysis.

**Table 4.16: Hicksian Elasticities: 66th Round: Urban Data**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.17353** | -.089858 | -.01693 | -.005006 | -.064163 |
| SE | **.01746** | .00990 | .003388 | .000517 | .009095 |
| Pulse | -.46254 | **-.49414** | -.006421 | -.001899 | -.024338 |
| SE | .05866 | **.05369** | .001436 | .00028 | .00408 |
| Sugar | -.190758 | -.01405 | **-.23095** | -.00078 | -.010037 |
| SE | .05137 | .00393 | **.04592** | .00021 | .002905 |
| Salt | -.39326 | -.02897 | -.00545 | **-.40337** | -.02069 |
| SE | .04484 | .00413 | .001187 | **.041032** | .00344 |
| Oil | -.343864 | -.02533 | -.004774 | -.00950 | **-.36863** |
| SE | .05541 | .00440 | .00114 | .00168 | **.05155** |

As predicted by the theory, own-price elasticities are negative. We can also see that all commodities are net substitutes to each other.

Now we turn to the rural sector.

**Table 4.17 Hicksian Elasticities: 66th Round: Rural Data**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.11484** | -.04928 | -.01607 | -.00329 | -.044395 |
| SE | **.00656** | .00321 | .00106 | .00021 | .00284 |
| Pulse | -.32123 | **-.34844** | -.00815 | -.001668 | -.02250 |
| SE | .02401 | **.02240** | .00070 | .000138 | .001806 |
| Sugar | -.23901 | -.018592 | **-.28302** | -.00124 | -.01674 |
| SE | .0201876 | .00174 | **.01846** | .00011 | .001540 |
| Salt | -.25281 | -.019666 | -.006415 | **-.29706** | -.017713 |
| SE | .01935 | .00166 | .000562 | **.01905** | .00148 |
| Oil | -.30745 | -.023917 | -.00780 | -.01155 | **-.32709** |
| SE | 02119 | 001820 | .000623 | .000902 | **.020549** |

For rural consumption as well, all commodities show negative own-price elasticities and negative cross-price elasticity. So the same conclusion as the urban consumption follows.

We complete our discussion on elasticities by providing a comparative analysis of own-price elasticities.[65] The data is collated from tables 4.17 and 4.18.

**Table 4.18: Cross-section Comparison of Hicksian (Own-price) Elasticities 66**

| Commodities | Rural | Urban |
|---|---|---|
| Cereal | **-.11484** | **-.17353** |
| \|z\| | **.00656** | **.01746** |
| Pulse | **-.34844** | **-.49414** |
| \|z\| | **.02240** | **.05369** |
| Sugar | **-.28302** | **-.23095** |
| \|z\| | **.01846** | **.04592** |
| Salt | **-.29706** | **-.40337** |
| \|z\| | **.01905** | **.041032** |
| Oil | **-.32709** | **-.36863** |
| \|z\| | **.020549** | **.05155** |

Thus, urban areas show higher (compensated) price sensitivity than the rural sector

### 4.3.2.2: Tax Reform

Here, first we present the urban and rural values for marginal welfare cost for different commodities

**Table 4.19: Marginal Welfare Cost (Urban)**

| Item | ε = 0 | ε = .5 | ε = 1 | ε = 1.25 | ε = 1.5 | ε = 2 |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 0.998924(5) | 0.553959(5) | 0.312062(5) | 0.235602(5) | 0.235602(5) | 0.103822 (5) |
| $\lambda_{pulses}$ | 1.001346 (4) | 0.569681(4) | 0.330212(4) | 0.253187(4) | 0.253187(4) | 0.117465(4) |
| $\lambda_{sugar}$ | 1.002187(2) | 0.573506(3) | 0.334975(3) | 0.258024(2) | 0.258024(2) | 0.121836 (2) |
| $\lambda_{salt}$ | 1.001676(3) | 0.574117(2) | 0.335225 (2) | 0.257958(3) | 0.257958(3) | 0.120932(3) |
| $\lambda_{oil}$ | 1.063257 (1) | 0.605137 (1) | 0.35063(1) | 0.268726 (1) | 0.268726 (1) | 0.124418 (1) |

This table for urban area indicates that the ranking of the commodities as per their lambda values are fairly robust to different values of epsilon. There are rank reversals for sugar and salt for ε=.5 and 1. Thus, if the social planner starts with those values, then taxes on cereals,

[65] It is not that other elasticities are not important. Other elasticities are omitted for the sake of the economy of space.

pulses and sugar should be increased and that on salt and oil may be decreased. For other values of epsilon, salt and sugar exchange rankings, prescribing a change in policies.

**Table 4.20: Marginal Welfare Cost (Rural)**

| Item | $\varepsilon = 0$ | $\varepsilon = .5$ | $\varepsilon = 1$ | $\varepsilon = 1.25$ | $\varepsilon = 1.5$ | $\varepsilon = 2$ |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.000917(5) | 0.513333 (5) | 0.268059(5) | 0.194976 (5) | 0.142424(5) | 0.07696(5) |
| $\lambda_{pulses}$ | 1.002357(4) | 0.527912 (2) | 0.283227(2) | 0.208867(2) | 0.154723(2) | 0.086052(2) |
| $\lambda_{sugar}$ | 1.002706(2) | 0.526669 (3) | 0.281816(3) | 0.207565(3) | 0.153573(3) | 0.085228(4) |
| $\lambda_{salt}$ | 1.002632 (3) | 0. 525735(4) | 0.281181(4) | 0.207139(4) | 0.153333(4) | 0.085244(3) |
| $\lambda_{oil}$ | 1.063219 (1) | 0.556528 (1) | 0.296998 (1) | 0.218505(1) | 0.161509 (1) | 0.089485 (1) |

For the rural sector in the 66th round using LES, apart from the case when ε=0, the rankings are fairly consistent: cereals, pulses and salt need an increase in taxation whereas sugar and oil may have their taxes reduced. The behaviour is in contrast with urban rankings. For the sake of completeness and clarity, we highlight this by presenting the data contained in tables 4.19 and 4.20 in a concise way.

**4.21 Cross-sectional Comparison: Relative Rankings of Marginal Welfare Cost**

| Item | **$\varepsilon = 0$** | | **$\varepsilon = .5$** | | **$\varepsilon = 1$** | | **$\varepsilon = 1.25$** | | **$\varepsilon = 1.5$** | | **$\varepsilon = 2$** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| $\lambda_{cereals}$ | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| $\lambda_{pulses}$ | 4 | 4 | 2 | **4** | 2 | **4** | 4 | 4 | 2 | **4** | 2 | **4** |
| $\lambda_{sugar}$ | 2 | 2 | 3 | 3 | 3 | 3 | 3 | **2** | 3 | **2** | 4 | **2** |
| $\lambda_{salt}$ | 3 | 3 | 4 | **2** | 4 | **2** | 2 | **3** | 4 | **3** | 3 | **3** |
| $\lambda_{oil}$ | 1 | 1 | 1 | **1** | 1 | **1** | 1 | **1** | 1 | **1** | 1 | **1** |

We can see that there exist variation in rankings for ε=.5 (pulse and salt), ε=1 (same), ε=1.15 (sugar and salt), ε=1.5 (pulse, sugar and salt), ε=2(pulse, sugar and salt). Thus, while the relative ranks of cereal and oil are fairly consistent across the sub-samples; other commodities change their ranks depending on the value judgement of the policymaker.

This concludes our discussion of the 66th round data. We will move towards an analysis of the 68th round.

### 4.3.3 Pooled Data: 68th Round

As before, we will first present the estimates, followed by an elasticity analysis and a discussion on tax reform. The whole process of calculation has been repeated using 68th Round NSSO data

#### 4.3.3.1 Regression Coefficients and Elasticity

First, we present the regression coefficients

**Table 4.22: 68th NSSO Round Assam: Regression Coefficients**

| Coefficient | Pooled Sample |
|---|---|
| a1 | 25.6630 |
| | (39.46)*** |
| a2 | 1.5162 |
| | (45.70)*** |
| a3 | 2.09632 |
| | (63.39)*** |
| a4 | 1.2573 |
| | (53.99)*** |
| a5 | 2.7282 |
| | (30.02)*** |
| b1 | .508796 |
| | (126.46)*** |
| b2 | .0955 |
| | (67.13)*** |
| b3 | .03597 |
| | (65.62)*** |
| b4 | .01331 |
| | (56.71)*** |
| b5 | .34640 |
| | (91.97)*** |
| *N* | 3368 |

* *p*<0.05; ** *p*<0.01

z values are reported in parenthesis

Also, the Akaike's information criterion and Bayesian information criterion for the pooled sample of Assam, 68th Round is summarized below:

| | |
|---|---|
| **AIC** | **-60503.92** |
| **BIC** | **-60448.82** |

Thus, the highest "committed consumption" is with cereal, followed by oil, sugar, pulse and salt. As far as marginal expenditure shares are concerned, the highest is that of cereal, followed by oil, pulse, sugar and salt.

The Marshallian elasticities based on the calculations above have been given below.

**Table 4.23: Marshallian Own and Cross-price Elasticity of Food Groups (Pooled 68th)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.98770** | -.04213 | -.02229 | -.006502 | -.093270 |
| P>(\|z\|) | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.214417 | **-.99293** | -.022107 | -.006448 | -.092492 |
| P>(\|z\|) | 0.000 | **0.000** | 0.000 | 0.000 | 0.000 |
| Sugar | -.18520 | -.03608 | **-.976126** | -.00556 | -.079889 |
| P>(\|z\|) | 0.000 | 0.000 | **0.000** | 0.000 | 0.000 |
| Salt | -.20827 | -.040584 | -.021473 | **-.955452** | -.08984 |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | **0.000** | 0.000 |
| Oil | -.25290 | -.04928 | -.026075 | -.00760 | **-.99701** |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | **0.000** |

In the 68th round data, all commodities are price inelastic. As far as own-prices are concerned, oil products exhibit the highest value, followed by pulses, cereals, sugar and salt. In the next table, we present own and cross-price elasticities for each item over time.

Comparing each item over the two rounds we have,

In the next table, we present the expenditure elasticities by looking at the pooled data

**Table 4.24: Expenditure Elasticity of Food Groups (Pooled) 68**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Expenditure Elasticity | .957087*** | .94910*** | .8197796*** | .9219052*** | 1.11947*** |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |

Thus the highest expenditure elasticity is that of oil, followed by cereal, pulse, salt and sugar.

In the next table, we will present the Hicksian estimates for the 68th round data. As before, all commodities are price inelastic. Somewhat surprisingly, salt exhibits the highest own (compensated) elasticity, followed by pulse, oil, sugar and cereals. Commodities are also net complements to each other.

**Table 4.25 Hicksian Elasticities: 68th Round: Pooled Data**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.282009** | -.05451 | -.01948 | -.007309 | -.205779 |
| z values | **.005003** | .000854 | .00039 | .000136 | .00345 |
| Pulse | -.289120 | **-.510171** | -.01931 | -.00724 | -.20406 |
| z values | .006402 | **.008497** | .000444 | 00016 | .00410 |
| Sugar | -.24972 | -.04669 | **-.44955** | -.00626 | -.17625 |
| z values | .00562 | .001039 | **.008066** | .000139 | .00357 |
| Salt | -.280834 | -.05250 | -.018765 | **-.522171** | -.19821 |
| z values | .006409 | .00121 | .00045 | **.008585** | .00426 |
| Oil | -.341020 | -.06376 | -.022786 | -.056518 | **-.44974** |
| z values | .006459 | .00120 | .000452 | .001077 | **.007030** |

The next table presents the marginal welfare cost of taxation for various commodities and their ranks.

**Table 4.26: Marginal Welfare Cost of Taxation (pooled sample 68)**

| Item | $\varepsilon = 0$ | $\varepsilon = .5$ | $\varepsilon = 1$ | $\varepsilon = 1.25$ | $\varepsilon = 1.5$ | $\varepsilon = 2$ |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.00891115 (5) | 0.745539 (5) | 0.55624 (5) | 0.482055(5) | 0.418633(5) | 0.317601(5) |
| $\lambda_{pulses}$ | 1.009176 (4) | 0.746475 (4) | 0.557865(4) | 0.483981(4) | 0.420822(4) | 0.320192(4) |
| $\lambda_{sugar}$ | 1.011154 (2) | 0.750549 (3) | 0.56271 (3) | 0.48893(3) | 0.425757(3) | 0.324881(3) |
| $\lambda_{salt}$ | 1.009869 (3) | 0.750618(2) | 0.563417 (2) | 0.489788(2) | 0.426692(2) | 0.325825(2) |
| $\lambda_{oil}$ | 1.0636268 (1) | 0.7788052 (1) | 0.5764548 (1) | 0.4977978 (1) | 0.430882 (1) | 0.3249937 (1) |

Thus the ranking of commodities is fairly consistent (except a switch in rank between sugar and salt as epsilon value foes beyond 0). The data indicates that taxes on sugar and oil need to be reduced to reach and taxes on cereals, pulses and sugar need to be increased.

### 4.3.4 68th Round: Urban-Rural Analysis

In this section, we begin our analysis of the urban/rural consumption pattern of the 68th round, beginning with regression coefficients, elasticities (Marshallian, Expenditure and Hicksian, in that order)

**Table 4.27: Urban/Rural: Regression Coefficients 68**

| Coefficient | Urban | Rural |
|---|---|---|
| a1 | 20.3025 | 30.616 |
| | (17.74)*** | (39.60)** |
| a2 | 1.4821 | 1.6082 |
| | (21.79)*** | (42.08)** |
| a3 | 1.80527 | 2.3043 |
| | (27.45)*** | (60.40)** |
| a4 | 1.2115 | 1.31791 |
| | (21.83)*** | (51.35)** |
| a5 | 2.5957 | 3.0062 |
| | (13.84)*** | (28.62)** |
| b1 | .51143 | .49575 |
| | (58.97)*** | (108.50)** |
| b2 | .097852 | .09718 |
| | (32.51)*** | (59.48)** |
| b3 | .037945 | .03551 |
| | (32.53)*** | (57.36)** |
| b4 | .015902 | .01290 |
| | (28.81)*** | (49.24)** |
| b5 | .33686 | .35864 |
| | (40.51)*** | (84.22)** |
| *N* | 793 | 2575 |

* $p<0.05$; ** $p<0.01$

z values are reported in parenthesis

Akaike's information criterion and Bayesian information criterion for the urban sample

| | Urban | Rural |
|---|---|---|
| AIC | -13636.3 | -47219.05 |
| BIC | -13594.22 | -47166.37 |

Looking at the regression table, one can see that the 'minimum consumption' is higher for all commodities in the rural sector. As far as marginal (group budget) shares are concerned, the rural sector shows a higher propensity of spending on oil, and the urban sector on cereals the other commodities.

Next, we discuss Marshallian own and cross-price elasticities. We start with the urban data.

**Table 4.28: Marshallian Own and Cross-price Elasticity of Food Groups (Urban, 68th round)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.99028** | -.042704 | -.021301 | -.006716 | -.089487 |
| P>(\|z\|) | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.19286 | **-.99343** | -.0204447 | -.006446 | -.085887 |
| P>(\|z\|) | 0.000 | **0.000** | 0.000 | 0.000 | 0.000 |
| Sugar | -.172312 | -.036618 | **-.980347** | -.00575 | -.076734 |
| P>(\|z\|) | 0.000 | 0.000 | **0.000** | 0.000 | 0.000 |
| Salt | -.199753 | -.04245 | -.021174 | **-.9626795** | -.088954 |
| P>(\|z\|) | 0.486 | 0.002 | 0.006 | **0.000** | 0.725 |
| Oil | -.221926 | -.047162 | -.02352 | -.00741 | **-.997174** |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | **0.000** |

As far as own-price elasticities are concerned, all commodities exhibit price inelastic behaviour. The magnitude of price elasticity is highest for oil products, followed by pulse, cereals, sugar and salt. Commodities are also gross complement to each other.

Marshallian elasticity estimates of the rural sub-sample are presented here.

**Table 4.29: Own and Cross-price Elasticity of Food Groups (Rural) 68**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.984962** | -.043122 | -.023117 | -.006505 | -.100038 |
| P>(\|z\|) | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.25100 | **-.992404** | -.02433 | -.006849 | -.105315 |
| P>(\|z\|) | 0.000 | **0.000** | 0.000 | 0.000 | 0.000 |
| Sugar | -.20999 | -.03798 | **-.97338** | -.00573 | -.08810 |
| P>(\|z\|) | 0.000 | 0.000 | **0.000** | 0.000 | 0.000 |
| Salt | -.23972 | -.04335 | -.023243 | **-.9510568** | -.100583 |
| P>(\|z\|) | 0.000 | 0.000 | 0.006 | **0.000** | 0.000 |
| Oil | -.298578 | -.054003 | -.02895 | -.008147 | **-.996749** |
| P>(\|z\|) | 0.488 | 0.000 | 0.000 | 0.061 | **0.000** |

In the rural sample also, commodities are price inelastic. The magnitude of price elasticity is highest for oil, followed by pulse, cereal, sugar and salt. Commodities are also gross complements to each other, but the effect of cereal price on oil. However, to appreciate the difference in a consistent manner, we put the two tables together.

**Table 30: Cross-section Comparison of Marshallian Elasticities: 68th Round**

| | Cereal | | Pulse | | Sugar | | Salt | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| Cereal | **-.984962** | **-.99028** | -.043122 | -.042704 | -.023117 | -.021301 | -.006505 | -.006716 | -.100038 | -.089487 |
| P>(\|z\|) | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.25100 | -.19286 | **-.992404** | **-.99343** | -.02433 | -.0204447 | -.006849 | -.006446 | -.105315 | -.085887 |
| P>(\|z\|) | 0.000 | 0.000 | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | -.20999 | -.172312 | -.03798 | -.036618 | **-.97338** | **-.980347** | -.00573 | -.00575 | -.08810 | -.076734 |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Salt | -.23972 | -.199753 | -.04335 | -.04245 | -.023243 | -.021174 | **-.9510568** | **-.9626795** | -.100583 | -.088954 |
| P>(\|z\|) | 0.000 | 0.486 | 0.000 | 0.002 | 0.006 | 0.006 | **0.000** | **0.000** | 0.000 | 0.725 |
| Oil | -.298578 | -.221926 | -.054003 | -.047162 | -.02895 | -.02352 | -.008147 | -.00741 | **-.996749** | **-.997174** |
| P>(\|z\|) | 0.488 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.061 | 0.000 | **0.000** | **0.000** |

For all commodities, urban price elasticities are higher in magnitude. Cross elasticities are higher (in magnitude) in rural areas, except for the effect of cereal on oil (insignificant) and the effects of salt on cereals and sugar. In the next table, we compare the expenditure elasticities.

**Table 4.31: Expenditure Elasticity of Food Groups (Urban/Rural) 68**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Expenditure Elasticity (Urban) | .978662 | .939292 | .83919 | .972837 | 1.08082 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |
| Expenditure Elasticity (Rural) | .927616 | .9765519 | .816998 | .932675 | 1.1616 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |

The table shows that expenditure elasticities are higher in the urban sub-sample for cereal, sugar and salt. For both urban and rural samples, oil is expenditure elastic. Thus, if the budget on the five food items increases (as a result of general economic growth), the rural sector may fall behind in cereal, sugar and salt consumption.

In the next section, we discuss the Hicksian elasticities for urban and rural sub-samples.

**Table 4.32: Hicksian Elasticities: 68th Round: Urban Data**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.29662** | -.059613 | -.022679 | -.009344 | -.21890 |
| z values | **.01043** | **.00224** | .00090 | .00035 | .00722 |
| Pulse | -.29805 | **-.525615** | -.021767 | -.008968 | -.21009 |
| z values | .013157 | .01700 | .00098 | .000403 | .00846 |
| Sugar | -.26629 | -.051117 | **-.49609** | -.00801 | -.187704 |
| z values | .011921 | .002265 | **.016864** | .000353 | .007562 |
| Salt | -.308699 | -.05925 | -.022544 | **-.572560** | -.21759 |
| z values | .014131 | .002755 | .001049 | **.01878** | .009362 |
| Oil | -.342969 | -.065836 | -.02504 | -.064178 | **-.470709** |
| z values | .013255 | .002547 | .00099 | .002554 | **.01434** |

As expected, the Hicksian own-price elasticities are negative, and commodities are net complements. Surprisingly, the magnitude of own-price elasticity is highest in salt, followed by pulse, sugar, oil and cereal.

In the next table, we show the Hicksian elasticities for rural data.

**Table 4.33: Hicksian Elasticities: 68th Round: Rural Data**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.25881** | -.04953 | -.016912 | -.006334 | -.189029 |
| z | **.00575** | **.001169** | .000434 | .000145 | .003976 |
| Pulse | -.264688 | **-.48262** | -.017804 | -.006668 | -.199001 |
| z | .007145 | .009886 | .00048 | .000171 | .004698 |
| Sugar | -.22143 | -.04362 | **-.407479** | -.00557 | -.166481 |
| z | .00614 | .00115 | **.009178** | .000147 | .00402 |
| Salt | -.25272 | -.04978 | -.01699 | **-.486949** | -.190004 |
| z | .006973 | .001347 | .000485 | **.009728** | .004774 |
| Oil | -.314860 | -.06202 | -.02117 | -.053472 | **-.41939** |
| z | .007329 | .001366 | .000504 | .00118 | **.008198** |

Here, too, own-price elasticities are negative and the commodities show the property of net complements. Here too, the highest magnitude of own-price elasticity is exhibited by salt, followed by pulse, oil, sugar, and cereal. Thus, except for oil and sugar, the rankings are consistent between the urban and rural sector.

## 4.4 Tax Reform: Cross-section Comparison of Urban and Rural Sub-samples

In this section, present a comparative analysis of optimal tax reform in rural and urban sectors. First, we begin with the urban sector.

**Table 4.34: Marginal Welfare Cost of Taxation (Urban): 68th Round**

| Item | $\varepsilon = 0$ | $\varepsilon = .5$ | $\varepsilon = 1$ | $\varepsilon = 1.25$ | $\varepsilon = 1.5$ | $\varepsilon = 2$ |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.008005 (5) | 0.744287 (3) | 0.55642(3) | 0.483124 (3) | 0.420578(3) | 0.483124(3) |
| $\lambda_{pulses}$ | 1.008538 (4) | 0.74298 (4) | 0.554934(4) | 0.481833(4) | 0.419569(4) | 0.481833 (4) |
| $\lambda_{sugar}$ | 1.009823(2) | 0.741207 (5) | 0.55215 (5) | 0.478937(5) | 0.416709 (5) | 0.478937 (5) |
| $\lambda_{salt}$ | 1.008549 (3) | 0.74584 (2) | 0.558213 (2) | 0.484907(2) | 0.422309(2) | 0.484907(2) |
| $\lambda_{oil}$ | 1.0636379 (1) | 0.7735026 (1) | 0.5702291 (1) | 0.4918993(1) | 0.4255756(1) | 0.4918993 (1) |

Thus, for the urban data, there is a switch of rankings (except oil) for all values of epsilon except 0 (and then the ranking is fairly robust to different specifications of epsilon). Adopting the convention that tax (subsidy) on "top 3" should be decreased (increased) and that on "bottom two" should be decreased, oil, salt and cereal qualifies for preferential tax treatment. A similar exercise is done for the rural sector.

**Table 4.35: Marginal Welfare Cost of Taxation (rural) 68**

| **Item** | **ε = 0** | **ε = .5** | **ε = 1** | **ε = 1.25** | **ε = 1.5** | **ε = 2** |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.010457 (4) | 0.749246 (5) | 0.560432 (5) | 0.486173(5) | 0.422563(5) | 0.320982 (5) |
| $\lambda_{pulses}$ | 1.010154 (5) | 0.750739(4) | 0.563038 (4) | 0.489153 (4) | 0.425824(4) | 0.324589 (4) |
| $\lambda_{sugar}$ | 1.012491 (2) | 0.756799 (2) | 0.570408 (2) | 0.496682 (2) | 0.433312(3) | 0.331633(2) |
| $\lambda_{salt}$ | 1.011024 (3) | 0.755772 (3) | 0.570017 (3) | 0.496577(3) | 0.433452 (2) | 0.332135 (1) |
| $\lambda_{oil}$ | 1.0636091 (1) | 0.7830248 (1) | 0.5821604 (1) | 0.5036835 (1) | 0.4367251 (1) | 0.3303583 (3) |

Thus, for the rural areas, there are rank reversals at ε=.5, 1.5 and 2. If we adopt the convention that "top three" commodities should have a reduction of taxes or increase in subsidy (and the rest qualifies for an increase in taxes or reduction in subsidy), then with ε=2, taxes on oil, salt and sugar should be decreased and that on pulse and cereal should be increased. Thus, comparing the rural and urban sectors, the prescription is that taxes on oil and salt should always be decreased and that on pulse should be increased.

For the sake of completeness and clarity, we present the values of lambda across the two sub-samples.

**Table 4.36 Cross-sectional Comparison: Relative Rankings of Marginal Welfare Cost**

| Item | **ε = 0** | | **ε = .5** | | **ε = 1** | | **ε = 1.25** | | **ε = 1.5** | | **ε = 2** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| $\lambda_{cereals}$ | 4 | **5** | 5 | **3** | 5 | **3** | 5 | **3** | 5 | **3** | 5 | **3** |
| $\lambda_{pulses}$ | 5 | **4** | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| $\lambda_{sugar}$ | 2 | 2 | 2 | **5** | 2 | **5** | 2 | **5** | 3 | **5** | 2 | **5** |
| $\lambda_{salt}$ | 3 | 3 | 3 | **2** | 3 | **2** | 3 | **2** | 2 | 2 | 1 | 2 |
| $\lambda_{oil}$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **1** |

This completes our analysis of both 66th and 68th round NSSO data for selected food products in Assam. The main analysis is already done. However, the analysis has only focused on cross-sectional analysis, omitting any behavioral pattern change over time. In the next section, we discuss comparisons over time.

## 4.5 Comparisons Over Time

In this section, we provide a brief comparative discussion on the evolution of coefficients, estimates, elasticities and their implication for tax rules over time. As already noted earlier, elasticities are dictated by behaviour. Hence, this exercise will show light on how behaviour has changed over time. We will begin with the pooled regression, followed by the sub-samples. The source tables have already been reported elsewhere in this chapter.

### 4.5.1 Pooled Data

In the next table, we compare the coefficients across the NSSO rounds

**Table 4.37: Over Time Comparison of Regression Coefficients: Pooled Sample**

| Coefficient | , 66th | 68th |
|---|---|---|
| a1 | -3.7665 | 25.6630 |
| | (-1.23) | (39.46)*** |
| a2 | 1.543778 | 1.5162 |
| | (23.09)*** | (45.70)*** |
| a3 | 1.7584 | 2.09632 |
| | (37.20)** | (63.39)*** |
| a4 | .90717 | 1.2573 |
| | (34.84)*** | (53.99)*** |
| a5 | 1.48564 | 2.7282 |
| | (27.90)*** | (30.02)*** |
| b1 | .86676 | .508796 |
| | (185.21)*** | (126.46)*** |
| b2 | .059755 | .0955 |
| | (18.25)*** | (67.13)*** |
| b3 | .01656 | .03597 |
| | (12.75)*** | (65.62)*** |
| b4 | .004190 | .01331 |
| | (19.21)*** | (56.71)*** |
| b5 | .0527334 | .34640 |
| | (19.21)*** | (91.97)*** |
| *N* | 3368 | 3368 |

It can be observed that "committed consumption" of cereals, sugar, salt and oil in the total food budget (of five items) has increased from the 66th to the 68th round, while that of pulses has reduced. The marginal budget share of cereals has fallen, but that of every other commodity has increased. . A negative z in a1 indicates that the subsistence value of cereals is below the mean average but is insignificant.

In the next table, we trace out the change in Marshallian elasticities over time

**Table 4.38 Over Time Comparison of Marshallian Elasticities: Pooled Sample**

| | Cereal | | Pulse | | **Sugar** | | **Salt** | | **Oil** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th |
| Cereal | -1.00047 | -.98770*** | -.07831 | -.04213 | -.041498 | -.02229 | -.0070967 | -.006502 | -.082763 | -.093270 |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | .022125 | -.214417 | -.99154 | -.99293 | -.01769 | -.022107 | -.003026 | -.006448 | -.035292 | -.092492 |
| P>(\|z\|) | 0.21 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | .01465 | -.18520 | -.022117 | -.03608 | -.97591 | -.976126 | -.002004 | -.00556 | -.023373 | -.079889 |
| P>(\|z\|) | 0.207 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Salt | .019114 | -.20827 | -.02885 | -.040584 | -.015287 | -.021473 | -.9351492 | -.955452 | -.030488 | -.08984 |
| P>(\|z\|) | 0.20 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Oil | .0199548 | -.25290 | -.03011 | -.04928 | -.01595 | -.026075 | -.002729 | -.00760 | -.99161 | -.99701 |
| P>(\|z\|) | -1.00047 | 0.000 | -.07831 | 0.000 | -.041498 | 0.000 | -.0070967 | 0.000 | -.082763 | 0.000 |

The magnitude of own-price elasticity of cereal has decreased. It is seen that cereals with all other food items are gross substitutes in the 68th round but it is not the same case in the 66th round where they are gross complements. However, the 66th round values are not significant.

The value of Own-price elasticity of pulse has increased. For pulses, sugar and salt with all other items are negative and significant indicating gross substitutes. The value of own-price elasticity of sugar has increased marginally. Sugar is also a gross complement with other commodities.

The value of own-price elasticity of salt has increased over time. The property of gross complement to other items is also maintained, i.e there are changes in value, but no change in properties**.**

The value of own-price elasticity has gone up for oil. Here too, there is no 'jump' in properties of gross complement, although the values have increased.

Now we turn to an analysis of change in expenditure elasticities

**Table 4.39 Over Time Comparison of Expenditure Elasticities: Pooled Sample**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| **68th round** | .957087 | .94910 | .8197796 | .9219052 | 1.11947 |
| **66th Round** | 1.214028 | .5176909 | .3428567 | .4472285 | .4669015 |

Thus we see that with time, the expenditure elasticities of cereal have decreased, while those of other commodities have increased. This probably reflects a change in preference over time. Next, we turn to a comparison of Hicksian (own-price) elasticities

**Table 4.40 Over Time: Comparison of Hicksian Own-price Elasticities**

| | 68th | 66th |
|---|---|---|
| Cereal | **-.282009** | **-.1411891** |
| Pulse | **-.510171** | **-.4208671** |
| Sugar | **-.44955** | **-.3021698** |
| Salt | **-.522171** | **-.3810814** |
| Oil | **-.44974** | **-.375079** |

Thus, the own (compensated) price elasticity of each commodity has increased over time. Next, we turn to a comparison of rankings of marginal welfare cost, as required by tax reform.

**Table 4.41 Over Time Change in Relative Rankings of Marginal Welfare Cost: Pooled**

| Item | **ε = 0** | | **ε = .5** | | **ε = 1** | | **ε = 1.25** | | **ε = 1.5** | | **ε = 2** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 68th | 66th | 68th | 66th | 68th | 66th | 66th | 68th | 68th | 66th | 68th | 66th |
| $\lambda_{cereals}$ | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| $\lambda_{pulses}$ | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 |
| $\lambda_{sugar}$ | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 |
| $\lambda_{salt}$ | 3 | 3 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 |
| $\lambda_{oil}$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

For values of epsilon other than zero, there is a change between the relative positions of pulse, sugar and salt over the two rounds. Hence, the implications on tax policy are different for these two periods. However, the relative positions of cereals and oil are robust to the years.

### 4.5.2 Urban and Rural Data

We begin by comparing the regression coefficients, followed by elasticities and marginal welfare costs.

**Table 4.42 Over Time Comparison of Regression Coefficients: Urban**

| Coefficient | 66th | 68th |
|---|---|---|
| a1 | -19.484 | 20.3025 |
| | (-2.77) | (17.74)*** |
| a2 | 1.3292 | 1.4821 |
| | (7.94)** | (21.79)*** |
| a3 | 1.8989 | 1.80527 |
| | (16.30)** | (27.45)*** |
| a4 | .77022 | 1.2115 |
| | (14.41)** | (21.83)*** |
| a5 | 1.5827 | 2.5957 |
| | (10.95)** | (13.84)*** |
| b1 | .87402 | .51143 |
| | (83.88)** | (58.97)*** |
| b2 | .063845 | .097852 |
| | (8.81)** | (32.51)*** |
| b3 | .011208 | .037945 |
| | (3.72)** | (32.53)*** |
| b4 | .003989 | .015902 |
| | (7.91)** | (28.81)*** |
| b5 | .046935 | .33686 |
| | (6.84)*** | (40.51)*** |
| *N* | 752 | 793 |

Thus the committed consumptions of cereal, pulses, salt and oil have increased 68th round, while that of sugar has fallen. As far as marginal budget shares are concerned, 68th round data exhibits an increase in pulses, sugar, salt and oil, while that of cereals have gone down.

Performing the same exercise for the rural sector

**Table 4.43 Over Time Comparison for Regression Coefficients: Rural**

| Coefficient | 66th | 68th |
|---|---|---|
| a1 | 16.504 | 30.616 |
| | (5.45)* | (39.60)** |
| b1 | .8472 | .49575 |
| | (153.5)** | (108.50)** |
| a2 | 1.74824 | 1.6082 |
| | (25.45)** | (42.08)** |
| a3 | 1.8173 | 2.3043 |
| | (37.27)** | (60.40)** |
| a4 | 1.0663 | 1.31791 |
| | (36.59)** | (51.35)** |
| a5 | 1.5792 | 3.0062 |
| | (29.2)** | (28.62)** |
| b2 | .066176 | .09718 |
| | (16.65)** | (59.48)** |
| b3 | .020494 | .03551 |
| | (12.81)** | (57.36)** |
| b4 | .00435 | .01290 |
| | (15.9)** | (49.24)** |
| b5 | .06177 | .35864 |
| | (20.00)** | (84.22)** |
| *N* | 2616 | 2575 |

The rural sample shows that the rural committed consumptions of cereals, sugar, salt and oil have increased, while that of pulses has gone down. As far as marginal budget shares are concerned, that of cereal has gone down, while the values for other commodities have gone up. Thus, this reflects more or less consistent behaviour with the urban sub-sample.

In the next section, we compare the Marshallian own and cross-price elasticities for the two sub-samples.

**Table 4.44 Over Time Comparison of Rural Elasticities (Marshallian)**

| | Cereal | | Pulse | | Sugar | | Salt | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th |
| Cereal | **-.984962** | **-.9977** | -.043122 | -.082805 | -.023117 | -.039566 | -.006505 | -.007738 | -.100038 | -.082947 |
| P>(\|z\|) | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.25100 | -.10615 | **-.992404** | **-.99033** | -.02433 | -.020059 | -.006849 | -.003923 | -.105315 | -.042053 |
| P>(\|z\|) | 0.000 | 0.000 | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | -.20999 | -.07898 | -.03798 | -.031236 | **-.97338** | **-.97468** | -.00573 | -.002919 | -.08810 | -.031289 |
| P>(\|z\|) | 0.000 | 0.005 | 0.000 | 0.000 | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 |
| Salt | -.23972 | -.083548 | -.04335 | -.03303 | -.023243 | -.01578 | **-.9510568** | **-.92482** | -.100583 | -.03309 |
| P>(\|z\|) | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 | 0.000 | **0.000** | **0.000** | 0.000 | 0.000 |
| Oil | -.298578 | -.10160 | -.054003 | -.040180 | -.02895 | -.019199 | -.008147 | -.00375 | **-.996749** | **-.99100** |
| P>(\|z\|) | 0.488 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.061 | 0.000 | **0.000** | **0.000** |

Over time,[66] the own-price elasticity of cereal has gone down in the rural sector. However the cross elasticity of cereal with respect to other commodities has gone up.

The own-price elasticity of pulse has increased, along with all other cross elasticities.

The Own-price elasticity of sugar has decreased. Cross elasticities with respect to cereal have decreased, while that with all other commodity has increased.

The own-price elasticity of salt has increased. The value of cross-price elasticity has decreased for all other commodities.

For oil, the own-price elasticity has decreased. However, the magnitudes of cross elasticities have increased.

[66] Here, and elsewhere, since the values are negative and increase or decrease in "magnitude".

**Table 4.45: Over Time Comparison of Urban Elasticities (Marshallian)**

| | Cereal | | Pulse | | Sugar | | Salt | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th |
| Cereal | **-.99028** | **-1.00261*****| -.042704 | -.08037*** | -.021301 | -.05555 | -.006716 | -.00735 | -.089487 | -.10172 |
| P>(\|z\|) | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pulse | -.19286 | .12676 | **-.99343** | **-.9931164** | -.0204447 | -.0210728 | -.006446 | -.002788 | -.085887 | -.038585 |
| P>(\|z\|) | 0.000 | 0.004 | **0.000** | **0.000** | 0.000 | 0.030 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sugar | -.172312 | .05227 | -.036618 | -.01257 | **-.980347** | **-.975598** | -.00575 | -.001149 | -.076734 | -.015913 |
| P>(\|z\|) | 0.000 | 0.015 | 0.000 | 0.001 | **0.000** | **0.000** | 0.000 | 0.000 | 0.000 | 0.001 |
| Salt | -.199753 | .10781*** | -.04245 | -.02593 | -.021174 | -.0132938 | **-.9626795** | **-.942232** | -.088954 | -.03281 |
| P>(\|z\|) | 0.486 | 0.002 | 0.002 | 0.000 | 0.006 | 0.000 | **0.000** | **0.000** | 0.725 | 0.000 |
| Oil | -.221926 | .09423*** | -.047162 | -.02266 | -.02352 | -.01566 | -.00741 | -.002072 | **-.997174** | **-.991561** |
| P>(\|z\|) | 0.000 | 0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.061 | **0.000** | **0.000** |

The own-price elasticity of cereal has fallen. With respect to the price of cereal, all commodities during the 68th round show gross complement, (insignificant for salt). For pulse, own-price elasticity has gone up. For other commodities, cross elasticity has gone up except cereal. For sugar, own-price elasticity has increased. For other commodities, the cross-price elasticities have increased except cereal and pulses. For salt, the own-price elasticity has increased. The cross-price elasticities have increased except cereal. For oil, the own-price elasticity has gone up. The cross-price elasticities have increased except for cereal.

Thus, a trend for almost all commodities is the cross-price elasticity with cereal has fallen over time.

Thus, over time, the urban and rural consumer behaviour shows some divergence.

In the next tables, we discuss the changes in expenditure elasticities

**Table 4.46 Over Time Comparison of Rural Expenditure Elasticities**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| 66th Round | 1.1702 | .59331 | .441454 | .46694 | .567869 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |
| 68th Round | .927616 | .9765519 | .816998 | .932675 | 1.1616 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |

It can immediately be seen that expenditure elasticities have changed considerably for the rural population. During the 66th round, cereal was expenditure elastic, while during the 68th round, oil products are expenditure elastic. It can be seen that expenditure elasticity for cereal has gone down, while that of each other commodity has gone up.

**Table 4.47 Over Time Comparison of Urban Expenditure Elasticities**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| 66th Round | 1.29280 | .49038 | .202244 | .41710 | .364562 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |
| 68th Round | .978662 | .939292 | .83919 | .972837 | 1.08082 |
| P>(\|z\|) | 0.000 | .000 | . 0.000 | 0.000 | .000 |

In line with the rural consumption pattern, the expenditure elasticity of urban cereal consumption has gone down, while those of the other commodities have increased.

In the next tables, we provide comparisons of own-price (Hicksian) elasticities.

**Table 4.48 Over Time Comparison of Rural Elasticities (Hicksian, Own-price)**

| | 68th | 66th |
|---|---|---|
| Cereal | **-.25881** | **-.11484** |
| \|z\| | .00575 | .00656 |
| Pulse | **-.48262** | **-.34844** |
| \|z\| | .009886 | .02240 |
| Sugar | **-.407479** | **-.28302** |
| \|z\| | .009178 | .01846 |
| Salt | **-.486949** | **-.29706** |
| \|z\| | .009728 | .01905 |
| Oil | **-.41939** | **-.32709** |
| \|z\| | .008198 | .020549 |

It can be seen that compensated own-price elasticity for the rural population has increased.

**Table 4.49 Over Time Comparison of Urban Elasticities (Hicksian, Own-price)**

| | 68th | 66th |
|---|---|---|
| Cereal | **-.29662** | **-.17353** |
| \|z\| | **.01043** | **.01746** |
| Pulse | **-.525615** | **-.49414** |
| \|z\| | .01700 | **.05369** |
| Sugar | **-.49609** | **-.23095** |
| \|z\| | **.016864** | **.04592** |
| Salt | **-.572560** | **-.40337** |
| \|z\| | **.01878** | **.041032** |
| Oil | **-.470709** | **-.36863** |
| \|z\| | **.01434** | **.05155** |

Similar to the rural experience, compensated own-price elasticity for the rural population has increased.

This concludes our discussion of over time comparison of relevant elasticities. We conclude this section by looking at the tax prescriptions or the change in rankings for marginal welfare cost of different commodities.

**Table 4.50 Over Time Change in Rank of Marginal Welfare Cost: Rural**

| Item | **ε = 0** | | **ε = .5** | | **ε = 1** | | **ε = 1.25** | | **ε = 1.5** | | **ε = 2** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th |
| $\lambda_{cereals}$ | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| $\lambda_{pulses}$ | 5 | 4 | 4 | **2** | 4 | **2** | 4 | **2** | 4 | **2** | 4 | **2** |
| $\lambda_{sugar}$ | 2 | 2 | 2 | **3** | 2 | **3** | 2 | **3** | 3 | **3** | 2 | **4** |
| $\lambda_{salt}$ | 3 | 3 | 3 | **4** | 3 | **4** | 3 | **4** | 2 | **4** | 1 | **3** |
| $\lambda_{oil}$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **1** |

Thus, the rankings are fairly consistent in the sense that the changes in ranks are robust to almost all values of epsilon. The only exception is ε=2, where, except cereal, all other commodities change rank.

Next, we proceed to the urban analysis

**Table 4.51 Over Time Change in Rank of Marginal Welfare Cost: Urban**

| Item | **ε = 0** | | **ε = .5** | | **ε = 1** | | **ε = 1.25** | | **ε = 1.5** | | **ε = 2** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th | 68th | 66th |
| $\lambda_{cereals}$ | 5 | 5 | 3 | **5** | 3 | **5** | 3 | **5** | 3 | **5** | 3 | **5** |
| $\lambda_{pulses}$ | 4 | 4 | 4 | **4** | 4 | **4** | 4 | **4** | 4 | **4** | 4 | **4** |
| $\lambda_{sugar}$ | 2 | 2 | 5 | **3** | 5 | **3** | 5 | **2** | 5 | **3** | 5 | **2** |
| $\lambda_{salt}$ | 3 | 3 | 2 | **2** | 2 | **2** | 2 | **3** | 2 | **2** | 2 | **3** |
| $\lambda_{oil}$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

In the urban case, for ε=.5 and ε=1, there are rank reversals between sugar and cereal. For ε=1.25, salt, sugar, and cereal change ranks. This is maintained for ε=1.5 and 2.

The discussion indicates that over time, depending on the value judgement of the social planner, tax policies are likely to be very different for urban and rural segments.

## 4.6 Conclusion

This chapter presents a comparative demand analysis of selected food items in Assam using 66th and 68th round secondary data of NSSO. Data has been analysed using LES and LA-AIDS Demand system. Own and Cross-price elasticities along with expenditure elasticities have been calculated. The marginal welfare cost of taxation has been calculated for two sub-samples, viz. rural and urban to predict the direction of optimal commodity tax reform. Comparisons of the marginal welfare cost of taxation within a single round and over time between different rounds have been estimated. It was found that depending on the value judgement of the social planner, for urban and rural sectors, the tax policies are expected to be very different.

But to fill up the gaps of this analysis which includes missing data regarding certain consumption items, a primary survey needs to be done at a much-disaggregated level. Thus, a primary survey has been done taking the present consumption levels in Assam which is presented in the next two chapters.

# Chapter 5

# Field Survey

## 5.1 Introduction

Apart from the welfare-centric application, analysis (positive and normative) of optimal commodity taxation requires consumer demand estimation. Previously in the earlier chapter, estimation of demand was done using secondary data using NSSO 66th and 68th Round data. Both these rounds are, however, pre-GST. The next NSSO round with consumer expenditure has not been published yet. In order to obtain the latest picture of consumption after the immediate implementation of GST, a field survey has been carried out in selected areas of Kamrup Metropolitan and Kamrup districts of Assam. The survey gathered information on certain food items of consumption as well as the relevant demographic features of the respondents. I provide a detailed account of the survey methodology. The rest of the chapter is then devoted to exploratory analysis of household-level consumption expenditures (at various levels) and their link with demographic characteristics.

The field survey gathered information on certain necessary food items of consumption such as cereals, pulses, sugar, salt and oil, fruits, vegetables, milk, egg, fish, meat, beverages[67], intoxicants, etc. including their monthly consumption expenditure. The questionnaire used in the field has questions that have been replicated from NSSO 66th round data.[68]

## 5.2 Area Selection for field survey

The field study has been carried out in two contiguous districts of Assam. NSSO presents data on urban/rural consumption of households. In order to replicate this, one urban district and one rural district have been selected; Kamrup Metropolitan (that is, Guwahati city mainly) and rural areas of Kamrup district. Kamrup Metropolitan has the highest per capita income among all districts of Assam (NEZINE, 2016). At the same time, the rural population is high in Kamrup District (90.16%) and the per capita income is below the state average (NEZINE, 2016).. The urban/rural gap is potentially very high within Kamrup (M) and

[67] Tea, coffee, fruit juice, shakes, mineral water, canned/bottled beverages, etc.

[68] Salt and sugar are not clubbed together as in 68th round NSSO.

Kamrup districts. Moreover, as Kamrup (rural) is adjacent to Kamrup Metropolitan, spatial/administrative distortions will be minimized. The average per capita annual income in rural areas is only about 40 percent of that of the urban areas (INR 22,087 in rural against INR 56,157 in urban areas).

**Table 5.1: DISTRICT-WISE DEMOGRAPHIC PROFILE OF ASSAM, 2011 CENSUS**

| District | Area (sq.km) | Population | Density | Annual PCI |
|---|---|---|---|---|
| Kamrup (M) | 955 | 1260419 | 1313 | 63,444 |
| Kamrup | 3105 | 1517542 | 489 | 23,316 |
| ASSAM | 78438 | 31205576 | 398 | 24,660 |

*Source: Census of India 2011*

### 5.2.1 Kamrup Metropolitan:

According to the Census of India 2011, the total population of Kamrup Metropolitan district is 1260419. The total area is 955 sq. km. Kamrup (Metro) District is situated in the Brahmaputra Valley Region of Assam. It consists of only one sub-division, i.e. Guwahati having six Revenue Circles viz., Dispur, Guwahati, Sonapur, Azara, Chandrapur and North Guwahati.

### 5.2.2 Kamrup Rural:

The total population of Kamrup district is 1517542 (according to the 2011 Census). There are 12 Revenue Circles and 14 Development blocks consisting of 1068 villages. Out of the total Kamrup population for the 2011 census, 90.16% live in rural regions of the district.

## 5.3 Sample Design

A stratified multi-stage design has been adopted for the primary survey. The first stage units (FSUs) are the villages in the rural sector and development blocks in the urban sector (known as Urban Frame Survey (UFS) in NSSO rounds). The ultimate stage units (USUs) are households in both sectors which are similar to NSSO. In the case of large FSUs, one intermediate stage of sampling is the selection of two hamlet-groups (hgs)/ sub-blocks (sbs) from each rural/ urban FSU. Unlike NSSO, where FSUs have been selected by using Simple Random Sampling without Replacement (SRSWOR), here, the FSU, that is the villages with certain similar characteristics were clubbed together and an SRS was done. The requirement of analysing certain characteristics in the population with consumption expenditure necessitated the change. It is worth mentioning that NSSO data collection is not strictly random and it depends on resource availability and the number of investigators available (NSSO $66^{th}$ Round).

**5.3.1 Stratification:** Within the two selected districts, two basic strata have been formed. First is the rural stratum comprising of all rural areas of the district and second is the urban stratum comprising of all the urban areas of the district. Here, within Kamrup (M) district Guwahati Municipal Corporation is the urban block and two other rural blocks have been chosen. While in the Kamrup district all rural villages have been chosen to get a contrast between urban and rural sectors. However, no sub-stratification has been done in urban areas (similar to NSSO) because we need the consumption of households with different demographic characteristics.

From the developmental angle, the rural part of Kamrup (M) districts is divided into two Development Blocks (Statistical Handbook, 2012). In Kamrup (M) district, there are two towns, viz., North Guwahati (TC) and Guwahati (M Corp.).

**5.3.2 Sample Size:**

The sample size is calculated by using the following formula (Yamane, 1973) with a 95% confidence level. The desired minimum sample size is as follows.

$$n = \frac{N}{1 + N(e)^2} \quad ...(1)$$

Where,

n = sample size

N = population size (= 2777621)

e = allowable error (% = .05)

This is the most appropriate formula since the population is finite and also the population size is known. After substituting the values in the above equation (1), we get the sample size to be 399.94 (approx. 400). Since we want to compare both urban and rural data, 240 (60%) urban households and 160 (40%) rural households have been allocated.

Both multi-stage random and purposive sampling procedures have been used. The city of Guwahati is divided into six zones by the Guwahati Municipal Corporation namely, East Guwahati, West Guwahati, South Guwahati, Central Guwahati, Dispur and Lokhra. One municipal ward from each zone has been selected randomly. A proportional random sampling technique is used. Thus, the number of sample units of households selected in each zone is proportional to the number of households in the zones (refer to Table 5.3). Chatribari from South, Adabari from West, Gorchuk from Lokhra, Fancy Bazar from Central, Khanapara from Dispur, Ganeshguri from East was randomly selected for the final survey. Also, Dharapur and Garal from the Azara block have been randomly selected.

For Kamrup district, Khepnikuchi village from Rangia, Hadala village from Hajo, Bansar village from Sualkuchi, Upar Hali village from Palashbari, Tinigharia from Boko and Kukur Mara from Chhaygaon have been randomly selected after purposively clubbing villages together with certain characteristics such as social groups, religion, etc. An equal number of sample villages/ blocks (FSUs) have been allotted for survey with a view to ensuring a uniform spread of sample FSUs over the entire survey period (as in 66 and 68 Rounds NSSO).

## 5.4 Brief Profile of the Sample Areas:

A brief demographic profile of the surveyed areas is discussed below:

1. **Kamrup Metropolitan District**

**Guwahati**

Guwahati city of Assam is governed by Municipal Corporation which comes under Guwahati Metropolitan Region. As per provisional reports of Census India, the population of Guwahati in 2011 is 957,352; of which males and females are 495,362 and 461,990 respectively. Although Guwahati city has a population of 957,352, its urban / metropolitan population is

962,334 of which 498,450 are males and 463,884 are females. 91.47 % of the population are literates. Hinduism is the majority religion in Guwahati city with 84.74 % followers. Islam is the second most popular religion in the city of Guwahati with approximately 12.45 % following it. In Guwahati city, Christianity is followed by 0.93 %, Jainism by 0.96 %, Sikhism by 0.36 % and Buddhism by 0.36 %.

**Table 5.2: Number of Sample Units in the surveyed area**

| Name of area / zones/ villages | Total Units |
|---|---|
| **<u>Urban Sector</u>** | |
| A. South (Chatribari) | 44 |
| B. West (Adabari) | 26 |
| C. Lokhra (Gorchuk) | 42 |
| D. Central (Fancy Bazar) | 27 |
| E. Dispur (Khanapara) | 64 |
| F. East (Ganeshguri) | 37 |
| **Total** | **240** |
| **<u>Rural Sector</u>** | |
| G. Dharapur | 20 |
| H. Garal | 20 |
| I. Khepnikuchi | 20 |
| J. Hadala | 20 |
| K. Upar Hali | 20 |
| L. Bansar | 20 |
| M. Kukurmara | 20 |
| N. Tinigharia | 20 |
| **Total** | **160** |
| **Grand Total** | **400** |

*Source:* Author

**Dharapur**

Dharapur has 1796 households with a population of 8095 of which 4,117 are males while 3,978 are females as per a report released by Census India 2011 with 195 Scheduled Caste Household and 33 Scheduled Tribe Households. The literacy rate of Dharapur is 89.40 %, which is higher than the state average of 72.19 %. In Dharapur, male literacy is around 94.02 % while the female literacy rate is 84.67 %. It is mainly dominated by the Hindu population of 78.63% followed by 21.14% Muslims.

**Garal**

Garal with 973 households has a population of 4400 with 144 Scheduled Caste Household. Among them 2239 (51%) are male and 2161 (49%) are female. 97% of the whole population are from general caste, 3% are from schedule caste and 0% are schedule tribes. Hindus contribute 99% of the total population and are the largest religious community in the region. The literacy rate of Garal is 90% of which 95% are male and 85% are female.

2. **Kamrup district**

**Khepnikuchi**

Khepnikuchi (Khopanikuchi) village is located in Rangia Tehsil of Kamrup district in Assam, India. The total geographical area of the village is 131.27 hectares. Khepnikuchi has a total population of 1,170 people (594 male, 576 female) in 210 households, out of which 713 persons are literate. It consists of 227 Scheduled tribe populations and no scheduled caste population. It consists of a population mainly belonging to Islamic religion.

**Hadala**

Hadala is a medium-sized village located in Hajo Circle of Kamrup district, Assam with total of 258 families residing in it. It has a population of 1370 of which 725 are males while 645 are females as per Population Census 2011. The Hadala village has a higher literacy rate compared to Assam. In 2011, the literacy rate of the Hadala village was 84.83 % compared to 72.19 % of Assam. Male literacy stood at 92.69 % while the female literacy rate was 75.87 %. Hadala village of Kamrup has a substantial population of Schedule Caste. Schedule Caste (SC) constitutes 28.61 % while Schedule Tribe (ST) was 0.07 % of the total population in Hadala village.

**Upar Hali**

As per the Population Census 2011, there are a total of 1,447 families residing in the Upar Hali. Out of the total population of 7,095, 3682 are males and 3413 are females. The Hindu population constitutes 84.45% of the total population (5992 persons) followed by 1.66% belonging to Islam religion. The literacy rate of Upar Hali is 87.4% which was higher than Kamrup district (75.5%). The male literacy rate is 91.75% and the female literacy rate is 82.79%. Schedule Caste (SC) constitutes 1.1% while there was no Schedule Tribe (ST) in the area.

**Bansar**

Bansar is a medium-sized village of Kamrup district, Assam with a total of 136 households. 360 are males while 328 are females out of the total population of 688 as per Population Census 2011. Bansar village has a lower literacy rate as compared to that of the state of Assam. In 2011, the literacy rate of Bansar village was 65.04 % which was lower than the state average of 72.19%. Male literacy stands at 69.37 % while the female literacy rate was 60.26 %. There is no recorded population of Schedule Caste (SC) and Schedule Tribe (ST) in the village.

**Kukurmara**

Kukur Mara is a large village located in Chhaygaon Circle of Kamrup district, Assam with total households of 540. It has a population of 2725 (1357 males and 1368 females) as per Population Census 2011. The literacy rate of Kukur Mara village was 72.97 % which was higher than the literacy rate of 72.19 % in Assam. In Kukur Mara Male literacy stands at 82.65 % while the female literacy rate was 63.29 %. Most of the villagers belong to Schedule Caste (SC) constituting 88.26 % of the population while Schedule Tribe (ST) was 0.99 % of the total population.

**Tinigharia**

Tinigharia is a medium size village located in Boko Circle of Kamrup district, Assam with a total of 107 families and a population of 511 of which 271 are males while 240 are females as per Population Census 2011. The village has a higher literacy rate compared to Assam. In 2011, the literacy rate of Tinigharia village was 78.45 % (Male literacy stands at 80.33 %

while female literacy stands at 76.36 %) compared to 72.19 % of Assam. Most of the village population is from Schedule Tribe (ST) which constitutes 81.80 % of the total population. There is no population of Schedule Caste (SC) in Tinigharia village of Kamrup.

## 5.5 Survey Design

The main objective of the survey is to obtain the pattern of total household consumption and a few of its components. Although the traditional approach is to gather information at a detailed level, the alternative approach has been used which is usually taken in the World Bank Living Standard Surveys (Deaton, 1997). Here, the collection of household consumption data is limited to a smaller number of items.

The main advantage of the traditional approach of measuring household consumption expenditure is that it generates more accurate detail than the second approach but at a significantly higher cost. In an Indonesian survey covering 8,000 households, two alternative questionnaires were tested (Deaton, 1997). The long questionnaire had 218 food items and 102 non-food items, whereas the short questionnaire had 15 food items and 8 non-food items. The estimates of total food expenditures were insignificantly different among the questionnaires. Moreover, the result showed that non-food expenditure estimates were about 15 percent higher for the long questionnaire (World Bank, 1992, appendix 4.2).

Another widely used method is the diary method, thus minimizing the reliance on respondents' memories. However, in a state like Assam where a substantial fraction of the population is illiterate (only 73.18% literate, 2011 census), it will be difficult to exercise the method. Even with a high literacy rate in the population, some problems with the diary method may arise; poor households are less likely to be able to use diaries and many households that are able to use diaries in fact do not use them (Deaton and Grosh, 2000). The General Statistics Office of Viet Nam found that in urban areas many households would not fill out the diaries for the 1995 Viet Nam Multi-purpose Household Survey (Glewwe and Yansaneh, 2001). Research indicates lower reporting of expenditures between the first and second week in two-week diaries, likely owing to a fatigue effect.

Ideally, the purchasing power should depend upon income. Income is a sensitive topic that may create suspicion among respondents that information on incomes could be used for taxation purposes, especially in the cases where the household operates a family business. Incomes need to be recorded for all household members and all kinds of incomes (incomes from household business or agriculture, informal incomes from part-time activities, returns on assets, etc.). Calculations of incomes are further complicated by gifts in cash and in-kind, remittances and loans. Incomes from agriculture for smallholder households present special problems; as such households obtain part of their food from subsistence production. Also, some of the cash income may come from sales of agricultural produce that take place intermittently, making it difficult for that income to be captured properly in the interview.

## 5.6 Commodities under Consideration

We propose to estimate demand for the commodities for which both price and quantity data are available. Starting with 12 commodities initially, we later focus on five commodity groups viz, a) cereal b) pulses c) oil, d) sugar e) salt due to inconsistent price data. We provide the summary statistics of expenditure and consumption in the following table. Expenditure as well consumption data of cereals, pulses, sugar, salt, milk, animal proteins (such as Egg, Fish and Meat), Fruits, Vegetables, spices, Pan/Tobacco and other Intoxicants (PTI) and beverages were sought. However, due to the nature of the data, the respondents could only provide a consistent answer regarding the consumption of only particular items. The items are presented here.

**Table 5.3: Consistent Data**

| Item | Consistent Expenditure data Available | Consistent Consumption Data Available |
|---|---|---|
| Cereals | Yes | Yes |
| Pulses | Yes | Yes |
| Sugar | Yes | Yes |
| Salt | Yes | Yes |
| Oil | Yes | Yes |
| Milk | Yes | Yes, with zero observations |
| Fruits | Yes | No |
| Vegetable | Yes | No |
| PTI | Yes | No |
| Spices | Yes | No (only in 32 cases) |
| EFM | Yes | No |
| Beverages | Yes | No |

## 5.7 Reference Period

Closely related to the decision on measurement instrument ('long' or 'short' questionnaire, diary method for the food consumption or recall questions, etc.) is the decision on reference period[69]. The reference period that the respondent is asked to recall must not be too long, as this would increase the recall errors. The effect of increasing the length of the reference period was studied in an experiment in the Living Standards Survey in Ghana. The study showed that for 13 frequent items, reported expenditures decreased on average 2.9 percent for every day added to the recall period (Scott and Amenuvegbe, 1990). There is some controversy among researchers over the effects of varying recall periods. An earlier study on the Indian National Sample Survey seems to indicate that, for certain food items, a one-month reference period produce less bias than a one-week reference period (Mahalanobis and Sen, 1954; Sen, 2000; Basu and Krishnakumar, 2004). Hence, a one-month reference period has been taken and the survey is done between September 2018 - May 2019.

## 5.8 Pilot Survey

Chatribari from South and Adabari from West had been chosen for the pilot survey. The questionnaire was pilot tested with 22 Respondents representing the sample in order to evaluate the effectiveness of the survey. The survey through questionnaire was administered using face-to-face interviews.

It also helped in identifying anomalies if any. It was found out that the term '*Head of the family*' generated a little confusion among respondents, thus a short explanation at the starting of the survey was given to the respondents. Also, the multiple-choice question addressing the *monthly income* was changed to *monthly expenditure* to derive appropriate results.

In order to deal with the problem of *non-response error*[70] in terms of the refusal of the respondent to answer a particular item or multiple items in the questionnaire, it was ensured that questionnaires, where several responses were left blank, were not included in the final analysis of the data set.

[69] period of time to which the information collected relates

[70] It occurs when sampling units selected for a sample are not interviewed. Sampled units typically do not respond because they are unable, unavailable, or unwilling to do so.

## 5.9 Research Instrument:

A structured Questionnaire (Appendix 5A, Table 5.36A) similar to that of NSSO 66th Round was adopted as a research instrument to conduct the study. The questionnaire was different from that of the NSSO in the following lines:

1. Although the traditional approach of measuring household consumption expenditure like in NSSO generates more accurate detail, it comes at a high cost. NSSO surveys depend on resource availability. Keeping that fact in mind, a primary survey had been carried out and the household consumption data was kept limited to a smaller number of items viz, cereal, pulses, sugar, salt and oil only.
2. NSSO has both a one-month recall period and one week recall period, for certain food items, a one-month reference period produces less bias than a one-week reference period (Mahalanobis and Sen, op cit). Hence, a one-month reference period had been used.
3. Although Income/Expenditure is an outcome variable in NSSO, it is not the case here. It was also found in the pilot survey that for many respondents of the households the problem of recalling expenditure on items other than food items was prevalent. Most of the rural households had no expenditure in bedding, footwear, and clothing to be recorded since these items are not one-time use and can be used over and over again.
4. Moreover, unlike NSSO, home-produced value/quantity was not included in the questionnaire. According to NSSO, home produce means the produce of cultivation or produce of livestock (for example, milk) and not food obtained in the home by the processing of other food items (e.g. curd from milk, or pickles from vegetables, spices, etc., or milk-based sweets from milk and sugar). Thus there is no concept of home produce of curd or ghee, home produce of pickles, or home produce of liquid tea. Again, *atta* obtained in the home from home-grown wheat, or *chira* (flattened rice) and other grains produced in the home from home-grown paddy, may be treated as "home produce" of wheat, *chira*, etc. These create a lot of perplexity in the minds of the respondents and were thus avoided.
5. It is worth mentioning that the different category codes regarding the level of general education attained by the members of the household are slightly different from that of NSSO because although some people were illiterate, they said that they attended

school for few years. Most rural households stated "under matriculation" (below class 10) as their household head's educational qualification.

## 5.10 Details of the Questionnaire

The Questionnaire had two sections each dedicated to the following theme.

<u>**Section 1:**</u> ***Consumer's demographic profile***

Consumer demographic profiling was done across gender of head, urban/rural area, family size, number of adults, and education of the head of the family, monthly expenditure/income, social group, religion and language spoken.

**Demographic Variables**

1. ***Gender of the Head:*** There is some evidence that male and female-headed households allocate resources differently. This is recognized by policy-making bodies like FAO.[71] Frazao (1992, in the context of the US), Rogers (1996, in the context of Dominican republic), Khan and Khalid (2012, in context of Pakistan), to name a few, have found differences both in level as well as patterns of consumption in female-headed households vis-à-vis male-headed households. However, in our sample, the number of female-headed households is low. A priori, the sample may not provide the necessary variability. Hence we do not use gender.

   Only 35 out of the total of 365 households were female-headed.

**Table 5.4: Frequency and Percentage of Gender**

| Gender | Frequency | Percentage |
|---|---|---|
| Female | 35 | 8.75 |
| Male | 365 | 91.25 |
| Total | 400 | 100 |

[71] **http://www.fao.org/3/ac685e/ac685e05.htm#TopOfPage**

2. ***Urban/Rural Area:*** As stated earlier in the chapter, 160 households were from the rural area and 240 from urban areas.

**Table 5.5: Frequency and Percentage of Households by Rural/Urban**

| Households | Numbers | Percent |
|---|---|---|
| Rural | 160 | 40 |
| Urban | 240 | 60 |
| Total | 400 | 100 |

3. ***Household size:*** Households with less than or equal to 3, 4 and 5 or more than 5 members were grouped under "small", "medium" and "large" households.

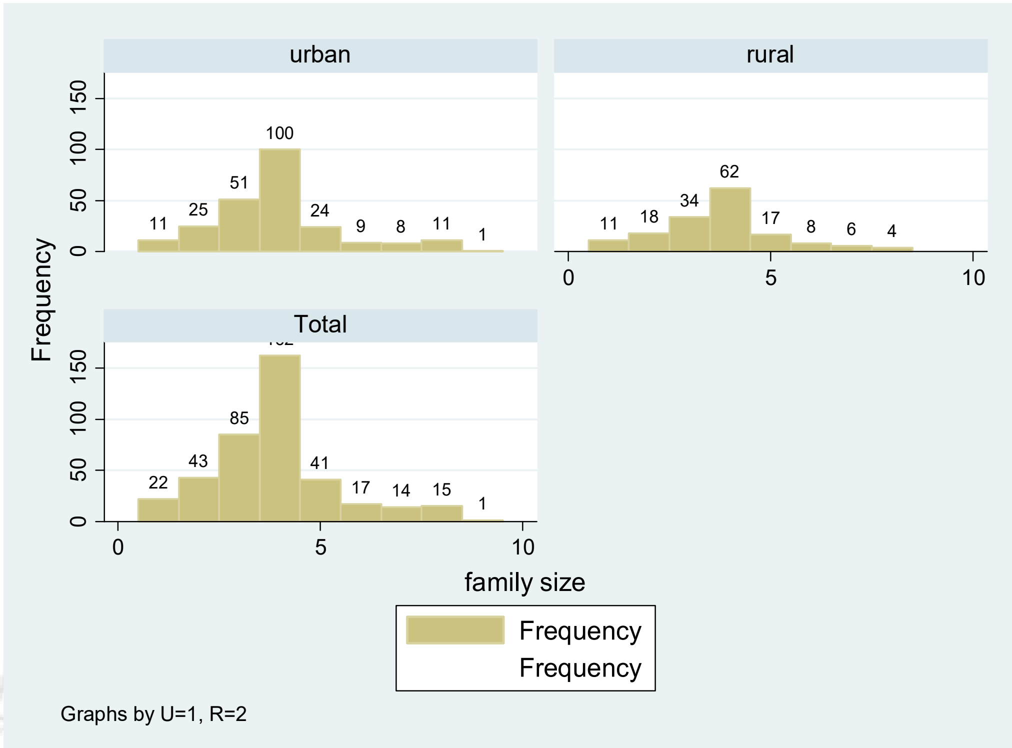
**Table 5.6: Household Size**

| HH size | Number | Percent |
|---|---|---|
| Small <= 3 | 150 | 37.5 |
| Medium = 4 | 162 | 40.5 |
| Large >=5 | 88 | 22 |

**Table 5.7: Urban/Rural Highest HH Size Frequency**

| HH | Size | Mode |
|---|---|---|
| Urban | 4 | 100 |
| Rural | 4 | 62 |
| Both U+R | 4 | 162 |

**Figure 5.1: HH size by urban/rural**




4. ***The number of adults:*** The number of adults present in a household also had an impact on consumption patterns.

**Table 5.8: Urban/Rural Highest Adult Frequency**

| HH | No. Of adults | Mode |
|---|---|---|
| Urban | 2 | 92 |
| Rural | 2 | 64 |
| Both U+R | 2 | 156 |

**Figure 5.2: Adults (Family Composition) in Urban/Rural areas**

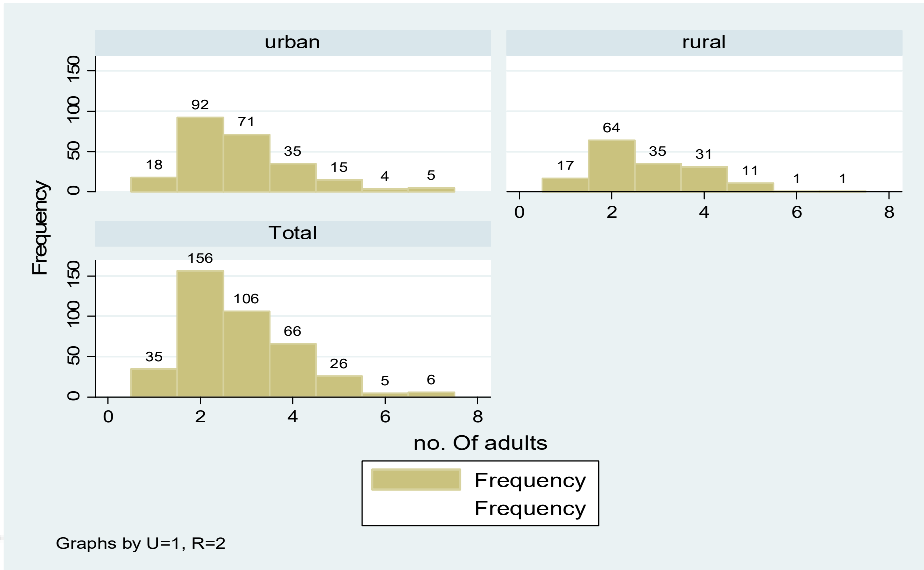
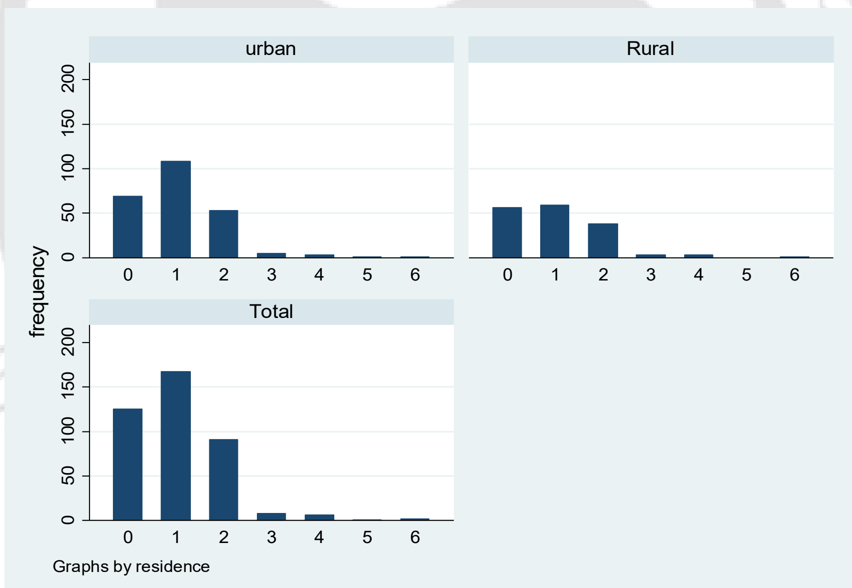
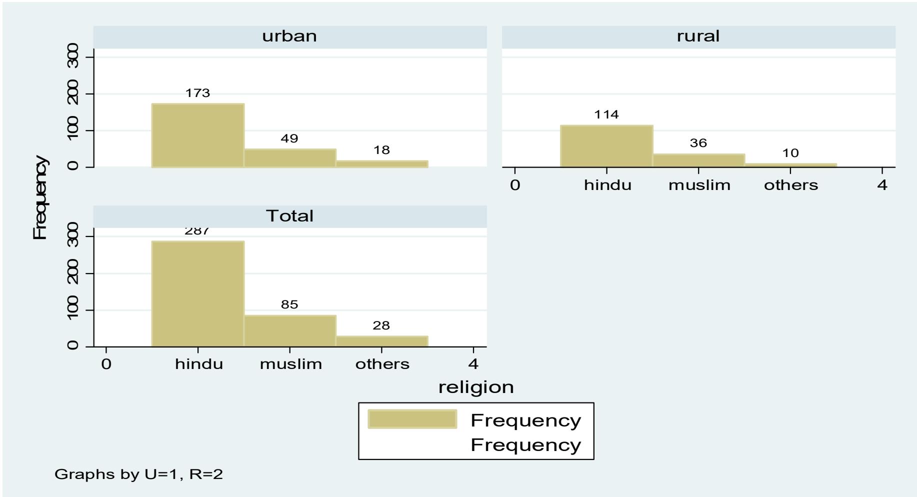



**Figure 5.3: Children (Family Composition) in Urban/Rural areas**




5. ***Religion:*** Expenditure on consumption varies significantly among different religions of the consumers.

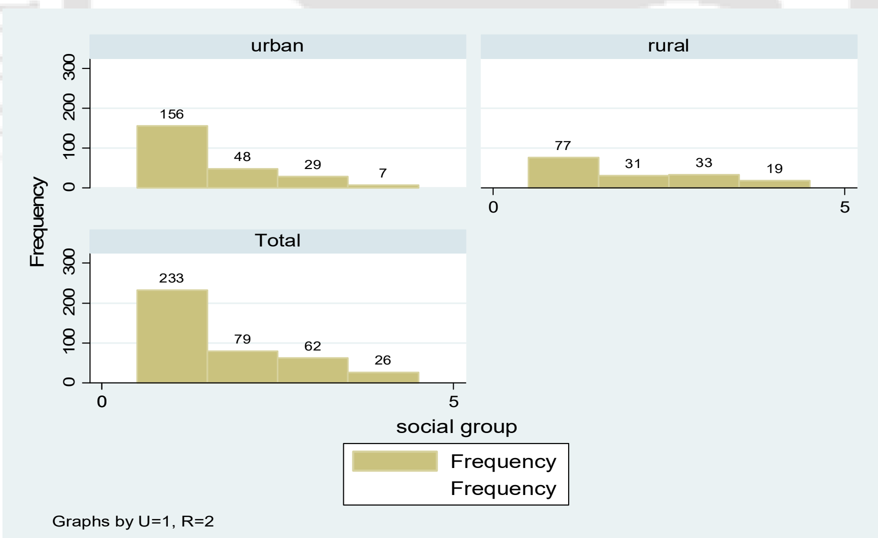
**Figure 5.4: Religious Affiliation in Sample by urban/rural (mode=287 Hindus)**




## *6.* Social Group/Ethnicity

The effect of social groups on households has been studied in various literature. General caste people constituted a major part of our sample.

**Figure 5.5: Social Groups in Sample: Urban/Rural (mode=233 General Caste)**




7. ***Education:*** The educational level of the household head was under four groups where most of them were "under matric" or "10th pass" qualification only.

**Table 5.9: Education of Head**

| Education of Head | Frequency | Percent |
|---|---|---|
| <= 10 pass | 169 | 42.25 |
| <= 12 pass | 136 | 3 |
| <= graduation | 79 | 19.75 |
| <=Post Graduation | 16 | 4 |

8. ***Income/Expenditure:*** According to Engels Law[72], subsistence expenditure makes up a high proportion of income for people with low per-capita income, thus leaving little room for saving (Chai and Moneta, 2008).

Thus, empirical evidence indicates that household characteristics such as household size, education, ethnicity of the household head, residential location of the household are important factors in determining household consumption behaviour. Hence, the household characteristics incorporated in this study are gender of head, urban/rural area, family/household size, number of adults, education of the head of the family, monthly expenditure/income, social group, religion and language spoken.

**Section 2:** ***Household Consumption***

Household Consumption including quantity and value of consumption of certain necessary food items of consumption such as cereals, pulses, sugar, salt[73], oil egg, fish, meat, milk and milk products, fruits, vegetables, pan, tobacco and intoxicants and beverages were recorded. It has to be noted that for certain items of food, both quantity and value of consumption have been recorded in the schedule. But for the other items, where reporting of quantity is difficult, only the value of consumption is required to be recorded (NSSO 68th Round).

## 5.11 Results based on the Questionnaire and Summary Statistics

Preliminary statistical analysis was done on the collected data from sample units. Inferential statistical tools such as t-test, analysis of variance were used to test the various hypotheses formulated by the researcher and to enhance understanding of the topic. The reason for decomposition in the present context is to examine the trend in inequality

[72] Refer to Deaton and Muelbauer (1980)
[73] Unlike the 68th round NSSO, sugar and salt have not been clubbed together. This is similar to 66th Round NSSO.

between and within the regions as well as between and within the sectors for each of the regions.

**5.11.1 Total Expenditure (Urban/Rural):** We now look at the summary statistics of the surveyed data-

**Table 5.10: Detailed summary of Household Consumption Data (Pooled)**

| Variable | Mean | S.D. | Min | Max | Q1 | Q2 (Median) | Q3 |
|---|---|---|---|---|---|---|---|
| Total Consumption Expenditure | 21023 | 16150.32 | 4500 | 200000 | 12000 | 17750 | 25000 |
| Adult per capita Expenditure | 6081.08 | 5316.63 | 1250 | 66666.66 | 3500 | 4500 | 6866.072 |

*Source:* Author's calculations

**Figure 5.11: Detailed summary of Household Consumption Data (Urban)**

| Variable | Mean | S.D. | Min | Max | Q1 | Q2 (Median) | Q3 |
|---|---|---|---|---|---|---|---|
| Total Consumption Expenditure | 23461.67 | 18656.77 | 6000 | 200000 | 14000 | 18000 | 27000 |
| Adult per capita Expenditure | 6695.16 | 6129.41 | 1500 | 66666.66 | 3571.42 | 5000 | 7732.14 |

*Source:* Author's calculations

**Figure 5.12: Summary Statistics of Household Consumption Data (Rural)**

| Variable | Mean | S.D. | Min | Max | Q1 | Q2 (Median) | Q3 |
|---|---|---|---|---|---|---|---|
| Total Consumption Expenditure | 17365 | 10435.22 | 4500 | 78000 | 10000 | 16000 | 20000 |
| Adult per capita Expenditure | 5159.958 | 3610.749 | 1250 | 30000 | 3000 | 4000 | 5750 |

*Source:* Author's calculations

It can be noted from tables 5.10, 5.11 and 5.12 that total food consumption was higher in the urban areas than in the rural areas. The detail of the total expenditure vary with respect to different demographic variables in pooled, urban and rural sectors are presented in Appendix 5A from Tables 5.37A to 5.61A.

### 5.11.2 Food Expenditure (Urban/Rural):

Now, we focus our summary statistics on food consumption expenditure in the following tables (Tables 5.13, 5.14 and 5.15). Interestingly, the per capita food expenditure of rural was higher than the per capita food expenditure of urban households Also, per-capita food expenditure was higher in rural than in urban areas. Moreover, it is observed in Appendix 5A from Tables 5.62A to 5.86A.that the total food expenditure varies with respect to different demographic variables in pooled, urban and rural sectors.

**Table 5.13: Detailed summary of Household Food Consumption Data (Pooled)**

| Variable | Mean | S.D. | Min | Max | Q1 | Q2 (Median) | Q3 |
|---|---|---|---|---|---|---|---|
| Per-capita food Expenditure | 3841.31 | 2346.37 | 912.48 | 22475 | 2419.09 | 3264.62 | 4601.33 |
| Total Food Expenditure | 9728.259 | 4788.201 | 2643 | 34877.5 | 6293 | 8353.5 | 12477.75 |
| Adult per capita food Expenditure | 1913.35 | 2416.77 | 228.121 | 22475 | 748.50 | 1226.89 | 2014.43 |

*Source:* Author's calculations

**Figure 5.14: Detailed summary of Household Food Consumption Data (Urban)**

| Variable | Mean | S.D. | Min | Max | Q1 | Q2 (Median) | Q3 |
|---|---|---|---|---|---|---|---|
| Per-capita food Expenditure | 1842.512 | 2185.174 | 283.74 | 22475 | 784.86 | 1214.80 | 1991.38 |
| Total Food Expenditure | 10023.71 | 4968.12 | 3685 | 34877.5 | 6389.75 | 8518.5 | 12749.13 |
| Adult per capita food Expenditure | 1842.51 | 2185.17 | 283.74 | 22475 | 784.86 | 1214.80 | 1991.38 |

*Source:* Author's calculations

**Figure 5.15: Summary Statistics of Household Food Consumption Data (Rural)**

| Variable | Mean | S.D. | Min | Max | Q1 | Q2 (Median) | Q3 |
|---|---|---|---|---|---|---|---|
| Per-capita food Expenditure | 3827.58 | 2564.83 | 912.48 | 19753 | 2412.18 | 3131.75 | 4505.66 |
| Total Food Expenditure | 9285.07 | 4483.638 | 2643 | 27724 | 5968.25 | 7987.5 | 11532 |
| Adult per capita food Expenditure | 2019.612 | 2731.425 | 228.12 | 19753 | 718.819 | 1261.43 | 2058.25 |

*Source:* Author's calculations

### 5.11.3 Commodity wise Expenditure:

The commodity-wise expenditure has been checked under this section. A detailed summary is given in in Appendix 5A from Tables 5.87A to 5.171A.

**Table 5.16: Sample Summary Commodity wise Expenditure Pooled**

| Food Item | Mean | SD | Min | Max | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Cereals | 1473.315 | 883.66 | 0 | 5400 | 822.5 | 1270 | 1948.5 |
| Pulses | 283.92 | 170.184 | 20 | 1326 | 160 | 245 | 371 |
| Sugar | 156.94 | 124.64 | 20 | 900 | 80 | 121.5 | 200 |
| Salt | 24.450 | 15.048 | 2 | 108 | 15 | 21 | 30 |
| Oil | 501.84 | 369.68 | 0 | 2750 | 230 | 367.5 | 605 |
| Milk | 1098.52 | 806.009 | 0 | 3600 | 496 | 1000 | 1500 |
| Spices | 220.037 | 132.02 | 10 | 100 | 100 | 200 | 300 |
| EFM | 2444.05 | 2216.342 | 0 | 13000 | 605 | 2000 | 3450 |
| Vegetable | 1477.05 | 1098.713 | 0 | 5000 | 700 | 1100 | 2000 |
| Fruit | 615.837 | 538.88 | 0 | 3200 | 200 | 440 | 900 |
| PTI | 867.137 | 1573.98 | 0 | 20000 | 150 | 390 | 1000 |
| Beverages | 571.45 | 698.42 | 0 | 3200 | 160 | 320 | 600 |

**Table 5.17: Sample Summary Commodity wise Expenditure: Urban**

| Food Item | Mean | SD | Min | Max | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Cereals | 1502.45 | 896.15 | 0 | 5400 | 877.5 | 1305 | 1989 |
| Pulses | 290.63 | 179.08 | 20 | 1326 | 160.5 | 252 | 381.5 |
| Sugar | 161.08 | 127.23 | 20 | 900 | 79.75 | 126 | 203.5 |
| Salt | 22.02 | 9.66 | 2 | 51 | 15 | 20 | 30 |
| Oil | 538.91 | 395.17 | 0 | 2750 | 241 | 428.75 | 669 |
| Milk | 1100.10 | 813.13 | 0 | 3600 | 500 | 1000 | 1515 |
| Spices | 233.92 | 128.98 | 10 | 600 | 135 | 210 | 320 |
| EFM | 2415.458 | 2193.27 | 0 | 13000 | 675 | 2000 | 3300 |
| Vegetable | 1645.25 | 1110.64 | 0 | 5000 | 845 | 1200 | 2200 |
| Fruit | 625.395 | 573.09 | 0 | 3200 | 200 | 400 | 1000 |
| PTI | 921.187 | 1831.12 | 0 | 20000 | 150 | 375 | 950 |
| Beverages | 567.270 | 698.78 | 0 | 3200 | 160 | 310 | 600 |

**Table 5.18: Sample Summary Commodity wise Expenditure: Rural**

| Food Item | Mean | SD | Min | Max | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Cereals | 1413.85 | 864.65 | 220 | 4144 | 720 | 1230 | 1907.5 |
| Pulses | 273.85 | 155.895 | 52.5 | 1000 | 160 | 240 | 355 |
| Sugar | 150.740 | 120.78 | 20 | 900 | 80 | 115 | 189.5 |
| Salt | 28.085 | 20.143 | 7 | 108 | 15 | 21 | 32 |
| Oil | 446.22 | 321.00 | 100 | 1725 | 220 | 330 | 562.5 |
| Milk | 1096.144 | 797.738 | 0 | 3000 | 450 | 1040 | 1500 |
| Spices | 199.206 | 134.177 | 20 | 600 | 80 | 195 | 285 |
| EFM | 2486.93 | 2256.73 | 0 | 10000 | 560 | 2050 | 3600 |
| Vegetable | 1224.75 | 1033.628 | 0 | 5000 | 460 | 900 | 1700 |
| Fruit | 601.5 | 484.45 | 0 | 220 | 250 | 450 | 835 |
| PTI | 786.062 | 1079.76 | 0 | 8750 | 150 | 390 | 1000 |
| Beverages | 577.718 | 700.040 | 0 | 3200 | 160 | 320 | 600 |

The mean expenditure in all the food items of urban consumption is found to be higher than in rural areas except for salt consumption expenditure. But the standard deviation seemed to be less in rural consumption indicating lesser dispersion among rural families except for salt consumption.

In this section, we present the summary statistics for food shares

**Table 5.19: Summary Statistics (food share)**

| Food Share | mean share | SD | min | max |
|---|---|---|---|---|
| Cereal | .1589996 | .0826758 | 0 | .505249 |
| Pulse | .035074 | .0238714 | .0010902 | .1456753 |
| Sugar | .0176212 | .012652 | .002101 | .068388 |
| Salt | .0028541 | .00197 | .0003054 | .0207657 |
| Oil | .0532727 | .0323823 | 0 | .3741497 |
| Spice | .0251565 | .016284 | .0014973 | .0893455 |
| EFM | .2242733 | .1367203 | 0 | .6547502 |
| Milk | .1189457 | .0807024 | 0 | .4084982 |
| Fruit | .0678421 | .0574908 | 0 | .3180981 |
| Vegetable | .1584153 | .1049889 | 0 | .6159321 |
| PTI | .0832233 | .0982238 | 0 | .5734356 |
| Beverage | .0543224 | .0481973 | 0 | .3610543 |

## Table 5.20 Rural/Urban Consumption (n=160,240)

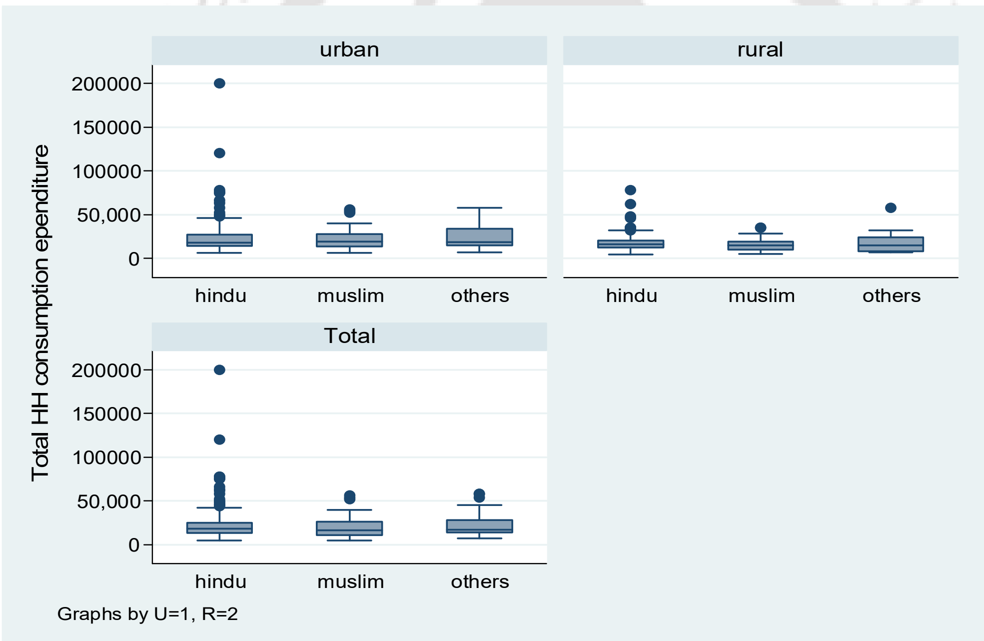
| Food Items (budget share) | Mean (R) | Mean (U) | SD (R) | SD(U) | Median (R ) | Median(U) |
|---|---|---|---|---|---|---|
| Cereal | .159 | 0.159 | 0.083 | 0.083 | 0.139 | 0.14 |
| Pulse | .035 | 0.034 | 0.027 | 0.022 | 0.031 | 0.031 |
| Sugar | .018 | 0.018 | 0.012 | 0.013 | 0.015 | 0.014 |
| Salt | .004 | 0.002 | 0.003 | 0.001 | 0.003 | 0.002 |
| Oil | .05 | 0.056 | 0.027 | 0.035 | 0.042 | 0.049 |
| Spice | .024 | 0.026 | 0.017 | 0.016 | 0.02 | 0.022 |
| EFM | .236 | 0.217 | 0.143 | 0.132 | 0.237 | 0.227 |
| Milk | .124 | 0.116 | 0.084 | 0.078 | 0.118 | 0.108 |
| Fruit | .068 | 0.068 | 0.053 | 0.06 | 0.055 | 0.05 |
| Vegetable | .14 | 0.171 | 0.104 | 0.104 | 0.121 | 0.15 |
| PTI | .085 | 0.082 | 0.095 | 0.101 | 0.051 | 0.048 |
| Beverages | .058 | 0.052 | 0.054 | 0.044 | 0.041 | 0.039 |

## 5.12 Summary Statistics of Groups: Urban/Rural

### 5.12.1 Box Plot

In order to present an idea about how the expenditure (total HH) are distributed around their respective median values by their demographic characteristics, the following figures represent box-plots of the values across pooled, urban and rural areas separately. The spread does not seem to be visibly different among different residential areas and also amongst the various religious groups, but there is the presence of a few outliers among the Hindus.

**Figure 5.6: Details of Total Household Expenditure by religion in urban/rural**

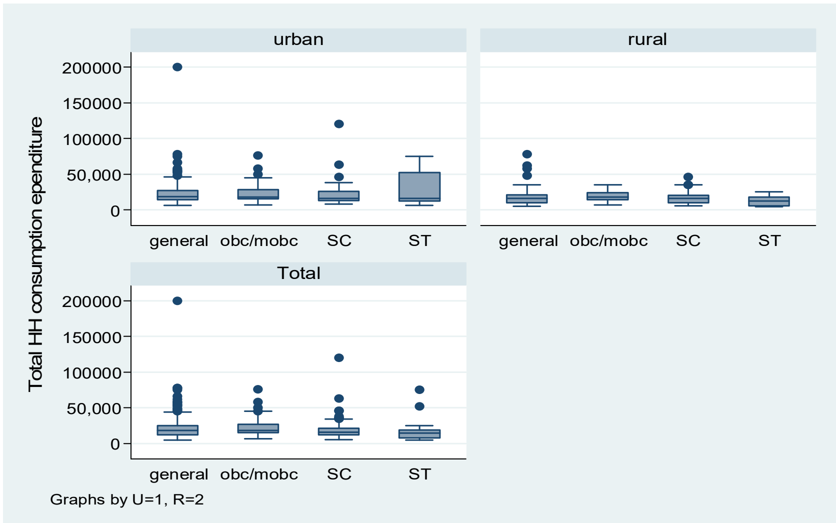



*Note:* The figure presents a box plot of total household expenditure in urban, rural and pooled samples categorized by religion

*Source:* Author's calculation

Figure 5.7 represents the details of total household expenditure among social groups by urban/rural and pooled samples.

**Figure 5.7: Summary of Household Consumption Expenditure among social groups**




*Note:* The figure represents a box plot of total household expenditure in urban, rural and pooled sample categorized by social groups. Each horizontal line represents a particular household's total expenditure. They vary differently among different social groups.

*Source:* Author's calculation

**Figure 5.8: Family size among social groups by religion and social groups**

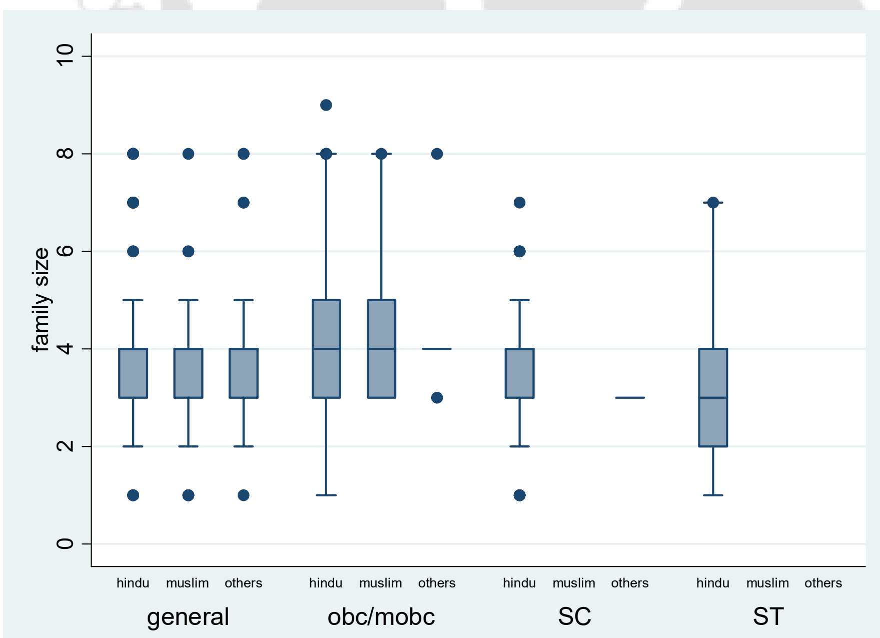
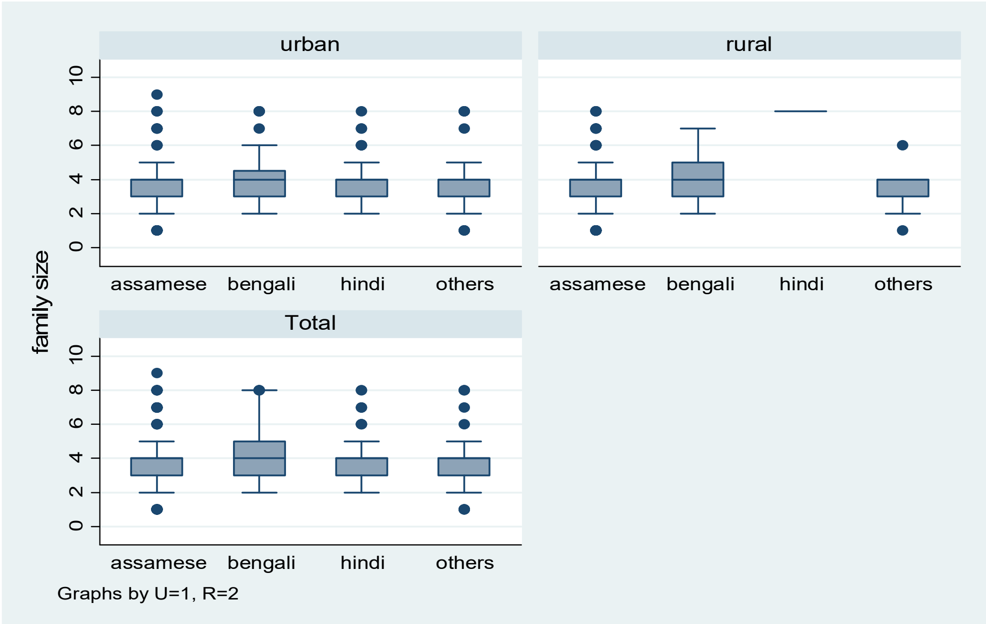
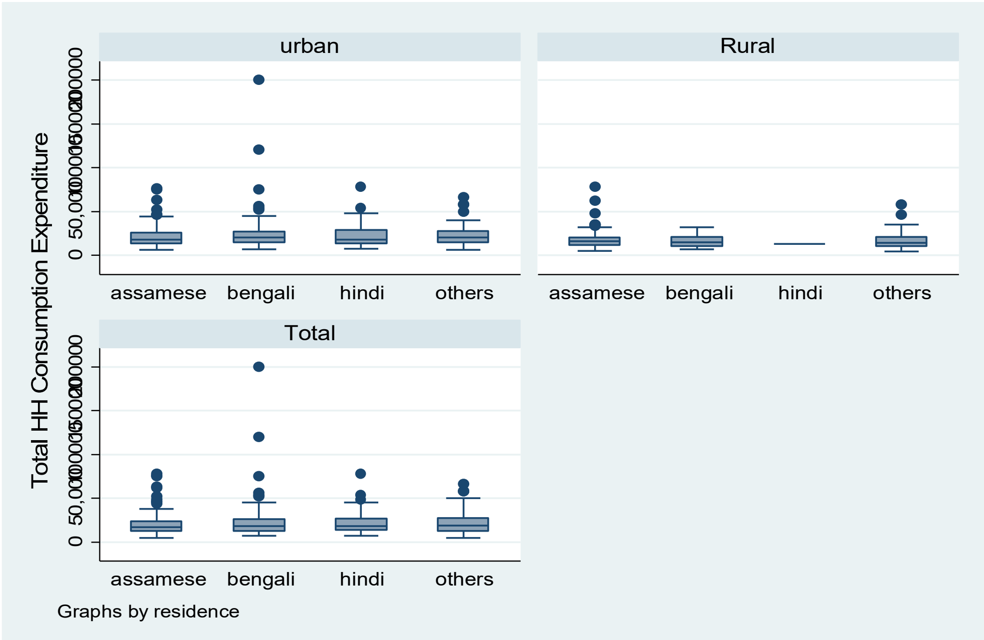


**Figure 5.9: Family size among social groups by linguistic groups**




Outliers were mainly present in Hindus in both rural and urban areas (refer to figure 5.6). Although all social groups were seen to have outliers that affected the mean total consumption expenditure but a disaggregated study among rural and urban areas indicated that General and Scheduled Caste groups had no outliers in rural areas (refer to figure 5.7). Outliers can be seen in Hindu families regarding total consumption expenditure both under rural and urban segregation. Figure 5.8 indicates the presence of outliers among all religious groups under general caste and Hindu SCs. Most households were found to have a family size of 4 in both rural and urban areas; the mean family size was estimated at 3.86. More than 50% of the population had a family size hovering around 4. 25% size of households in the Bengali linguistic group was nearly all higher than the highest 4$^{th}$ quartile among other linguistic groups in both urban and rural areas (refer to Figure 5.9). In the box plot (refer to figure 5.10), outliers were found to be present among general caste in both urban and rural areas. Also, SCs showed the presence of outliers mostly in urban areas.

**Figure 5.10 Summary of Household Consumption Expenditure among linguistic groups**




## 5.12.2 Independent Samples t–test[74]

In order to identify whether total consumption expenditure differed significantly across urban and rural areas, a t-test was used. Independent samples t-test was chosen as the population from which the sample was chosen in both cases was different for each sample group.

The first null hypothesis assumes that there is no significant difference between the two means of urban expenditure and rural expenditure.

[74] It is a statistical tool that determines whether the means of the two groups of samples are significantly different

**Table 5.21: t-test total expenditure**

| Null Hypothesis (NH) | t- value | P value | Significant | Result |
|---|---|---|---|---|
| Urban Expenditure = Rural Expenditure | 4.1765 | 0.00*** | Yes | Reject |
| Urban food expenditure = Rural food expenditure | 1.5139 | 0.13 | No | Accept |
| Urban per capita food expenditure = Rural per capita food expenditure | 0.095 | 0.92 | No | Accept |
| Urban adult per capita food expenditure = Rural adult per capita food expenditure | 3.146 | 0.00*** | Yes | Reject |
| Male-Headed HH Total Expenditure = Female-Headed HH Total Expenditure | -0.8973 | 0.374 | No | Accept |
| Male-Headed HH Food Expenditure = Female-Headed HH Food Expenditure | -2.8573 | 0.006*** | Yes | Reject |

*Note*: p-value is < 0.05 indicating that there is statistical evidence not to accept the null hypothesis at 95% confidence intervals. Thus, it can be inferred that the associated means are significantly different.

Again, the null hypothesis assumes that there is no significant difference between the two means per capita food expenditure in urban and rural areas. Analysis shows that the p-value is > 0.05 indicating that there is statistical evidence to accept the null hypothesis at 95% confidence intervals and it can be said that the associated means per capita food expenditure in urban and rural areas are not significantly different from each other. Also, the associated means of food expenditure in urban and rural areas are not significantly different from each other. We have evidence to accept our null hypothesis. Thus, urban and rural per capita food expenditure pattern is similar.

Again, if we assume the null hypothesis as no significant difference between the two means of adult per capita food expenditure under urban and rural areas, we find that the p-value is < 0.01 showing statistical evidence not to accept the null hypothesis at 99% confidence intervals. Therefore, it can be interpreted that the associated means of adult per capita expenditure under urban and rural areas have a significant difference. The observed mean is 6695.16 in urban which is much higher than 5159.95 in rural areas.

Moreover, there is statistical evidence to accept that the associated mean on Total Expenditure of Male-Headed HH and Female-Headed HHs are not different. But, the associated mean on food expenditure of Male-Headed HH and Female-Headed HHs are significantly different.

The following table shows an item-wise t-test on food expenditure between urban and rural households. Results indicate that there is no statistical difference between associated means of urban and rural households regarding expenditure on cereal, pulse, sugar, significant, EFM, milk, fruits, PTI and beverages. And there is a statistical difference between associated means of urban and rural households regarding expenditure on salt, oil, spices and vegetables.

**Table 5.22: t-test item-wise food expenditure**

| Null Hypothesis (NH) | t- value | P value | Significant | Result |
|---|---|---|---|---|
| Urban Cereal Expenditure = Rural Cereal Expenditure | 0.9895 | 0.3231 | No | Accept |
| Urban Pulse Expenditure = Rural Pulse Expenditure | 0.9927 | 0.3215 | No | Accept |
| Urban Sugar Expenditure = Rural Sugar Expenditure | 0.8210 | 0.4122 | No | Accept |
| Urban Salt Expenditure = Rural Salt Expenditure | -3.5419 | 0.0005*** | Yes | Reject |
| Urban Oil Expenditure = Rural Oil Expenditure | 2.5761 | 0.0104** | Yes | Reject |
| Urban Spices Expenditure = Rural Spices Expenditure | 2.5746 | 0.0105** | Yes | Reject |
| Urban EFM Expenditure = Rural EFM Expenditure | -0.3138 | 0.7538 | No | Accept |
| Urban Milk Expenditure = Rural Milk Expenditure | 0.0483 | 0.9615 | No | Accept |
| Urban Fruits Expenditure = Rural Fruits Expenditure | 0.4488 | 0.6539 | No | Accept |
| Urban Vegetables Expenditure = Rural Vegetables Expenditure | 3.8682 | 0.0001*** | Yes | Reject |
| Urban PTI Expenditure = Rural PTI Expenditure | 0.9268 | 0.3546 | No | Accept |
| Urban Beverages Expenditure = Rural Beverages Expenditure | -0.1463 | 0.8837 | No | Accept |

### 5.12.3 One Way Analysis of Variance (ANOVA)

Now, to examine differences among more than two groups, one way ANOVA[75] has been used. By analyzing the variation among and within the groups, conclusions can be made about the possible differences in group means. In the study, one-way ANOVA was used to examine whether consumption expenditure differs between and within groups with certain demographic characteristics.

The following tables (table 5.23) show the impact of various demographic variables on the total expenditure and food expenditure of households.

**Table 5.23: ANOVA on total consumption expenditure among religious groups**

. oneway totalhhconsumptionependiture religion, bonferroni tabulate

| religion | Summary of Total HH consumption ependiture Mean | Std. Dev. | Freq. |
|---|---|---|---|
| hindu | 21424.39 | 17510.304 | 287 |
| muslim | 19204.706 | 10789.312 | 85 |
| others | 22428.571 | 15178.734 | 28 |
| Total | 21023 | 16150.317 | 400 |

Analysis of Variance

| Source | SS | df | MS | F | Prob > F |
|---|---|---|---|---|---|
| Between groups | 382583871 | 2 | 191291936 | 0.73 | 0.4814 |
| Within groups | 1.0369e+11 | 397 | 261183084 | | |
| Total | 1.0407e+11 | 399 | 260832753 | | |

Bartlett's test for equal variances: chi2(2) = 25.1960 Prob>chi2 = 0.000

Comparison of Total HH consumption ependiture by religion (Bonferroni)

| Row Mean-Col Mean | hindu | muslim |
|---|---|---|
| muslim | -2219.68<br>0.800 | |
| others | 1004.18<br>1.000 | 3223.87<br>1.000 |

Table 5.23 indicates there is a significant difference of means between the groups and also within the groups (p-value>0.05) on total consumption expenditure pattern among religious groups. Hence, we reject our null hypothesis ($H_0$ = means are equal for all groups) and accept the alternative hypothesis ($H_1$ = at least one pair of means are not equal) at a 5% level of significance. Now, checking the Bonferroni test we figure out that all groups have significantly different pair-wise means. A higher F value indicates there is more difference of means between groups than within groups. Here F value is as low as 0.73.

[75] an extension of t-test for the difference between two means which is used to simultaneously compare the difference between the means of more than two groups

It can be observed from table 5.24 that there is no significant difference of means between the groups and also within the social groups (p-value>0.05) on total consumption expenditure. The General group was found to be spending more. Hence, we reject our null hypothesis ($H_0$ = means are equal for all groups) and accept the alternative hypothesis ($H_1$ = at least one pair of means are not equal) at a 5% level of significance. Now, checking the Bonferroni test we figure out that all groups have significantly different pair-wise means. A higher F value indicates there is more difference of means between groups than within groups. Here F value is as low as 0.62.

**Table 5.24: ANOVA on total consumption expenditure among social groups**

```
. oneway totalhhconsumptionependiture socialgroup, bonferroni tabulate

            |  Summary of Total HH consumption
    social  |           ependiture
     group  |        Mean   Std. Dev.       Freq.
------------+------------------------------------
   general  |   21532.189   17359.797         233
  obc/mobc  |   21320.253   11388.696          79
        SC  |   20358.065   16983.903          62
        ST  |   17142.308   15436.818          26
------------+------------------------------------
     Total  |       21023   16150.317         400

                        Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups     486357792      3   162119264      0.62     0.6025
 Within groups    1.0359e+11    396   261580582
------------------------------------------------------------------------
    Total         1.0407e+11    399   260832753

Bartlett's test for equal variances:  chi2(3) =  18.0952  Prob>chi2 = 0.000

        Comparison of Total HH consumption ependiture by social group
                                (Bonferroni)
Row Mean-|
Col Mean |    general   obc/mobc         SC
---------+---------------------------------
obc/mobc |   -211.936
         |      1.000
         |
      SC |   -1174.12   -962.189
         |      1.000      1.000
         |
      ST |   -4389.88   -4177.95   -3215.76
         |      1.000      1.000      1.000
```

The above table (refer to table 5.25) indicates there is a significant difference between the groups and also within the groups (p-value<0.05) in the consumption pattern of different household sizes, which means we have evidence not to accept our null hypothesis ($H_0$ = means are equal for all groups).

### Table 5.25: ANOVA on total consumption expenditure with household size

```
. oneway totalhhconsumptionependiture familysize, bonferroni tabulate
```

| family size | Summary of Total HH consumption ependiture Mean | Std. Dev. | Freq. |
|---|---|---|---|
| 1 | 13027.273 | 8293.0368 | 22 |
| 2 | 15227.907 | 9125.196 | 43 |
| 3 | 19594.118 | 22293.664 | 85 |
| 4 | 22074.074 | 15606.71 | 162 |
| 5 | 20226.829 | 9823.0093 | 41 |
| 6 | 28647.059 | 9669.1596 | 17 |
| 7 | 35571.429 | 15335.802 | 14 |
| 8 | 25533.333 | 12550.564 | 15 |
| 9 | 29000 | 0 | 1 |
| Total | 21023 | 16150.317 | 400 |

Analysis of Variance

| Source | SS | df | MS | F | Prob > F |
|---|---|---|---|---|---|
| Between groups | 7.5492e+09 | 8 | 943649417 | 3.82 | 0.0002 |
| Within groups | 9.6523e+10 | 391 | 246862079 | | |
| Total | 1.0407e+11 | 399 | 260832753 | | |

Bartlett's test for equal variances: chi2(7) = 74.7434 Prob>chi2 = 0.000

note: Bartlett's test performed on cells with positive variance:
1 single-observation cells not used

Comparison of Total HH consumption ependiture by family size (Bonferroni)

| Row Mean-Col Mean | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 2 | 2200.63<br>1.000 | | | | | |
| 3 | 6566.84<br>1.000 | 4366.21<br>1.000 | | | | |
| 4 | 9046.8<br>0.420 | 6846.17<br>0.413 | 2479.96<br>1.000 | | | |
| 5 | 7199.56<br>1.000 | 4998.92<br>1.000 | 632.712<br>1.000 | -1847.24<br>1.000 | | |
| 6 | 15619.8<br>0.080 | 13419.2<br>0.110 | 9052.94<br>1.000 | 6572.98<br>1.000 | 8420.23<br>1.000 | |
| 7 | 22544.2<br>0.001 | 20343.5<br>0.001 | 15977.3<br>0.017 | 13497.4<br>0.079 | 15344.6<br>0.062 | 6924.37<br>1.000 |
| 8 | 12506.1<br>0.645 | 10305.4<br>1.000 | 5939.22<br>1.000 | 3459.26<br>1.000 | 5306.5<br>1.000 | -3113.73<br>1.000 |
| 9 | 15972.7<br>1.000 | 13772.1<br>1.000 | 9405.88<br>1.000 | 6925.93<br>1.000 | 8773.17<br>1.000 | 352.941<br>1.000 |

| Row Mean-Col Mean | 7 | 8 |
|---|---|---|
| 8 | -10038.1<br>1.000 | |
| 9 | -6571.43<br>1.000 | 3466.67<br>1.000 |

.

It can be seen from table 5.26 that indicates there is a significant difference between the groups and also within the groups (p-value<0.05) in the consumption pattern with educational qualification of the household head. We have evidence not to accept our null hypothesis ($H_0$ = means are equal for all groups).

Table 5.27 reveals that there is no significant difference of means between the groups and also within the linguistic groups (p-value>0.05) on total consumption expenditure. The OBC/MOBC group was found to be spending more. Hence, we can accept our alternative hypothesis ($H_1$ = at least one pair of means are not equal). Each value under Bonferroni[76] comparison test helps to find of which pair is not equal. Data revealed that the pair-wise means of Assamese speaking household groups were lower than other linguistic groups.

[76] A type of multiple comparison test used in statistical analysis attempts to prevent data from incorrectly appearing to be statistically significant by lowering the alpha value.

## Table 5.26: ANOVA on total consumption expenditure with the education of head

```
. oneway totalhhconsumptionependiture eduqual, bonferroni tabulate
```

| eduquali | Summary of Total HH consumption ependiture Mean | Std. Dev. | Freq. |
|---|---|---|---|
| <=10 pass | 15402.367 | 5984.195 | 169 |
| <=12th pa | 19109.559 | 9876.0907 | 136 |
| <=graduat | 31687.342 | 25393.46 | 79 |
| <=PG/prof | 44000 | 27475.444 | 16 |
| Total | 21023 | 16150.317 | 400 |

Analysis of Variance

| Source | SS | df | MS | F | Prob > F |
|---|---|---|---|---|---|
| Between groups | 2.3269e+10 | 3 | 7.7562e+09 | 38.01 | 0.0000 |
| Within groups | 8.0804e+10 | 396 | 204049909 | | |
| Total | 1.0407e+11 | 399 | 260832753 | | |

Bartlett's test for equal variances: chi2(3) = 279.8084 Prob>chi2 = 0.000

Comparison of Total HH consumption ependiture by eduquali (Bonferroni)

| Row Mean-Col Mean | <=10 pas | <=12th p | <=gradua |
|---|---|---|---|
| <=12th p | 3707.19<br>0.149 | | |
| <=gradua | 16285<br>0.000 | 12577.8<br>0.000 | |
| <=PG/pro | 28597.6<br>0.000 | 24890.4<br>0.000 | 12312.7<br>0.011 |

## Table 5.27: ANOVA on total consumption expenditure with linguistic groups

```
. oneway totalhhconsumptionependiture language, bonferroni tabulate
```

| Language | Summary of Total HH consumption ependiture Mean | Std. Dev. | Freq. |
|---|---|---|---|
| assamese | 19350.661 | 11602.08 | 227 |
| bengali | 24357.333 | 26602.429 | 75 |
| hindi | 22158.537 | 14145.14 | 41 |
| others | 22478.947 | 14414.783 | 57 |
| Total | 21023 | 16150.317 | 400 |

Analysis of Variance

| Source | SS | df | MS | F | Prob > F |
|---|---|---|---|---|---|
| Between groups | 1.6424e+09 | 3 | 547461094 | 2.12 | 0.0976 |
| Within groups | 1.0243e+11 | 396 | 258661326 | | |
| Total | 1.0407e+11 | 399 | 260832753 | | |

Bartlett's test for equal variances: chi2(3) = 95.0524 Prob>chi2 = 0.000

Comparison of Total HH consumption ependiture by Language (Bonferroni)

| Row Mean-Col Mean | assamese | bengali | hindi |
|---|---|---|---|
| bengali | 5006.67<br>0.120 | | |
| hindi | 2807.88<br>1.000 | -2198.8<br>1.000 | |
| others | 3128.29<br>1.000 | -1878.39<br>1.000 | 320.411<br>1.000 |

**Table 5.28: ANOVA on total consumption expenditure with number of adults**

```
. oneway con_exp n_adult
```

| Source | SS | df | MS |
|---|---|---|---|
| | Analysis of Variance | | |
| Between groups | 5.8959e+09 | 6 | 982652926 |
| Within groups | 9.8176e+10 | 393 | 249812598 |

Table 5.28 indicates there is a significant difference between the groups and also within the groups (p-value<0.05) in the consumption pattern with the number of adults in the household. We have evidence not to accept our null hypothesis that the means are equal.

**Table 5.29: ANOVA on total consumption expenditure with number of children**

```
. oneway con_exp child
```

| Source | SS | df | MS |
|---|---|---|---|
| | Analysis of Variance | | |
| Between groups | 1.8699e+09 | 6 | 311646732 |
| Within groups | 1.0220e+11 | 393 | 260056967 |

Table 5.29 indicates there is no significant difference between the groups and also within the groups (p-value<0.05) in the consumption pattern with the number of children of the household. We have evidence to accept our null hypothesis that the means are equal.

**Table 5.30: ANOVA on food consumption expenditure with religious groups**

```
. oneway fooditems relg

                        Analysis of Variance
    Source              SS          df      MS
> > F
-----------------------------------------------
> -----
Between groups      54414464.9       2    272072
> 060
 Within groups      9.0934e+09     397    229053
-----------------------------------------------
```

Table 5.30 indicates there is no significant difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern of the different religious groups of the household. We have evidence to accept our null hypothesis that the means are equal among religious groups.

**Table 5.31: ANOVA on food consumption expenditure with social groups**

```
. oneway fooditems socialgroup

                        Analysis of Variance
    Source              SS          df      MS
> > F
-----------------------------------------------
> -----
Between groups       222869270       3    74289756
> 205
 Within groups      8.9250e+09     396    22537753
-----------------------------------------------
```

Table 5.31 above indicates there is a significant difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern of the different religious groups of the household. We have evidence not to accept our null hypothesis that the means are equal.

**Table 5.32: ANOVA on food consumption expenditure with linguistic groups**

```
. oneway fooditems language

                        Analysis of Variance
    Source              SS          df      MS
> > F
--------------------------------------------------
> -----
Between groups      43295002.9       3   144316
> 975
 Within groups      9.1045e+09     396     2299
--------------------------------------------------
```

Table 5.32 indicates there is no significant difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern with the linguistic groups. We have evidence to accept our null hypothesis that the means are equal.

**Table 5.33: ANOVA on food consumption expenditure with family size**

```
. oneway fooditems fam_size

                        Analysis of Variance
    Source              SS          df      MS
> > F
--------------------------------------------------
> -----
Between groups      2.8364e+09       8    35454
> 000
 Within groups      6.3114e+09     391   161417
--------------------------------------------------
```

Table 5.33 indicates there is significant statistical difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern with the family size of the household. We have evidence not to accept our null hypothesis that the means are equal

**Table 5.34: ANOVA on food consumption expenditure with the education of the Head**

```
. oneway fooditems eduqual

                        Analysis of Variance
    Source              SS          df       MS
> > F
------------------------------------------------
> -----
Between groups      464002177        3     15466?
> 001
 Within groups     8.6838e+09      396    219288?
------------------------------------------------
```

Table 5.34 indicates there is a significant statistical difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern with the family size of the household. We have evidence to reject our null hypothesis that the means are equal.

**Table 5.35: ANOVA on food consumption expenditure with social groups**

```
. oneway fooditems n_adult

                        Analysis of Variance
    Source              SS          df        MS
---------------------------------------------------
Between groups     2.4596e+09        6     409938829
 Within groups     6.6882e+09      393    17018286.9
---------------------------------------------------
```

Table 5.35 indicates there is a significant statistical difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern with the number of adults in the household. We have evidence to reject our null hypothesis that the means are equal.

**Table 5.36: ANOVA on food consumption expenditure with social groups**

```
. oneway fooditems child
```

| Source | Analysis of Variance SS | df | MS |
|---|---|---|---|
| Between groups | 642934217 | 6 | 107155703 |
| Within groups | 8.5049e+09 | 393 | 21640930 |

Table 5.36 indicates there is a significant statistical difference between the groups and also within the groups (p-value<0.05) in the food consumption pattern with the number of children in the household. We have evidence to reject our null hypothesis that the means are equal.

## 5.13 Conclusion

This chapter helps in obtaining an overall picture of well-being in the sampled household which is representative of the population under study. But there is no single and universally adopted indicator as a yardstick. The indicators such as per capita expenditure, total household consumption expenditure and adult per capita expenditure provide only a quantitative aspect of welfare. The expenditure patterns are significantly nonlinear and the expenditure patterns are significantly different for different demographic groups. Further tests of tax optimality including the demographic variables too have been conducted and presented in the next chapter.

# Appendix 5A

## Tables

### Table 5.36 A: Questionnaire

**I. Personal details**

A. Name:

B. Gender:

C. Educational Qualification:

1) < class10
2) < class12
3) < graduation
4) > graduation

D. Family size[77]:

E. Number of adults:

F. District:

G. Zone/Block:

H. Village/City:

I. Language;

J. Social Group:

K. Religion[78]:

**II. Consumption Expenditure Details:**

1) How much did you spend in a month for buying these food items during the last month as ended on 30th September 2018? (Quantity and Value)

a) cereals[79] :

[77] The size of the sample household i.e., the total number of persons normally residing together (i.e., under the same roof) and taking food from the same kitchen (including temporary stay-aways and excluding temporary visitors) will be recorded against this item.

[78] If different members of the household claim to belong to different religions, the religion of the head of the household will be considered as the religion of the household.

| |
|---|
| b) pulses[80] : |
| c) sugar[81] : |
| d) salt[82] : |
| e) oil[83] : |
| f) spices[84] : |
| g) egg, fish, meat: |
| h) milk and milk products: |
| i) fruits: |
| j) vegetables: |
| k) pan, tobacco and intoxicants: |
| l) beverages: |
| |

| |
|---|
| 2) What is your total consumption expenditure (food+non-food items) during the last month as ended on 30th September 2018? |
| |
| |
| Rs. |

[79] **Cereals**: Household consumption of cereals

[80] **Pulses**: arhar, gram, moong, masur, urad, peas, khesari, besan etc.

[81]**Sugar**: includes khandsari

[82] **Salt:** includes all edible salts

[83] **Edible oil**: Oils such as mustard oil, groundnut oil, etc. are considered as "edible oil" when they are used in cooking. The same oils, when used for toilet purposes, are not included here.

[84] **Spices:** There are huge assortments of spices that are generally used in food preparations. Of these items, turmeric and chillies are most commonly used. Items not listed here are mostly purchased in the villages as a mixed spice and it may be difficult to collect information on expenditure and consumption of each individual item of spices.

**Table 5.37 A: HH consumption expenditure: Gender**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Male | 21233.97 | 16253.13 | 200000 | 4800 | 13000 | 18000 | 25000 |
| Female | 18822.86 | 15079.05 | 75000 | 4500 | 9000 | 16000 | 19000 |

**Table 5.38 A: HH consumption expenditure: Gender (Urban)**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Male | 23533.03 | 18712.87 | 200000 | 6000 | 14000 | 18000 | 27000 |
| Female | 22631.58 | 18466.07 | 75000 | 6000 | 12000 | 17000 | 26000 |

**Table 5.39 A: HH consumption expenditure: Gender (Rural)**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Male | 17705.56 | 10629.52 | 78000 | 4800 | 11000 | 16000 | 20500 |
| Female | 14300 | 8124.038 | 34000 | 4500 | 13500 | 19000 | 24000 |

**Table 5.40 A: HH consumption expenditure:  Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 17379.33 | 17896.58 | 200000 | 4500 | 9000 | 15000 | 19000 |
| 4 | 22074.07 | 15606.71 | 120000 | 5000 | 11000 | 14000 | 25000 |
| >=5 | 8582.173 | 3808.067 | 200000 | 2643 | 12000 | 16000 | 22000 |

**Table 5.41 A: HH consumption expenditure: Gender (Urban)**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 19727.59 | 22349.39 | 200000 | 6000 | 11000 | 16000 | 200000 |
| 4 | 9849.342 | 4027.215 | 34877.5 | 3685 | 7243.5 | 9036.5 | 11319 |
| >=5 | 22343.85 | 19874.11 | 200000 | 6000 | 13000 | 17000 | 26000 |

### Table 5.42 A: HH consumption expenditure: Gender (Rural)

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 14136.51 | 7645.414 | 35000 | 4500 | 8000 | 12000 | 19000 |
| 4 | 17967.74 | 11541.03 | 78000 | 2899 | 7028 | 8467 | 10488 |
| >=5 | 16036.8 | 9922.129 | 78000 | 4500 | 9500 | 15000 | 19000 |

### Table 5.43A: HH consumption expenditure: No of Adults

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 18150.26 | 16566.39 | 200000 | 4500 | 9500 | 15000 | 21000 |
| 3 | 22586.79 | 13775.41 | 78000 | 9500 | 14000 | 18000 | 26000 |
| >=4 | 24740.78 | 16786.88 | 120000 | 6800 | 15000 | 21000 | 26000 |

### Table 5.44 A: HH consumption expenditure: No of Adults (Urban)

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 20778.18 | 20459.35 | 200000 | 6000 | 12000 | 16000 | 25000 |
| 3 | 23625.35 | 13605.46 | 75000 | 9500 | 15000 | 18000 | 27500 |
| >=4 | 28267.8 | 19673.9 | 120000 | 6800 | 16500 | 23000 | 28000 |

### Table 5.45 A: HH consumption expenditure: No of Adults (Rural)

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 14581.48 | 7687.313 | 35000 | 4500 | 8000 | 14000 | 18000 |
| 3 | 20480 | 14074.88 | 78000 | 9500 | 12000 | 16000 | 21000 |
| >=4 | 20011.36 | 10315.61 | 62000 | 7000 | 15000 | 18000 | 21500 |

### Table 5.46A: HH consumption expenditure: No of Children

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 18235.2 | 14519.63 | 120000 | 4800 | 11000 | 15000 | 21000 |
| 1 | 22668.26 | 19692.69 | 200000 | 4500 | 12000 | 17500 | 27000 |
| >=2 | 21705.56 | 10626.05 | 66000 | 5000 | 15000 | 19000 | 26000 |

**Table 5.47A: HH consumption expenditure: No of Children urban**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 21213.04 | 17877.94 | 120000 | 6000 | 12000 | 16500 | 24000 |
| 1 | 24568.52 | 22302.91 | 200000 | 7000 | 13750 | 18000 | 27500 |
| >=2 | 24026.98 | 11166.23 | 66000 | 6000 | 16000 | 22000 | 28000 |

**Table 5.48A: HH consumption expenditure: No of Children rural**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 14566.07 | 7436.575 | 48000 | 4800 | 8850 | 14000 | 19000 |
| 1 | 19189.83 | 13161.7 | 78000 | 4500 | 9800 | 16000 | 21000 |
| >=2 | 18455.56 | 8965.09 | 62000 | 5000 | 13000 | 18000 | 22000 |

**Table 5.49A: HH consumption expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 15402.37 | 5984.19 | 35000 | 4500 | 11000 | 15000 | 19000 |
| 10-12 | 19109.56 | 9876.09 | 52000 | 4800 | 12000 | 16500 | 23500 |
| graduation | 31687.34 | 25393.46 | 200000 | 6800 | 18500 | 26000 | 35000 |
| PG | 44000 | 27475.44 | 120000 | 13500 | 27000 | 33000 | 58500 |

**Table 5.50 A: HH consumption expenditure: Education: Urban**

| Education (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 15924.66 | 5627.037 | 32000 | 6000 | 12000 | 15000 | 19000 |
| 10-12 | 19219.51 | 9920.504 | 52000 | 7000 | 12000 | 16500 | 23000 |
| graduation | 31714.49 | 25594.02 | 200000 | 6800 | 14000 | 19000 | 26000 |
| PG | 44000 | 27475.44 | 120000 | 13500 | 27000 | 33000 | 58500 |

**Table 5.51 A: HH consumption expenditure: Education: Rural**

| Education (Rural) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 15005.21 | 6241.919 | 35000 | 4500 | 9800 | 15000 | 19000 |
| 10-12 | 18942.59 | 9898.82 | 48000 | 4800 | 12000 | 17000 | 25000 |
| graduation | 31500 | 25281.75 | 78000 | 7000 | 14000 | 19500 | 58000 |
| PG | - | - | - | - | - | - | - |

**Table 5.52 A: HH consumption expenditure: Religion**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 21424.39 | 17510.3 | 200000 | 4500 | 13000 | 18000 | 25000 |
| Muslim | 19204.71 | 10789.3 | 56000 | 5000 | 11000 | 16500 | 26000 |
| Others | 22428.57 | 15178.73 | 58000 | 7000 | 14000 | 17000 | 28000 |

**Table 5.53 A: HH consumption expenditure: Religion: Urban**

| Education (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 23806.94 | 20514.9 | 200000 | 6000 | 14000 | 18000 | 27000 |
| Muslim | 21993.88 | 11936.28 | 56000 | 6000 | 13500 | 19000 | 27500 |
| Others | 24138.89 | 15005.69 | 58000 | 7000 | 15000 | 18250 | 34000 |

**Table 5.54 A: HH consumption expenditure: Religion: Rural**

| Education (Rural) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 17808.77 | 10655.33 | 78000 | 4500 | 12000 | 16000 | 20000 |
| Muslim | 15408.33 | 7633.661 | 35000 | 5000 | 9500 | 14500 | 19000 |
| Others | 19350 | 15794.88 | 58000 | 7000 | 8000 | 15000 | 24000 |

**Table 5.55 A: HH consumption expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 21532.19 | 17359.8 | 200000 | 5000 | 12000 | 18000 | 25000 |
| SC | 20358.06 | 16983.9 | 120000 | 5500 | 12000 | 16000 | 21000 |
| ST | 17142.31 | 15436.82 | 75000 | 4500 | 8000 | 14250 | 19000 |
| OBC | 21320.25 | 11388.7 | 76000 | 6800 | 15000 | 18000 | 27000 |

**Table 5.56 A: HH consumption expenditure: Social Group: Urban**

| Education SS Group (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 23178.21 | 19172.02 | 200000 | 6000 | 14000 | 18500 | 27000 |
| SC | 24127.59 | 22454.5 | 120000 | 7800 | 13000 | 16000 | 26000 |
| ST | 28500 | 25450.93 | 75000 | 6000 | 12000 | 16000 | 52000 |
| OBC | 23245.83 | 13052.71 | 76000 | 6800 | 15250 | 18000 | 28000 |

**Table 5.57 A: HH consumption expenditure: Social Group: Rural**

| SS Group (Rural) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 18197.4 | 12388.65 | 78000 | 5000 | 10000 | 16000 | 21000 |
| SC | 17045.45 | 9191.81 | 46000 | 5500 | 10000 | 16000 | 20000 |
| ST | 12957.89 | 6811.862 | 25000 | 4500 | 5300 | 12000 | 18000 |
| OBC | 18338.71 | 7428.983 | 35000 | 7000 | 14000 | 17500 | 24000 |

**Table 5.58 A: HH consumption expenditure: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 19350.66 | 11602.08 | 78000 | 4800 | 12000 | 17000 | 24000 |
| Bengali | 24357.33 | 26602.43 | 200000 | 7000 | 12000 | 18000 | 26000 |
| Hindi | 22158.54 | 14145.1 | 78000 | 7200 | 13500 | 18000 | 27000 |
| Others | 22478.95 | 14414.78 | 66000 | 4500 | 12000 | 19000 | 27500 |

**Table 5.59 A: HH consumption expenditure:  Social Group: Urban**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 21226.85 | 12581.71 | 76000 | 6000 | 13500 | 18000 | 26000 |
| Bengali | 28371.15 | 30894.23 | 200000 | 7000 | 15000 | 20000 | 27000 |
| Hindi | 22387.5 | 14248.19 | 78000 | 7200 | 13750 | 18000 | 29000 |
| Others | 24187.5 | 14139.73 | 66000 | 6000 | 15000 | 20000 | 27500 |

**Table 5.60 A: HH consumption expenditure:  Linguistic Group: Rural**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 17647.9 | 10398.1 | 78000 | 4800 | 11000 | 16000 | 20000 |
| Bengali | 15282.61 | 6605.965 | 32000 | 7000 | 9500 | 15000 | 21000 |
| Hindi | 13000 | - | 13000 | 13000 | 13000 | 13000 | 13000 |
| Others | 18458.82 | 14678.13 | 58000 | 4500 | 9800 | 14000 | 21000 |

**Table 5.61 A: HH consumption expenditure: Residence**

| Residence | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Urban | 23461.67 | 18656.77 | 200000 | 6000 | 14000 | 18000 | 27000 |
| Rural | 17365 | 10435.22 | 78000 | 4500 | 10000 | 16000 | 20000 |

**Table 5.62 A: HH Food: Gender**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Male | 9917.20 | 4802.23 | 34877.5 | 2899 | 6416 | 8535 | 12552.5 |
| Female | 7757.80 | 4216.59 | 16642.5 | 2643 | 5031.5 | 6286.5 | 9770 |

**Table 5.63A: HH Food: Gender (Urban)**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Male (Urban) | 10170.69 | 5002.65 | 34877.5 | 3685 | 6575 | 8991.5 | 12693.25 |
| Female (Urban) | 8314.11 | 4300.64 | 16642.5 | 3802 | 5090.6 | 6691 | 12927 |

**Table 5.64A: HH Food expenditure: Gender (Rural)**

| HH Head | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Male (Urban) | 9528.17 | 4466.309 | 27724 | 2899 | 6245 | 8206.75 | 24134 |
| Female (Urban) | 7097.18 | 4153.13 | 15396.5 | 2643 | 4164.5 | 5760.5 | 8783.75 |

**Table 5.65A: HH Food expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 7588.36 | 3665.92 | 22475 | 2643 | 5154 | 6322 | 8519 |
| 4 | 9502.36 | 3715.16 | 34877.5 | 2899 | 7093 | 8874.25 | 10706 |
| >=5 | 8582.173 | 3808.067 | 34877.5 | 2643 | 5983.25 | 7691 | 10481.5 |

**Table 5.66 A: HH Food expenditure: Gender (Urban)**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 11385.63 | 5152.37 | 34877.5 | 3685 | 7738 | 10299.5 | 13750 |
| 4 | 9849.34 | 4027.21 | 34877.5 | 3685 | 7243.5 | 9036.5 | 11319 |
| >=5 | 14284.3 | 5798.15 | 28764 | 5637 | 9965 | 14365 | 16937.5 |

**Table 5.67A: HH Food expenditure: Gender (Rural)**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 7532.79 | 3854.227 | 19753 | 2643 | 4996 | 6118 | 9770 |
| 4 | 8942.72 | 3097.07 | 17996 | 2899 | 7028 | 8467 | 10488 |
| >=5 | 13045.65 | 5408.564 | 27724 | 5781.5 | 7848.8 | 13698 | 16460 |

**Table 5.68A: HH Food expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 8067.305 | 3682.38 | 22475 | 2643 | 5504 | 6892 | 10299.5 |
| 3 | 9562.843 | 3551.236 | 18109 | 3802 | 6741.1 | 8394.75 | 12652.5 |
| >=4 | 12978.51 | 5965.01 | 34877.5 | 3649.95 | 8350 | 11340 | 15482 |

**Table 5.69A: HH Food expenditure: No of Adults (Urban)**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 8270.92 | 3688.20 | 22475 | 3685 | 5813.5 | 7056.375 | 10302.5 |
| 3 | 9530.64 | 3431.28 | 18109 | 3802 | 6741.1 | 8499 | 12154 |
| >=4 | 13884.97 | 6375.2 | 34877.5 | 4539.95 | 9064 | 12805 | 16918 |

**Table 5.70A: HH Food expenditure: No of Adults (Rural)**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 7790.79 | 3679.21 | 19753 | 2643 | 5198 | 6560 | 10087 |
| 3 | 9628.15 | 3834.064 | 17996 | 4646 | 6575 | 8058 | 13175.5 |
| >=4 | 11763.03 | 5190.54 | 27724 | 3649.95 | 7966.9 | 10527 | 14623 |

**Table 5.71A: HH Food expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 8873.925 | 5119.3 | 34877.5 | 2932 | 5167 | 7432.5 | 10621 |
| 1 | 9502.647 | 4440.93 | 26173 | 2643 | 6326 | 7848.8 | 11946 |
| >=2 | 11065.93 | 4667.68 | 28407 | 2899 | 7711.25 | 10324.25 | 13755 |

**Table 5.72A: HH Food expenditure: No of Children urban**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 9102.209 | 5569.07 | 34877.5 | 3802 | 5605 | 7432.5 | 10919 |
| 1 | 9817.724 | 4473.13 | 26173 | 3711.75 | 6460 | 8394.75 | 12423.63 |
| >=2 | 11386.1 | 4867.611 | 28407 | 3685 | 7807 | 10637 | 14365 |

**Table 5.73A: HH Food expenditure: No of Children rural**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 8592.646 | 4538.21 | 24134 | 2932 | 5021.25 | 7483 | 10606.25 |
| 1 | 8925.89 | 4359.934 | 21918 | 2643 | 6112 | 7057 | 11389 |
| >=2 | 10617.7 | 4386.79 | 27724 | 2899 | 7415 | 10048 | 13698 |

**Table 5.74A: HH Food expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 9053.076 | 3797.94 | 21536.5 | 2643 | 6326 | 8343.5 | 10637 |
| 10-12 | 9260.739 | 4632.24 | 26173 | 3839.5 | 6114 | 7623 | 11318.5 |
| graduation | 11368.34 | 6019.01 | 34877.5 | 3649.95 | 7057 | 10330 | 14365 |
| PG | 12735.91 | 5988.36 | 28407 | 5486 | 7527.5 | 13642.25 | 15393 |

**Table 5.75A: HH Food expenditure: Education: Urban**

| Education (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 9229.347 | 3923.80 | 21536.5 | 3685 | 6372 | 8499 | 10551 |
| 10-12 | 8984.321 | 4313.083 | 26173 | 3839.5 | 6244 | 7792 | 10980 |
| graduation | 11470.43 | 5877.48 | 34877.5 | 4175 | 7161.5 | 10903 | 14365 |
| PG | 12735.91 | 5988.368 | 28407 | 5486 | 7527.5 | 13642.25 | 15393 |

**Table 5.76A: HH Food expenditure: Education: Rural**

| Education (Rural) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 8919.036 | 3714.521 | 17996 | 2643 | 6073.5 | 8062.5 | 10784.5 |
| 10-12 | 9680.485 | 5091.967 | 24134 | 3940 | 5963.5 | 7311.75 | 13203.25 |
| graduation | 10663.87 | 7234.897 | 27724 | 3649.95 | 5973 | 8178.9 | 14000 |
| PG | - | - | - | - | - | - | - |

**Table 5.77A: HH Food expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 9915.653 | 4978.68 | 34877.5 | 2643 | 6335 | 8458 | 12912 |
| Muslim | 9486.03 | 4312.859 | 26173 | 2899 | 6278.25 | 8317 | 11675 |
| Others | 8542.802 | 4045.05 | 17648 | 4099.95 | 4862.25 | 7081.75 | 10699 |

**Table 5.78A: HH Food expenditure: Religion: Urban**

| Religion (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 9917.598 | 5070.69 | 34877.5 | 3711.75 | 6372 | 8357 | 12403 |
| Muslim | 10726.6 | 4821.86 | 26173 | 3685 | 7109 | 9960 | 13068 |
| Others | 9129.944 | 4338.93 | 17648 | 4175 | 6197.5 | 7081.75 | 11765 |

**Table 5.79A: HH Food expenditure: Religion: Rural**

| Religion(Rural) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 9912.70 | 4857.88 | 27724 | 2643 | 6261 | 8612 | 13203.25 |
| Muslim | 7797.36 | 2769.03 | 14243.5 | 2899 | 5854 | 7265.5 | 9563.5 |
| Others | 7485.94 | 3405.30 | 14498.5 | 4099.95 | 4600 | 7231.25 | 9700 |

**Table 5.80A: HH Food expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 9583.461 | 4757.55 | 28764 | 2899 | 6260 | 8087.5 | 11765 |
| SC | 8585.89 | 3915.29 | 19333 | 3106 | 5740 | 7244.25 | 10903 |
| ST | 9747.731 | 6941.78 | 34877.5 | 2643 | 4621.75 | 8374.5 | 11483 |
| OBC | 11045.45 | 4434.67 | 22475 | 3649.95 | 7306 | 10475 | 13698 |

**Table 5.81A: HH Food expenditure: Social Group: Urban**

| SS Group (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 9811.40 | 4798.13 | 28764 | 3685 | 6330.5 | 8343.75 | 12376.5 |
| SC | 8140.345 | 3856.02 | 17670 | 3802 | 5740 | 7014 | 10213.5 |
| ST | 13966.86 | 10731.89 | 34877.5 | 4013 | 4364.25 | 11483 | 18345.25 |
| OBC | 11276.53 | 4446.36 | 22475 | 4539.95 | 8153.75 | 10448 | 13494.5 |

**Table 5.82A: HH Food expenditure: Social Group: Rural**

| SS Group (Rural) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 9121.646 | 4671.03 | 27724 | 2899 | 5918 | 7797.5 | 10488 |
| SC | 8977.43 | 3984.18 | 19333 | 3106 | 6261 | 7358 | 11340 |
| ST | 8193.316 | 4366.247 | 19044 | 2643 | 4621.75 | 7352 | 10373 |
| OBC | 10687.65 | 4465.592 | 19800 | 3649.95 | 6531 | 10591.5 | 19800 |

**Table 5.83A: HH Food expenditure: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 9494.353 | 4710.137 | 34877.5 | 2899 | 6229 | 8067 | 12556.5 |
| Bengali | 9856.388 | 4352.43 | 21312 | 3649.95 | 6502 | 9064 | 12927 |
| Hindi | 10555.13 | 5326.045 | 28764 | 4175 | 6934 | 9739.5 | 12552.5 |
| Others | 9896.421 | 5268.041 | 28407 | 2643 | 6416 | 8518 | 11758.6 |

**Table 5.84A: HH Food expenditure: Social Group: Urban**

| Linguistic Group (urban) | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 9366.535 | 4669.36 | 34877.5 | 3711.75 | 6282.375 | 8043.65 | 11428.25 |
| Bengali | 10749.15 | 4663.75 | 21312 | 3839.5 | 6706.5 | 9419.75 | 14057.25 |
| Hindi | 10567.81 | 5393.26 | 28764 | 4175 | 6754.5 | 9370.75 | 12921.25 |
| Others | | | | | | | |

**Table 5.85A: HH Food expenditure: Linguistic Group: Rural**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 9610.35 | 4763.57 | 27724 | 2899 | 5973 | 8067 | 13024 |
| Bengali | 7837.972 | 2674.80 | 14498.5 | 3649.95 | 5781.5 | 7225.5 | 14498.5 |
| Hindi | 10048 | - | 10048 | 10048 | 10048 | 10048 | 10048 |
| Others | 10310.93 | 5623.458 | 28407 | 3685 | 6441.75 | 8754.75 | 12084 |

### Table 5.86A: HH Food expenditure: Residence

| Residence | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Urban | 10023.71 | 4968.126 | 34877.5 | 3685 | 6389.75 | 8518.5 | 12749.13 |
| Rural | 9285.078 | 4483.638 | 27724 | 2643 | 5968.25 | 7987.5 | 11532 |

## Item-wise Expenditure

### Table 5.87A: Gender and Commodity Expenditures

| **Item Head** | Mean (M) | Mean (F) | Min (M) | Min (F) | Max (M) | Max (F) | Q2 (M) | Q2 ( F) |
|---|---|---|---|---|---|---|---|---|
| Cereal | 1514.18 | 1047.086 | 222 | 47 | 5400 | 3240 | 1320 | 825 |
| Pulse | 283.548 | 287.828 | 20 | 56 | 1326 | 874 | 250 | 210 |
| Salt | 25.103 | 17.645 | 2 | 2.6 | 108 | 32 | 21 | 17 |
| Sugar | 159.90 | 126.1 | 20 | 21 | 900 | 330 | 126 | 88 |
| Spices | 225.83 | 159.6 | 10 | 30 | 600 | 1452 | 200 | 287.5 |
| Oil | 504.493 | 474.17 | 0 | 115 | 2750 | 350 | 385 | 140 |
| Milk | 1114.19 | 935.085 | 0 | 0 | 3600 | 3000 | 1040 | 520 |
| EFM | 2504.98 | 1808.57 | 0 | 200 | 13000 | 5500 | 2100 | 1500 |
| Veg | 1489.09 | 1351.42 | 0 | 140 | 5000 | 4100 | 1100 | 840 |
| Fruit | 623.24 | 538.571 | 0 | 100 | 3200 | 1900 | 450 | 370 |
| PTI | 919.58 | 320.142 | 0 | 0 | 20000 | 1500 | 400 | 290 |
| Bev | 559.93 | 691.571 | 0 | 20 | 3200 | 2800 | 300 | 400 |

### Table 5.88A: Cereal Expenditure: Family Size

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 976.773 | 614.899 | 47 | 3162 | 525 | 815 | 1320 |
| 4 | 1406.77 | 634.45 | 3913 | 420 | 969 | 1251 | 1710 |
| >=5 | 2442.18 | 890.91 | 5400 | 598 | 1824 | 2244 | 2993 |

### Table 5.89A: Pulse Expenditure: Family Size

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 259.248 | 143.93 | 720 | 20 | 160 | 222.5 | 355 |
| 4 | 301.55 | 161.43 | 1000 | 76 | 190 | 258.1 | 400 |
| >=5 | 293.52 | 217.70 | 1326 | 66 | 140 | 240 | 402.5 |

**Table 5.90A: Salt Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 20.13 | 15.254 | 108 | 2 | 9 | 13 | 16 |
| 4 | 26.071 | 15.717 | 7 | 90 | 16 | 22.5 | 30 |
| >=5 | 28.817 | 11.25 | 80 | 8 | 22.5 | 30 | 32 |

**Table 5.91A: Sugar Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 132.838 | 97.301 | 385 | 20 | 63 | 92 | 174 |
| 4 | 138.998 | 81.48 | 400 | 24.8 | 66 | 120 | 186 |
| >=5 | 231.07 | 188.66 | 900 | 49.6 | 145.5 | 168 | 254 |

**Table 5.92A: Oil Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 369.003 | 294.96 | 2750 | 0 | 210 | 256 | 550 |
| 4 | 484.595 | 312.80 | 1452 | 115 | 242 | 245 | 605 |
| >=5 | 760.011 | 445.33 | 1800 | 112 | 450 | 660 | 1050 |

**Table 5.93A: Milk Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 811.93 | 606.41 | 3000 | 0 | 390 | 750 | 1100 |
| 4 | 1169.4 | 645.995 | 3200 | 0 | 750 | 1200 | 1500 |
| >=5 | 1456.44 | 1138.774 | 3600 | 0 | 250 | 1500 | 2250 |

**Table 5.94A: EFM Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 1694.86 | 1892.58 | 10000 | 0 | 320 | 1000 | 2400 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | 2269.32 | 1478.69 | 8000 | 0 | 1000 | 2300 | 3200 |
| >=5 | 4042.72 | 2955.961 | 13000 | 0 | 2000 | 4000 | 5750 |

**Table 5.95A: Spice Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 179.333 | 124.38 | 520 | 10 | 98 | 145 | 300 |
| 4 | 221.75 | 111.98 | 520 | 30 | 105 | 220 | 300 |
| >=5 | 286.25 | 151.45 | 600 | 40 | 195 | 250 | 355 |

**Table 5.96A:Vegetable Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 1451.2 | 1139.419 | 5000 | 0 | 700 | 1000 | 2000 |
| 4 | 1306.852 | 931.519 | 4500 | 80 | 700 | 990 | 1800 |
| >=5 | 1834.43 | 1234.005 | 4500 | 0 | 840 | 1640 | 2550 |

**Table 5.97A:Fruit Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 522.233 | 491.17 | 1900 | 0 | 200 | 370 | 640 |
| 4 | 644.382 | 544.924 | 3200 | 0 | 250 | 500 | 1000 |
| >=5 | 722.840 | 583.873 | 2200 | 0 | 250 | 575 | 1200 |

**Table 5.98A:PTI Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 707.56 | 1150.37 | 8750 | 0 | 100 | 300 | 1000 |
| 4 | 1021.72 | 1888.92 | 20000 | 0 | 200 | 405 | 1000 |
| >=5 | 854.54 | 1550.50 | 12500 | 0 | 290 | 355 | 950 |

**Table 5.99A:Beverages Expenditure: Family Size**

| Family Size | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=3 | 463.23 | 546.88 | 3200 | 0 | 140 | 300 | 590 |
| 4 | 510.86 | 637.620 | 3000 | 0 | 150 | 300 | 650 |
| >=5 | 867.44 | 925.698 | 3200 | 85 | 285 | 425 | 1325 |

**100**

**Table 5.100 A: Cereal Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 925.780 | 544.50 | 3120 | 47 | 532 | 820 | 1220 |
| 3 | 1574.32 | 605.112 | 3913 | 550 | 1176 | 1392 | 1881 |
| >=4 | 2384.69 | 839.18 | 5400 | 1050 | 1750 | 2220 | 2916 |

**Table 5.101 A: Pulse Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 286.452 | 154.35 | 1000 | 20 | 176 | 252 | 357 |
| 3 | 286.40 | 181.49 | 1120 | 52.5 | 133 | 242 | 422.5 |
| >=4 | 276.67 | 186.90 | 1326 | 66 | 147 | 228 | 360 |

**Table 5.102 A: Sugar Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 128.727 | 88.774 | 385 | 24.5 | 61.5 | 96 | 174 |
| 3 | 26.1028 | 16.609 | 108 | 2 | 16.5 | 24 | 30 |
| >=4 | 222.953 | 171.92 | 900 | 63 | 147 | 180 | 240 |

**Table 5.103 A: Salt Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 20.35 | 12.9590 | 96 | 2 | 15 | 16 | 24 |
| 3 | 143.64 | 100.82 | 400 | 20 | 67.5 | 100 | 180 |
| >=4 | 30.35 | 14.815 | 85 | 8 | 22.5 | 28 | 36 |

**Table 5.104 A: Oil Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 388.400 | 307.69 | 2750 | 0 | 220 | 287.5 | 550 |
| 3 | 507.523 | 328.69 | 1495 | 112 | 230 | 438.75 | 605 |
| >=4 | 706.34 | 425.07 | 1800 | 180 | 345 | 605 | 880 |

**Table 5.105 A: Milk Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 963.0131 | 678.90 | 3000 | 0 | 450 | 900 | 1440 |
| 3 | 1174.65 | 760.41 | 3200 | 0 | 690 | 1100 | 1560 |
| >=4 | 1271.45 | 1008.4 | 3600 | 0 | 250 | 1300 | 1800 |

**Table 5.106 A: EFM Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 1846.85 | 1858.58 | 10000 | 0 | 360 | 1200 | 3000 |
| 3 | 2397.35 | 1629.08 | 6500 | 0 | 1000 | 2300 | 3600 |
| >=4 | 3599.515 | 2833.81 | 13000 | 200 | 1680 | 3000 | 4350 |

**Table 5.107 A: Spice Expenditure: No of Adults**

| | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 172.27 | 115.65 | 520 | 10 | 80 | 150 | 250 |
| 3 | 232.122 | 120.348 | 520 | 25 | 150 | 210 | 300 |
| >=4 | 296.16 | 134.46 | 600 | 50 | 200 | 270 | 350 |

**Table 5.108 A: Vegetables Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 1423.40 | 1067.11 | 5000 | 0 | 700 | 1000 | 2000 |
| 3 | 1351.22 | 986.38 | 4500 | 120 | 700 | 1000 | 1800 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| >=4 | 1706.01 | 1234.76 | 4500 | 0 | 840 | 1200 | 2500 |

**Table 5.109 A: Fruit Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 606.727 | 553.08 | 2000 | 0 | 200 | 400 | 1000 |
| 3 | 628.207 | 548.353 | 3200 | 0 | 250 | 500 | 700 |
| >=4 | 620 | 506.218 | 2200 | 0 | 250 | 480 | 900 |

**Table 5.110 A: PTI Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 853.717 | 1280.39 | 8750 | 0 | 100 | 390 | 1000 |
| 3 | 716.462 | 927.63 | 6400 | 0 | 200 | 400 | 800 |
| >=4 | 1047.08 | 2386.39 | 20000 | 0 | 230 | 300 | 1000 |

**Table 5.111 A: Beverages Expenditure: No of Adults**

| No of Adults | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=2 | 451.596 | 517.316 | 3200 | 0 | 120 | 300 | 600 |
| 3 | 524.811 | 659.70 | 2800 | 0 | 150 | 300 | 560 |
| >=4 | 841.699 | 926.68 | 3200 | 0 | 260 | 450 | 1200 |

**Table 5.112 A: Cereal Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 1354.344 | 905.55 | 4144 | 47 | 525 | 1305 | 1925 |
| 1 | 1522.52 | 828.146 | 4275 | 342 | 897 | 1305 | 1856 |
| >=2 | 1534.91 | 929.23 | 5400 | 420 | 888 | 1200 | 2020 |

**Table 5.113 A: Pulse Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 268.90 | 145.44 | 720 | 20 | 160 | 228 | 360 |
| 1 | 256.84 | 150.12 | 874 | 66 | 143 | 225 | 336 |
| >=2 | 343.174 | 208.74 | 1326 | 114 | 200 | 295 | 450 |

**Table 5.114 A: Sugar Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 161.71 | 149.695 | 900 | 20 | 66 | 120 | 220 |
| 1 | 154.446 | 87.37 | 400 | 30 | 84 | 126 | 200 |
| >=2 | 155.28 | 141.71 | 900 | 24.8 | 63 | 120 | 186.75 |

**Table 5.115 A: Salt Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 24.42 | 18.631 | 108 | 2 | 15 | 18 | 30 |
| 1 | 23.898 | 13.27 | 90 | 2 | 15 | 24 | 30 |
| >=2 | 25.3351 | 12.949 | 85 | 10 | 16 | 22.5 | 30 |

**Table 5.116 A: Oil Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 400.124 | 266.708 | 1320 | 57.5 | 220 | 315 | 550 |
| 1 | 554.826 | 425.33 | 2750 | 0 | 240 | 460 | 690 |
| >=2 | 537.63 | 358.85 | 1560 | 112 | 240 | 385 | 660 |

**Table 5.117 A: Milk Expenditure: No of Children**

| No of | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|

| Children | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 899.724 | 649.53 | 3000 | 0 | 416 | 975 | 1500 |
| 1 | 1019.45 | 734.783 | 3200 | 0 | 500 | 900 | 1500 |
| >=2 | 1450.88 | 956.4227 | 3600 | 0 | 780 | 1425 | 2100 |

**Table 5.118 A: EFM Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 2122.64 | 2262.26 | 10000 | 0 | 400 | 1200 | 3200 |
| 1 | 2343.29 | 2177.19 | 13000 | 0 | 900 | 2000 | 3000 |
| >=2 | 2971.85 | 2148.20 | 10000 | 0 | 1200 | 3000 | 4050 |

**Table 5.119 A: Spices Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 197.92 | 136.759 | 600 | 10 | 98 | 150 | 300 |
| 1 | 248.64 | 127.44 | 600 | 20 | 100 | 150 | 250 |
| >=2 | 201.38 | 126.191 | 520 | 30 | 90 | 200 | 260 |

**Table 5.120 A: Vegetable Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 1418.08 | 1079.07 | 4500 | 0 | 700 | 980 | 2000 |
| 1 | 1500.65 | 1187.75 | 5000 | 0 | 700 | 1000 | 2200 |
| >=2 | 1508.79 | 978.50 | 4500 | 80 | 750 | 1380 | 2000 |

**Table 5.121 A: Fruit Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 515 | 446.92 | 1800 | 0 | 200 | 370 | 740 |
| 1 | 623.113 | 551.21 | 3200 | 0 | 240 | 470 | 900 |
| >=2 | 721.296 | 597.35 | 2200 | 0 | 285 | 500 | 1200 |

**Table 5.122 A: PTI Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 989.64 | 2130.732 | 20000 | 0 | 150 | 400 | 1200 |
| 1 | 634.431 | 891.26 | 6400 | 0 | 200 | 300 | 600 |
| >=2 | 1085.185 | 1610.758 | 12500 | 0 | 200 | 680 | 1200 |

**Table 5.123 A: Beverages Expenditure: No of Children**

| No of Children | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| 0 | 541.56 | 626.45 | 3200 | 0 | 180 | 350 | 600 |
| 1 | 620.50 | 809.880 | 3200 | 0 | 150 | 300 | 600 |
| >=2 | 530.18 | 583.19 | 3200 | 0 | 200 | 350 | 600 |

**Table 5.124 A: Cereal expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 1437.041 | 813.6291 | 3840 | 47 | 800 | 1275 | 3240 |
| 10-12 | 1367.32 | 877.14 | 4200 | 225 | 702 | 1220 | 1817.5 |
| graduation | 1673.64 | 963.42 | 5400 | 222 | 1000 | 1449 | 2160 |
| PG | 1768.25 | 1055.53 | 4275 | 315 | 1172 | 1442.5 | 1966.5 |

**Table 5.125 A: Pulse expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 274.494 | 169.70 | 1120 | 52.5 | 152 | 240 | 360 |
| 10-12 | 291.59 | 162.94 | 874 | 52.5 | 165.25 | 252 | 408 |
| graduation | 292.93 | 185.51 | 1326 | 20 | 175 | 253.8 | 371 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PG | 273.84 | 166.92 | 675 | 100 | 138.25 | 223.25 | 345.5 |

**Table 5.126 A: Salt expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 26.025 | 18.609 | 108 | 2 | 15 | 20 | 30 |
| 10-12 | 23.724 | 12.9903 | 96 | 2 | 15.5 | 21 | 30 |
| graduation | 21.83 | 8.484 | 48 | 7.5 | 15 | 21 | 28 |
| PG | 26.906 | 13.294 | 51 | 10 | 15 | 27 | 36 |

**Table 5.127 A: Sugar expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 136.04 | 84.575 | 400 | 20 | 77.5 | 110 | 180 |
| 10-12 | 164.44 | 134.55 | 900 | 30 | 80 | 125.5 | 207 |
| graduation | 183.46 | 170.747 | 900 | 24.8 | 80 | 135 | 228 |
| PG | 183 | 93.65 | 300 | 40.5 | 91 | 214.5 | 216 |

**Table 5.128 A: Oil expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 502.902 | 393.07 | 2750 | 0 | 230 | 345 | 600 |
| 10-12 | 451.91 | 349.714 | 1740 | 100 | 222 | 307.5 | 575 |
| graduation | 558.07 | 336.60 | 1650 | 112 | 287.5 | 517.5 | 770 |
| PG | 637.3 | 395.1 | 1380 | 57.5 | 277.5 | 602.5 | 908 |

**Table 5.129 A: Milk expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 1130.61 | 755.43 | 3120 | 0 | 750 | 1040 | 1500 |
| 10-12 | 1016.48 | 812.22 | 3600 | 0 | 363 | 900 | 1500 |
| graduation | 1160.34 | 908.86 | 3600 | 0 | 450 | 1040 | 1560 |
| PG | 1151.5 | 748.6 | 2340 | 50 | 400 | 1500 | 1665 |

**Table 5.130 A: EFM expenditure:  Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 2324.7 | 1928.54 | 10000 | 0 | 560 | 2200 | 3300 |
| 10-12 | 2507.5 | 2422.47 | 13000 | 0 | 835 | 1935 | 3200 |
| graduation | 2597.21 | 2494.08 | 10000 | 0 | 700 | 2000 | 4100 |
| PG | 2408.12 | 1877.3 | 6450 | 300 | 820 | 2150 | 3250 |

**Table 5.131 A: Spice expenditure:  Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 221.065 | 139.03 | 600 | 20 | 100 | 210 | 329 |
| 10-12 | 202.38 | 127.825 | 600 | 10 | 100 | 200 | 285 |
| graduation | 237.341 | 123.33 | 600 | 35 | 150 | 210 | 300 |
| PG | 273.75 | 116.15 | 500 | 100 | 200 | 260 | 340 |

**Table 5.132 A: Vegetable expenditure:  Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 1216.15 | 921.87 | 5000 | 0 | 600 | 930 | 1600 |
| 10-12 | 1492.2 | 1060.10 | 4500 | 0 | 700 | 1200 | 2000 |
| graduation | 1882.6 | 1317.1 | 5000 | 300 | 800 | 1600 | 3000 |
| PG | 2100.62 | 1186.06 | 4100 | 400 | 915 | 2500 | 3100 |

**Table 5.133 A: Fruit expenditure:  Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 535.50 | 473.659 | 200 | 0 | 200 | 370 | 740 |
| 10-12 | 593.34 | 463.155 | 200 | 0 | 250 | 490 | 790 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| graduation | 773.92 | 705.54 | 320 | 0 | 250 | 600 | 1200 |
| PG | 875 | 641.87 | 1800 | 100 | | | |

**Table 5.134 A: PTI expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 717.218 | 939.02 | 520 | 0 | 150 | 320 | 950 |
| 10-12 | 605.220 | 987.54 | 875 | 0 | 100 | 300 | 600 |
| graduation | 1378.16 | 2520.2 | 2000 | 0 | 230 | 600 | 2000 |
| PG | 2153.75 | 3194.17 | 12500 | 0 | 250 | 850 | 1475 |

**Table 5.135 A: Beverages expenditure: Education**

| Education | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| <=10 | 531.21 | 638.30 | 320 | 0 | 150 | 320 | 600 |
| 10-12 | 563.051 | 734.613 | 320 | 0 | 150 | 300 | 600 |
| graduation | 608.73 | 700.33 | 320 | 0 | 200 | 350 | 650 |
| PG | 883.75 | 935.25 | 3000 | 120 | 300 | 1000 | 2450 |

**Table 5.136 A: Cereal Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 1520.65 | 919.19 | 5400 | 47 | 825 | 1305 | 2088 |
| Muslim | 1375.84 | 766.830 | 4200 | 222 | 810 | 1275 | 1800 |
| Others | 1283.92 | 793.75 | 3913 | 335 | 706.5 | 1179.5 | 1548 |

**Table 5.137 A: Pulses Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 284.43 | 161.71 | 1120 | 20 | 160 | 240 | 396 |
| Muslim | 268.67 | 175.45 | 1326 | 66 | 152 | 240 | 336 |
| Others | 324.98 | 229.64 | 1000 | 80 | 166.5 | 28. | 371 |

**Table 5.138 A: Sugar Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 164.034 | 136.94 | 900 | 20 | 80 | 123 | 200 |
| Muslim | 140.035 | 85.60 | 400 | 24.8 | 66 | 120 | 186 |
| Others | 135.616 | 78.95 | 330 | 41 | 68.75 | 113.625 | 193.5 |

**Table 5.139 A: Salt Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 24.903 | 16.0134 | 108 | 2 | 15 | 21 | 30 |
| Muslim | 23.047 | 11.74 | 85 | 8 | 15 | 22.5 | 27 |
| Others | 24.071 | 13.882 | 75 | 9 | 15.5 | 18 | 27.75 |

**Table 5.140 A: Oil Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 517.10 | 370.99 | 2750 | 100 | 240 | 402.5 | 660 |
| Muslim | 460.88 | 366.389 | 1740 | 57.5 | 220 | 299 | 575 |
| Others | 469.73 | 367.86 | 1680 | 0 | 287.5 | 337.5 | 602.5 |

**Table 5.141 A: Milk Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 1088.42 | 808.147 | 3600 | 0 | 500 | 1000 | 1500 |
| Muslim | 1128.48 | 781.56 | 3380 | 0 | 450 | 1040 | 1500 |
| Others | 1111.10 | 881.96 | 3120 | 0 | 450 | 1040 | 1299 |

**Table 5.142 A: EFM Expenditure:  Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 2345.36 | 2222.13 | 10000 | 0 | 560 | 2000 | 3200 |
| Muslim | 2957.52 | 2151.87 | 13000 | 0 | 1400 | 2470 | 4200 |
| Others | 1896.78 | 2153.007 | 6450 | 0 | 280 | 950 | 2500 |

**Table 5.143 A: Spices Expenditure:  Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 209.16 | 130.815 | 600 | 10 | 100 | 200 | 300 |
| Muslim | 245.29 | 117.97 | 520 | 35 | 180 | 250 | 340 |
| Others | 254.78 | 168.79 | 600 | 30 | 100 | 235 | 350 |

**Table 5.144 A: Vegetable Expenditure:  Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 1535.8 | 1160.1 | 5000 | 0 | 700 | 1200 | 2000 |
| Muslim | 1312.94 | 899.392 | 4100 | 0 | 740 | 1000 | 1700 |
| Others | 1372.5 | 965.77 | 3200 | 350 | 700 | 900 | 2350 |

**Table 5.145 A: Fruit Expenditure:  Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 633.432 | 510.42 | 2200 | 0 | 250 | 500 | 900 |
| Muslim | 580.82 | 627.77 | 3200 | 0 | 200 | 360 | 600 |
| Others | 541.78 | 541.035 | 1800 | 0 | 175 | 300 | 915 |

**Table 5.146 A: PTI Expenditure:  Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 975.59 | 1744.70 | 20000 | 0 | 200 | 410 | 1200 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Muslim | 543.88 | 1003.05 | 6400 | 0 | 0 | 200 | 600 |
| Others | 736.785 | 874.909 | 3200 | 0 | 200 | 360 | 1000 |

**Table 5.147 A: Beverages Expenditure: Religion**

| Religion | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Hindu | 625.47 | 732.43 | 3200 | 20 | 200 | 340 | 600 |
| Muslim | 448.58 | 654.18 | 3200 | 0 | 100 | 250 | 560 |
| Others | 390.714 | 286.85 | 1450 | 120 | 190 | 270 | 570 |

**Table 5.148 A: Cereal expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 1474.74 | 846.98 | 4200 | 222 | 880 | 1320 | 1820 |
| SC | 1325.74 | 735.80 | 2976 | 225 | 800 | 1181 | 1820 |
| ST | 940.96 | 689.374 | 2976 | 220 | 506 | 721 | 1240 |
| OBC | 1760.12 | 1037.44 | 5400 | 47 | 1014 | 1404 | 2565 |

**Table 5.149 A: Pulses expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 291.62 | 186.61 | 1326 | 52.5 | 160 | 250 | 396 |
| SC | 270.17 | 161.41 | 720 | 52.5 | 140 | 230 | 396 |
| ST | 261.78 | 128.82 | 598.5 | 20 | 152 | 255 | 355 |
| OBC | 279.26 | 135.52 | 675 | 56 | 176 | 256.2 | 350 |

**Table 5.150 A: Sugar expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 159.91 | 134.97 | 900 | 30 | 80 | 120 | 200 |
| SC | 151.80 | 127.11 | 900 | 20 | 79.5 | 123 | 198 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ST | 105.96 | 63.35 | 280 | 41 | 61.5 | 82.12 | 130 |
| OBC | 168.99 | 101.51 | 400 | 24.8 | 90 | 157.5 | 200 |

**Table 5.151 A: Salt expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 23.66 | 14.30 | 108 | 2 | 15 | 20 | 30 |
| SC | 26.32 | 20.22 | 108 | 7 | 15 | 21 | 30 |
| ST | 22.80 | 10.01 | 45 | 11.25 | 15 | 18 | 32 |
| OBC | 25.829 | 13.78 | 85 | 2.6 | 16 | 22.5 | 30 |

**Table 5.152 A: Oil expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 503.57 | 379.4 | 2750 | 57.5 | 230 | 345 | 610 |
| SC | 518.572 | 366.3 | 1725 | 112 | 230 | 380 | 660 |
| ST | 303.21 | 224.08 | 1265 | 112 | 200 | 235 | 345 |
| OBC | 548.96 | 366.28 | 1800 | 0 | 287.5 | 525 | 660 |

**Table 5.153 A: Milk expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 1135.67 | 822.98 | 3600 | 0 | 500 | 975 | 1560 |
| SC | 1089.24 | 779.977 | 3200 | 0 | 468 | 1200 | 1500 |
| ST | 1079.42 | 625.63 | 2080 | 0 | 550 | 1120 | 1650 |
| OBC | 1002.53 | 832.94 | 3600 | 0 | 450 | 1000 | 1500 |

**Table 5.154 A: EFM expenditure:  Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 2278.32 | 2184.18 | 13000 | 0 | 500 | 1800 | 3300 |
| SC | 1861.29 | 1689.75 | 9000 | 0 | 560 | 1250 | 2700 |
| ST | 2434.23 | 2223.78 | 10000 | 200 | 560 | 2200 | 3200 |
| OBC | 3393.41 | 2419.75 | 10000 | 100 | 1600 | 3000 | 5000 |

**Table 5.155 A: Spices expenditure:  Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 225.50 | 120.31 | 600 | 10 | 120 | 210 | 300 |
| SC | 177.419 | 118.32 | 600 | 24 | 80 | 150 | 260 |
| ST | 103.19 | 85.45 | 320 | 24 | 50 | 70 | 100 |
| OBC | 275.81 | 153.55 | 520 | 20 | 150 | 260 | 400 |

**Table 5.156 A: Vegetables expenditure:  Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 1586.48 | 1048.53 | 4500 | 0 | 840 | 1200 | 2200 |
| SC | 1236.93 | 1014.41 | 4500 | 90 | 410 | 870 | 2000 |
| ST | 759.615 | 937.1 | 3200 | 80 | 250 | 360 | 840 |
| OBC | 1578.86 | 1247.05 | 5000 | 250 | 700 | 980 | 2200 |

**Table 5.157 A: Fruits expenditure:  Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 617.10 | 544.14 | 2200 | 0 | 200 | 400 | 900 |
| SC | 644.67 | 516.33 | 1900 | 0 | 250 | 470 | 1900 |
| ST | 349.61 | 264.67 | 1020 | 0 | 200 | 265 | 450 |
| OBC | 677.088 | 587.99 | 3200 | 0 | 250 | 500 | 1000 |

**Table 5.158 A: PTI expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 760.27 | 1225.48 | 12500 | 0 | 150 | 360 | 900 |
| SC | 603.38 | 717.75 | 3200 | 0 | 100 | 300 | 700 |
| ST | 2862.69 | 4106.84 | 20000 | 100 | 1200 | 1400 | 2700 |
| OBC | 732.53 | 980.94 | 5200 | 0 | 150 | 290 | 1000 |

**Table 5.159 A: Beverages expenditure: Social Group**

| Social Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Gen | 526.56 | 638.266 | 3200 | 0 | 150 | 300 | 600 |
| SC | 720.96 | 801.80 | 3000 | 20 | 200 | 400 | 840 |
| ST | 524.23 | 652.79 | 3200 | 100 | 250 | 350 | 500 |
| OBC | 602.02 | 786.61 | 3200 | 0 | 160 | 300 | 650 |

**Table 5.160 A: Cereal: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 1443.45 | 912.39 | 5400 | 47 | 792 | 1254 | 1881 |
| Bengali | 1682.82 | 813.71 | 3990 | 525 | 1080 | 1512 | 2244 |
| Hindi | 1471.61 | 847.06 | 4144 | 525 | 924 | 1222 | 1820 |
| Others | 1317.77 | 842.99 | 3774 | 259 | 704 | 1134 | 1708 |

**Table 5.161 A:Pulses: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 268.002 | 139.07 | 720 | 52.5 | 165 | 240 | 350 |
| Bengali | 284.50 | 204.53 | 1326 | 20 | 152 | 236 | 396 |
| Hindi | 298.87 | 208.68 | 1000 | 75 | 138 | 240 | 396 |
| Others | 335.79 | 194.87 | 1120 | 117 | 196 | 308 | 422.5 |

**Table 5.162 A: Sugar: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 155.58 | 125.07 | 900 | 20 | 80 | 120 | 200 |
| Bengali | 166.2 | 98.78 | 450 | 30 | 82.5 | 150 | 252 |
| Hindi | 181.45 | 149.2 | 900 | 40 | 66 | 168 | 220 |
| Others | 132.572 | 132.67 | 900 | 24.8 | 60 | 84.5 | 168 |

**Table 5.163 A: Salt: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 25.411 | 16.85 | 108 | 2 | 15 | 21 | 30 |
| Bengali | 22.65 | 12.66 | 85 | 8 | 15 | 19 | 27 |
| Hindi | 22.51 | 10.39 | 48 | 9 | 15 | 17 | 30 |
| Others | 24.37 | 12.91 | 75 | 9 | 16 | 21 | 27 |

**Table 5.164 A:Oil: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 473.98 | 357.28 | 2750 | 0 | 230 | 345 | 575 |
| Bengali | 555.21 | 370.25 | 1650 | 157.5 | 250 | 440 | 786.5 |
| Hindi | 634.08 | 443.11 | 1800 | 115 | 287.5 | 575 | 840 |
| Others | 447.41 | 338.26 | 1650 | 118 | 220 | 299 | 575 |

**Table 5.165 A:Milk: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 1118.69 | 821.42 | 3600 | 0 | 450 | 1040 | 1560 |
| Bengali | 1095.87 | 789.90 | 3600 | 0 | 750 | 1000 | 1500 |
| Hindi | 1152.80 | 827.89 | 3120 | 0 | 550 | 930 | 1560 |
| Others | 982.63 | 757.72 | 3000 | 0 | 260 | 900 | 1500 |

**Table 5.166 A:EFM:  Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 2449.07 | 2172.10 | 13000 | 0 | 600 | 2100 | 3500 |
| Bengali | 2312.26 | 2009.87 | 9000 | 0 | 560 | 2000 | 3300 |
| Hindi | 2537.80 | 2600.56 | 10000 | 0 | 420 | 1870 | 3300 |
| Others | 2530 | 2398.45 | 10000 | 0 | 870 | 2300 | 3400 |

**Table 5.167 A:Spices:  Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 215.67 | 130.53 | 600 | 20 | 100 | 200 | 300 |
| Bengali | 240.17 | 123.92 | 520 | 10 | 150 | 250 | 340 |
| Hindi | 271.70 | 140.48 | 600 | 35 | 190 | 250 | 350 |
| Others | 173.75 | 127.58 | 520 | 24 | 65 | 150 | 250 |

**Table 5.168 A:Vegetables:  Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 1341.41 | 1044.11 | 5000 | 0 | 600 | 980 | 1900 |
| Bengali | 1488.4 | 966.37 | 4500 | 0 | 850 | 1200 | 2000 |
| Hindi | 1977.56 | 1148.67 | 4500 | 0 | 900 | 2000 | 3000 |
| Others | 1642.28 | 1318.69 | 5000 | 180 | 700 | 1100 | 2200 |

**Table 5.169 A: Fruit:  Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 622.224 | 533.269 | 3200 | 0 | 250 | 450 | 850 |
| Bengali | 580.13 | 463.91 | 1900 | 0 | 250 | 450 | 900 |
| Hindi | 554.87 | 601.26 | 2000 | 0 | 150 | 250 | 600 |
| Others | 681.22 | 608.12 | 2000 | 0 | 200 | 450 | 1050 |

**Table 5.170 A: PTI: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 849.05 | 1668.05 | 20000 | 0 | 150 | 350 | 950 |
| Bengali | 850.8 | 1343.2 | 8100 | 0 | 200 | 340 | 800 |
| Hindi | 793.90 | 1021.62 | 5200 | 0 | 150 | 400 | 1000 |
| Others | 1013.33 | 1807.11 | 12500 | 0 | 100 | 400 | 1290 |

**Table 5.171 A: Beverages: Linguistic Group**

| Linguistic Group | Mean | SD | Max | Min | Q1 | Q2 | Q3 |
|---|---|---|---|---|---|---|---|
| Assamese | 542.88 | 619.78 | 3200 | 0 | 190 | 320 | 600 |
| Bengali | 577.33 | 843.90 | 3200 | 0 | 100 | 270 | 540 |
| Hindi | 657.92 | 744.93 | 3200 | 0 | 210 | 500 | 650 |
| Others | 615.26 | 759.67 | 3200 | 0 | 160 | 300 | 650 |

# Chapter 6

# Consumption Patterns in Kamrup District (Metro & Rural): Demand Systems and Engle Curve Analysis

## 6.1 Introduction

In this chapter, we provide and analyse the results of a household-level survey of Kamrup Districts (both Metro and Rural), Assam, India, conducted during 2018-19. The details and exploratory analysis of the survey are already available in chapter 5. We also investigate the effects of household budgets, demography[85], residence (that is urban and rural) and income status (that is, rich and poor by MPCE class) on demand systems as well as Engle curves by the survey.

Since the chief objective is to analyze food consumption patterns, two different techniques to analyze demand have been used. First, multiple equation demand system estimation (where the data permitted) is used, followed by a single equation model. The difference between urban/rural as well as poor/rich sub-samples was also emphasized (the latter in the case of Engel curve).

## 6.2 Demography and Consumption Pattern Estimation Using LES

We run the regression twice (equation given in Chapter 3),

a) Over the pooled sample of 400 households

b) Over the rural and urban sub-samples separately.

Effects of socio-demographic variables on parameter estimates are an important guide to policymakers to formulate differential food policy for different groups of the society.

### 6.2.1 Variables and Justification

1) Total household expenditure proxies household income. It is surmised that as income increases, committed expenditure will also increase (see Rapper et al, 2002).
2) Higher family size will increase committed expenditure (see Lahiri, 1990)

[85] Such as family size and composition, household-level educational attainment, socio-demographic variables such as caste, religion and linguistic identity)

3) Family composition is taken care of by adding the proportion of children as a variable. The role may be different for different goods. For example, one may think that consumption of sugar or milk (not included in our study) may increase with a higher proportion of children in a family. On the other hand, consumption of many commodities will increase if the proportion of children goes down. (See Rapper et al, ibid)
4) Caste, Religion and Language reflect the caste category ( =1 for general category and 0 for others), religion (=1 for Hindu and 0 for others) and Linguistic category (=1 for Assamese and 0 for others).[86] The reason for including these variables is the following. It is possible that these characteristics represent different availability of resources in society. To what extent this claim is true (at least in our sample) remains to be investigated.
5) Finally, we include the urban/rural variable as two categories as this basic distinction is followed by NSS.

**Table 6.1 Summary Statistics: Rural and Urban**

| Variables | Mean | SD | Mean (Urban) | SD (Urban) | Mean (Rural) | SD (Rural) |
|---|---|---|---|---|---|---|
| Family size | 3.8625 | 1.54095 | 3.920833 | 1.55982 | 3.775 | 1.51283 |
| Proportion of children | .43580 | .512 | .429 | .463 | .445 | .579 |

### 6.2.2 Demographic Variables

Apart from this, data on demographic variables were also collected. These demographic variables are, respectively, Gender of HH Head, Family Size, Number of Children, Religion, Caste Categories, Linguistic characteristics, as well as educational attainment for the household head. The summary statistics are provided below:

***Gender and Consumption***

There is some evidence that male and female-headed households allocate resources differently. This is recognized by policy-making bodies like FAO.[87] Blumberg (1988),

[86]These have been recoded a bit. For example, in our sample, we had 4 caste categories. We have put "SC(79)", "ST(62)" and "OBC(26)" in "other". Similarly "Bengali(75)", "Hindi(41)" and "Others(57)" in the language category are coded as 0. Similarly for religion (287 Hindu)
[87] http://www.fao.org/3/ac685e/ac685e05.htm#TopOfPage

Frazao (1992, in the context of US), Rogers (1996, in the context of Dominican republic), Khan and Khalid (2012, in the context of Pakistan), to name a few, have found differences both in level as well as the pattern of consumption in female-headed households vis-à-vis male-headed households. However, in our sample, the number of female-headed households is low. Hence, a priori, the sample may not provide the necessary variability. Hence we do not use gender.

**Table 6.2**

**Gender of HH Head**

| Gender | Numbers |
|---|---|
| Male | 365 |
| Female | 35 |
| Total | 400 |

***Family Size and Consumption***

First, we provide the summary statistics to Family size

**Table 6.3Family Size**

| | |
|---|---|
| Min | 1 |
| Max | 9 |
| Mean | 3.8625 |
| Median | 4 |

**Table 6.4 Family size frequency**

| Family size | Freq. |
|---|---|
| 1 | 22 |
| 2 | 43 |
| 3 | 85 |
| 4 | 162 |
| 5 | 41 |
| 6 | 17 |
| 7 | 14 |
| 8 | 15 |
| 9 | 1 |
| Total | 400 |

The effect of family size on consumption patterns is well documented, beginning from Engel. Again, for some representative analysis, one may refer to Lahiri (1990, ibid), Raper et al (2002, ibid). The null hypothesis is that higher family size has a positive effect on consumption (including food) expenditure. Higher family size may also affect the composition of demand.

### ***Family Composition and Consumption***

Family composition is captured in the number of children. The presence of children may reduce expenditure on "adult goods" (such as PTI) and increase the consumption of more calorie-rich products, such as sugar. It can be seen from the following table that numbers of households having more than 2 children are considerably rare.

**Table 6.5: Children**

| No of Children | Freq. |
|---|---|
| 0 | 125 |
| 1 | 167 |
| 2 | 91 |
| 3 | 8 |
| 4 | 6 |
| 5 | 1 |
| 6 | 2 |
| Total | 400 |

For this reason, we transform the variables into two groups. We create the following dummies, the base case being families with no children.

**Table 6.6: Children Dummy**

| No of Children | Freq. |
|---|---|
| 0 | 125 |
| 1 | 167 |
| >=2 | 108 |
| Total | 400 |

*Note:* The variable dum_onech assumes a value of 1 for families with 1 child and 0 otherwise. Similarly, the variable dum_morech assumes a value of 1 if the number of children is ≥2, and 0 otherwise. Thus, the reference household is families with no children.

### ***Educational Attainment and Consumption***

At one level, higher educational attainment may simply be a proxy of higher wealth (in the sense that rich families can invest in education) and therefore, higher education may be linked with a higher level of consumption expenditure, including food expenditure. On the other hand, a higher education level may also imply that the family is aware of the nutrition status of certain food groups, and hence can spend more on those food groups than otherwise. For example, Stea et al (2020) conducted a cross-country analysis within 21 states of Europe and found that there is (more or less) a positive association between higher fruit and vegetable consumption and educational level. Similarly, Agrawal et. al (2019) uses data from India (National Family Health Survey-4) and conclude that *maternal* education is positively related to consumption of higher basic food items.

In what follows, we have used the following educational group

**Table 6.7: Education**

| Educational Qualification | Freq. |
|---|---|
| less than equal to 10th | 169 |
| Between 10th and 12th | 136 |
| Between Graduation and 12th | 79 |
| Postgraduate | 16 |
| Total | 400 |

We assigned indices of 1,2,3 and 4 respectively. Then we constructed an education index of household h as

$$educ_h = \frac{ind_h - \min}{\max - \min}$$

The summary statistics of educational qualification is given below

**Table 6.8: Education Index**

| Variable | Obs | Max | Min | Mean | Std. Dev. |
|---|---|---|---|---|---|
| Educational Qualification Index | 400 | 1 | 0 | .855 | .8722827 |

***Social and Demographic Indicators***

We considered the following social and demographic indicators: religion, language and caste groups. The summaries are given below

**Table 6.9: Social Groups**

| Household Religion | Freq. |
|---|---|
| Hindu | 287 |
| Muslim | 85 |
| Others | 28 |
| Total | 400 |

| Household Castes | Freq. |
|---|---|
| General | 233 |
| OBC | 79 |
| SC | 62 |
| ST | 26 |
| Total | 400 |

| Household Language | Freq. |
|---|---|
| Assamese | 227 |
| Bengali | 75 |
| Hindi | 41 |
| Others | 57 |
| Total | 400 |

Given these statistics, we use the following dummies

**Tables 6.10: Social Group Dummies**

| Religion (Relcode) | Freq |
|---|---|
| Hindu (=1) | 287 |
| Other (-0) | 113 |

| Caste (Socgcode) | Freq |
|---|---|
| General (=1) | 233 |
| Others (=0) | 167 |

| Language (Lancode) | Freq |
|---|---|
| Assamese(=1) | 227 |
| Others (=0) | 173 |

*Note:* The dummy variable for religion (relgcode in the data set) assumes a value of 1 if the family is Hindu and 0 otherwise; The dummy variable caste (socgcode in data set) assumes a value of 1 if the family belongs to general caste category and 0 if the family belongs to other caste categories ( SC, ST, OBC); The variable language (lancode in data set) assumes a value of 1 if the mother language of the household head is Assamese and 0 otherwise.

The idea here is to separate the population into a "majority" and "minority" status. There is some evidence that race and ethnicity (e.g. Raper et *al ibid*, Charles *et al* 2009) matters both the level and composition of consumption. Charron-Chennier *et al* (2016) have argued that in the context of the US, racial disparities in consumption occur independently of economic disparities. We have adopted their structure in our analysis. We conjecture that 'majorities' and 'minorities' in a society may have differential access to resources and social networks (Grimard, 1997) effects on consumption and welfare (in addition to effects created by market variables). The inclusion of linguistic identity reflects the fact that at least in India, different languages imply different cultures (including culinary culture).[88]

## 6.3 Demographics in LES

We now will check the elasticities using the **demographic characteristics.**

The LES equation is

$$E_i^h = p_i^h a_i + b_i\left(M - \sum p_j a_j\right)$$

We translate the variable **a** (committed expenditure) as

$$a_i = \alpha_i + \beta_i * fam\_size + \gamma_i * dum\_onech + \delta_i * dum\_morech + \theta_i * religion + \phi_i * caste + \lambda_i * language + \varepsilon_i$$

Running the regression, we report our regression results: first for the pooled sample of 400 households.

[88] Moreover, in Assam, language-based political movements sought to guarantee the participation of Assamese speakers in the economy.

**Table 6.11: Demographic Variables for Pooled Sample**

| Food Groups (Pooled) | | | | | |
|---|---|---|---|---|---|
| | Cereal | Pulse | Sugar | Salt | Oil |
| Intercept | -10.99 | 4.28 | -.558 | .749 | -.860 |
| P>(\|z\|) | .077 | .000 (**) | .584 | .000 (**) | .473 |
| Family Size | 9.73 | .508 | .764 | .175 | 1.07 |
| P>(\|z\|) | .000 (**) | .000 (**) | .000 (**) | .000 (**) | .000 (**) |
| One child_dummy | 2.79 | -.342 | .564 | -.139 | .475 |
| P>(\|z\|) | .386 | 0.283 | .260 | 0.185 | 0.440 |
| More child dummy | .00013 (**) | .000099 (**) | -.000006 | -.000004 | -.0000825 |
| P>(\|z\|) | 0.008 (**) | 0.003 (**) | 0.413 | 0.220 | 0.003 (**) |
| Religion | -.621 | -.138 | .014 | -.108 | -.062 |
| P>(\|z\|) | 0.867 | 0.701 | 0.980 | 0.371 | 0.928 |
| Caste | -1.96 | -.276 | -.284 | -.021 | -.497 |
| P>(\|z\|) | 0.560 | 0.402 | 0.593 | 0.844 | 0.438 |
| Language | -2.47 | -.583 | -.349 | .101 | -.582 |
| P>(\|z\|) | 0.422 | 0.060 | 0.474 | 0.334 | 0.326 |
| Marginal Budget Share | .5777552 | .0431785 | .096455 | .0038819 | .2787293 |
| P>(\|z\|) | .000 (**) | .000 (**) | .000 (**) | .000 (**) | .000 (**) |
| Value of "a" at sample mean | 24.76309 | 5.510256 | 2.276849 | 1.336377 | 2.808016 |
| P>(\|z\|) | .000 (**) | .000 (**) | .000 (**) | .000 (**) | .000 (**) |

*Note:* $^{**}p<0.01$, $^{*}p<0.05$

**AIC/BIC Results**

| | |
|---|---|
| **AIC** | -6193.44 |
| **BIC** | -6037.773 |

It may be noted that except for cereal, sugar and oil, intercept terms are statistically significant. The effect of Family size is always significant. The magnitude is very high for cereal demand. For others, the effect is not so prominent. A higher proportion of children increases demand for cereals and pulses. Religion, caste and Linguistic groups are not significant. The marginal budget shares of all groups are significant. Marginal budget share is highest in cereals followed by oil.

Next, we turn to the elasticity calculations.

The next section focuses on the difference between urban and rural groups.

### 6.3.1 Rural and Urban estimates:

Similarly, for Rural and Urban, the values are as follows,

**Table 6.12**

**Family size (Urban Rural)**

| | **Rural** | **Urban** |
|---|---|---|
| Min | 1 | 1 |
| Max | 8 | 8 |
| Mean | 3.775 | 3.775 |

**Table 6.13: No. of children**

| no. of children | Frequency | |
|---|---|---|
| | **Rural** | **Urban** |
| 0 | 56 | 69 |
| 1 | 59 | 108 |
| 2 | 38 | 53 |
| 3 | 3 | 5 |
| 4 | 3 | 3 |
| 5 | 0 | 1 |
| 6 | 1 | 1 |

**Table 6.14: No. of children (modified)**

| no. of children | Frequency | |
|---|---|---|
| | Rural | Urban |
| 0 children | 56 | 69 |
| 1 child | 59 | 108 |
| 2 or more | 45 | 63 |
| Total | 160 | 240 |

**Table 6.15: Religion**

| Religion | Frequency | |
|---|---|---|
| | Rural | Urban |
| Hindu (1) | 114 | 173 |
| Others (0) | 46 | 67 |
| Sample Mean | .7125 | .7208 |

**Table 6.16: Social Group**

| Caste | Frequency | |
|---|---|---|
| | **Rural** | **Urban** |
| General Category (1) | 77 | 156 |
| Others (0) | 83 | 84 |
| Sample Mean | .48125 | .65 |

**Table 6.17: Language**

| Language | Frequency | |
|---|---|---|
| | **Rural** | **Urban** |
| Assamese (1) | 119 | 108 |
| Others (0) | 41 | 132 |
| Sample Mean | .74375 | .45 |

Running the regression, we have

**Table 6.18: Food Groups (Rural)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Intercept | -.47797 | 5.1621 | 1.16404 | .74056 | 1.6370 |
| P>(\|z\|) | .963 | .000(**) | .419 | .162 | .369 |
| Family Size | 5.6715 | .23207 | .07579 | .06673 | .23535 |
| P>(\|z\|) | .010(*) | .096 | .799 | .534 | .537 |
| One child_dummy | 7.1286 | -.67568 | 1.0794 | .19483 | 1.1006 |
| P>(\|z\|) | .211 | .120 | .145 | .504 | .260 |
| More child dummy | .000084 | .0001792 | .000006 | -.0000070 | -.00013 |
| P>(\|z\|) | .409 | .004(**) | .632 | .485 | .007(**) |
| Religion | -6.02538 | .03546 | -.57312 | .07596 | -.71525 |
| P>(\|z\|) | .337 | .945 | .467 | .817 | .501 |
| Caste | -.68568 | -.18882 | .08629 | .36694 | -.1803 |
| P>(\|z\|) | .908 | .672 | .910 | .206 | .860 |
| Language | -1.71887 | -.32078 | -.01066 | .15619 | -.36654 |
| P>(\|z\|) | .765 | .489 | .989 | .617 | .373 |
| Marginal Budget Share | .6220139 | .0149155 | .0823971 | .0087672 | .2719062 |
| P>(\|z\|) | .000(**) | .373 | .000(**) | .004(**) | .000(**) |
| Value of "a" at the sample mean | 17.65918 | 5.48494 | 1.473438 | 1.411217 | 2.062336 |
| P>(\|z\|) | .000(**) | .000(**) | .001(**) | .000(**) | .002(**) |

*Note:* **p<0.01, *p<0.05

Running the regression for the urban group, we have

**Table 6.19: Food Groups (Urban)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Intercept | -18.32253 | 3.19754 | -2.082546 | .86117 | -2.73005 |
| P>(\|z\|) | .027(*) | .000(**) | .137 | .000(**) | .097 |
| Family Size | 11.139 | .74281 | 1.08357 | .14935 | 1.47391 |
| P>(\|z\|) | .000(**) | .000(**) | .000(**) | .000(**) | .000(**) |
| One child_dummy | 3.04284 | .057633 | .6837262 | -.10702 | .68806 |
| P>(\|z\|) | .453 | .898 | .320 | .172 | .403 |
| More child dummy | .000127 | .000106 | .000006 | .000007 | -.000076 |
| P>(\|z\|) | .035(*) | .011(*) | .473 | .002(**) | .026(*) |
| Religion | 1.20147 | -.170244 | .29802 | -.244371 | .084982 |
| P>(\|z\|) | .799 | .741 | .703 | .005(**) | .928 |
| Caste | .29768 | .04076 | .087943 | -.045249 | -.03884 |
| P>(\|z\|) | .945 | .929 | .906 | .567 | .965 |
| Language | -3.26271 | -1.02141 | -.607313 | -.056960 | -.72043 |
| P>(\|z\|) | .415 | .021(*) | .377 | .464 | .375 |
| Marginal Budget Share | .5777552 | .0431785 | .096455 | .0038819 | .2787293 |
| P>(\|z\|) | 0.000(**) | 0.00(**) | 0.00(**) | 0.00(**) | 0.00(**) |
| Value of ä at the sample mean | 26.31352 | 5.580249 | 4.565151 | 0.313398 | 5.806684 |
| P>(\|z\|) | .000(**) | .000(**) | .000(**) | .000(**) | .000(**) |

*Note:* **p<0.01, *p<0.05

**AIC/BIC Results**

| | |
|---|---|
| AIC (Rural) | -2425.652 |
| BIC (Rural) | -2305.72 |
| AIC (Urban) | -3908.102 |
| BIC(Urban) | -3772.35 |

1) Family size is statistically significant and of positive sign in urban areas. However, in rural areas, family size is significant (at a 5% level of significance) only in the case of cereals. Thus, there is a differential response to family size in the case of the urban and rural populations. The marginal effect of family size is very high in the case of urban demand for cereal.
2) A higher proportion of children increases demand for urban cereal demand, urban pulse demand and urban salt demand and decreases both rural and urban oil demand. The other cases are statistically insignificant.
3) Religion and caste are almost insignificant save in one case: urban salt demand
4) The linguistic group is always insignificant except in urban pulse demand

It is to be noted that, although statistically insignificant, in many cases, magnitudes of the consumption (in value terms) of majority caste/religious/social groups *are less.* The value of a at the sample mean is higher for all commodities of the rural sector except that of salt.

Marginal budget shares for all commodities under consideration and both in urban and rural areas are significant. For both rural and urban groups, cereals and oil have maximum marginal budget share (together close to 80%). Thus any additional earmarked expenditure assistance (for example, hypothetical food stamps, or other expenditure subsidies through PDS that can be spent only on these five groups of commodities) will generate demand for cereals and oil.

These results are only preliminary and can be extended to multiple directions, each of which has potential policy implications. We are currently extending the work.

a) Subsistence quantities (fitted values of $a_i$) at the population mean provides information about caloric/nutritional intake of various social groups

b) Price elasticities (again, computed at the sample mean) are important for the tax/subsidy programme

c) Last, expenditure elasticities provide valuable information about targeted income subsidies.

### 6.3.2 Demographically Corrected Elasticities

Own-price Elasticities are given by

$$\eta_{ii} = -1 + \frac{a_i(1-b_i)}{q_i} = -1 + \frac{\bar{a}_i(1-b_i)}{\bar{q}_i}$$

Cross-price Elasticities are given by

$$\eta_{ij} = -b_i \frac{p_j \bar{a}_j}{q_i p_i} = -b_i \frac{\bar{p}_j \bar{a}_j}{\bar{E}_i}$$

Here, $b_i$ is the marginal budget share as calculated above, $\bar{p}_j$ is the average price of good j, $\bar{a}_j$ is the average "committed" amount of good j (as defined above) and $\bar{E}_i$ is the average expenditure on commodity i.

**Table 6.20: Own and Cross-price Elasticity of Food Groups (Pooled)**

| | **Cereal** | **Pulse** | **Sugar** | **Salt** | **Oil** |
|---|---|---|---|---|---|
| **Cereal** | **-.6537406*** ** | -.1059934*** | -.0418397*** | -.008288*** | -.1253214*** |
| **P>(\|z\|)** | **0.000** | .000 | . 0.000 | 0.000 | .000 |
| **Pulse** | -.1814499*** | **-.0833519*** ** | -.0161565*** | -.0032004*** | -.0483931*** |
| **P>(\|z\|)** | .000 | **0.000** | .001 | .000 | .001 |
| **Sugar** | -.7332735*** | -.1654043 | **-.3818634*** ** | -.0129336*** | -.1955658*** |
| **P>(\|z\|)** | .000 | .000 | **. 0.000** | .000 | .000 |
| **Salt** | -.1894258*** | -.0427287*** | -.0168667*** | **-.1418831** ** | -.0505203*** |
| **P>(\|z\|)** | .006 | .005 | .008 | **0.013** | .009 |
| **Oil** | -.6626838*** | -.1494814*** | -.059006*** | -.0116885*** | **-.5437755*** ** |
| **P>(\|z\|)** | .000 | .000 | .000 | .000 | **.000** |

We now look at the Marshallian elasticities for the pooled data which shows that all the commodities viz., cereals, pulses, sugar, salt and oil are gross complements.

**Table 6.21: Expenditure Elasticity of Food Groups (Pooled)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Expenditure Elasticity | .9586517 | .3701855 | 1.49599 | .3864576 | 1.351976 |
| P>(\|z\|) | 0.00 | .000 | . 0.000 | 0.004 | .000 |

Similarly, repeating for urban and rural groups, we get the following:

**Table 6.22: Own and Cross-price Elasticity of Food Groups (Rural)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| **Cereal** | **-.7788845*****| -.1135887*** | -.0291502*** | -.0094226*** | -.0990926*** |
| **P>(\|z\|)** | **0.00** | .000 | . 0.001 | 0.000 | .002 |
| **Pulse** | -.0447129 | **-.0606113** | -.0036117 | -.0011675 | -.0122776 |
| **P>(\|z\|)** | .392 | **.301** | .390 | .381 | .401 |
| **Sugar** | -.4468474*** | -.0377828*** | **-.5937561***** | -.0116673*** | -.1226986*** |
| **P>(\|z\|)** | .001 | .005 | **.000** | .000 | .010 |
| **Salt** | -.3051871** | -.0960596*** | -.0246517** | **-.0982708** | -.0838005** |
| **P>(\|z\|)** | .020 | .004 | .038 | **.529** | . 043 |
| **Oil** | -.4611572*** | -.1451522*** | -.0372503*** | -.0120409*** | **-.661758***** |
| **P>(\|z\|)** | .000 | .000 | .002 | .000 | **.000** |

**Table 6.23: Own and Expenditure Elasticity of Food Groups (Rural)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Expenditure Elasticity | 1.032089 | .1278762 | 1.277955 | .8728157 | 1.31888 |
| P>(\|z\|) | 0.00 | .373 | . 0.000 | 0.004 | .000 |

**Table 6.24: Own and Cross-price Elasticity of Food Groups (Urban)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| **Cereal** | **-.6181302** *** | -.1043894 *** | -.0441846*** | -.0070413*** | -.1332656 *** |
| **P>(\|z\|)** | **0.00** | .000 | . 0.000 | 0.000 | .000 |
| **Pulse** | -.2323918*** | **-.0803172** | -.0099817*** | -.0033688*** | -.0637588*** |
| **P>(\|z\|)** | .000 | **.009** | .001 | .000 | .001 |
| **Sugar** | -.819437*** | -.1761057*** | **-.332468*** | -.0118787*** | -.22482*** |
| **P>(\|z\|)** | .000 | .000 | **0.057** | .000 | .000 |
| **Salt** | -.0691875 | -.0148691 | -.0062936 | **-.5043438***** | -.0189822 |
| **P>(\|z\|)** | .203 | .201 | .210 | **.000** | .211 |
| **Oil** | -.7160179*** | -.1538798*** | -.0651322*** | -.0103795*** | **-.5043438***** |
| **P>(\|z\|)** | .000 | .000 | .000 | .000 | **.000** |

**Table 6.25: Expenditure Elasticity of Food Groups (Urban)**

| | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Expenditure Elasticity | .9323252 | .4460563 | 1.57284 | .1327994 | 1.374335 |
| P>(\|z\|) | 0.00 | .000 | . 0.000 | 0.20 | .000 |

It can be observed from the above tables that-

a) Own-price Elasticity of Food Groups-pulses and salt in rural households were found to be insignificant
b) Expenditure Elasticity of salt for Urban households was insignificant
c) Expenditure Elasticity of pulses for rural households was not found to be significant
d) Cross-price Elasticity of Pulses with all food groups were observed to be insignificant
e) Cross-price Elasticity of salt with all food groups was insignificant.
f) In both urban and rural sub-samples, sugar and oil are expenditure elastic.
g) But cereal is expenditure elastic only in the rural sector.

Thus, demography plays an important role only in rural consumption, not in Urban Assam consumption.

### 6.3.3 Calculating Direction of Tax Reform: Demography Augmented LES

In this section, we present the calculations for marginal welfare cost of taxation

**Table 6.26: Marginal Welfare Cost of Taxation:** ***(pooled sample)***

| **Item** | **ε = 0** | **ε = .5** | **ε = 1.25** | **ε = 1** | **ε = 1.5** | **ε = 2** |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.021188 (5) | 0.50053(5) | 0.193068(5) | 0.261368(5) | 0.144634 (5) | 0.084561(5) |
| $\lambda_{pulses}$ | 1.024782(3) | 0.535894(1) | 0.231313(1) | 0.300924(1) | 0.180746 (1) | 0.115732(1) |
| $\lambda_{sugar}$ | 1.058489 (1) | 0.526286(2) | 0.213577(3) | 0.283237(3) | 0.163855(3) | 0.101259(3) |
| $\lambda_{salt}$ | 1.02245(4) | 0.525399(3) | 0.219088(2) | 0.288686(2) | 0.168823(2) | 0.104849(2) |
| $\lambda_{oil}$ | 1.035763(2) | 0.504678(4) | 0.197335(4) | 0.265185(4) | 0.149313(4) | 0.089681(4) |
| Top Two Commodities | Sugar, Oil | Pulses, Sugar | Pulses, Salt | Pulses, Salt | Pulses, Salt | Pulses, Salt |

Data reveals that the "top two" commodities salt for ε=0 and.5 are sugar, oil and pulses, sugar respectively. For all other values of ε, they are consistent for pulse and sugar. Hence, a planner may prescribe various changes in policies. Thus, there exists consistency (as far as the identification of commodities is concerned) for a wide value of ε.

Next, we present the same tables for rural and urban sectors.

Here, we provide marginal welfare costs for the urban sector.

**Table 6.27: Marginal Welfare Cost of Taxation: Urban**

| Item | ε = 0 | ε = .5 | ε = 1 | ε = 1.25 | ε = 1.5 | ε=2 |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.0239437(5) | 0.555162(5) | 0.321116(4) | 0.249602(4) | 0.196662(5) | 0.126862(5) |
| $\lambda_{pulses}$ | 1.026672(3) | 0.58593(1) | 0.355591(1) | 0.282986(1) | 0.228248(1) | 0.154237(1) |
| $\lambda_{sugar}$ | 1.053509(1) | 0.576307(2) | 0.340607(2) | 0.268977(2) | 0.216008(2) | 0.146005(3) |
| $\lambda_{salt}$ | 1.023668(4) | 0.567027(3) | 0.336776(3) | 0.265681(3) | 0.212661(3) | 0.141956(2) |
| $\lambda_{oil}$ | 1.0344268(2) | 0.553753(4) | 0.319844(5) | 0.249413(5) | 0.197629(4) | 0.129812(4) |
| Top Two Commodities | Sugar, oil | Pulse, Sugar | Pulse, Sugar | Pulse, Sugar | Pulse, Sugar | Pulse, Salt |

The optimality table for urban and rural areas indicates that as per their lambda values, the ranking of the commodities is reasonably robust to the changing values of epsilon. Again, for the urban sector, sugar and oil are the top two commodities for ε=0. For other all, it is pulses and sugar except for ε=2, where it is pulses and salt. Thus, the taxes mainly on pulses and sugar should be decreased and that on cereals and oil may be increased.

**Table 6.28: Marginal Welfare Cost of Taxation: Rural**

| Item | ε = 0 | ε = .5 | ε = 1 | ε = 1.25 | ε = 1.5 | ε=2 |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 0.222116(5) | 0.529872(5) | 0.29281(5) | 0.222116(5) | 0.170765(5) | 0.105079(5) |
| $\lambda_{pulses}$ | 0.282842(1) | 0.576864(2) | 0.352634(1) | 0.282842(1) | 0.230579(1) | 0.160487(1) |
| $\lambda_{sugar}$ | 0.259487(2) | 0.579274(1) | 0.333423(2) | 0.259487(2) | 0.205218(2) | 0.134361(2) |
| $\lambda_{salt}$ | 0.2576564(3) | 0.563675(3) | 0.32987(3) | 0.257656(3) | 0.204112(3) | 0.133704(3) |
| $\lambda_{oil}$ | 0.239938(4) | 0.551069(4) | 0.311602(4) | 0.239938(4) | 0.187652(4) | 0.120135(4) |
| Top Two Commodities | Pulses, Sugar | Pulses, Sugar | Pulses, Sugar | Pulses, Sugar | Pulses, Sugar | Pulses, Sugar |

For the rural sector, there are rank reversals for sugar and pulses for ε=.5 and all other values of ε. Thus, the taxes on pulses and sugar should be decreased and that on cereals and oil may be increased. In the rural sector also, we have remarkable consistency: taxes on pulse and sugar to be reduced.

For better understanding, we rank them separately, in the following table-

**Table 6.29: Cross-sectional Comparison: Relative Rankings of Marginal Welfare Cost**

| Item | **ε = 0** | | **ε = .5** | | **ε = 1** | | **ε = 1.25** | | **ε = 1.5** | | **ε = 2** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| $\lambda_{cereals}$ | 5 | 5 | 5 | 5 | 5 | **4** | 5 | **4** | 5 | 5 | 5 | 5 |
| $\lambda_{pulses}$ | 1 | **3** | 2 | **1** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $\lambda_{sugar}$ | 2 | **1** | 1 | **2** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| $\lambda_{salt}$ | 3 | **4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| $\lambda_{oil}$ | 4 | 2 | 4 | 4 | 4 | **5** | 4 | **5** | 4 | 4 | 4 | 4 |

The cross-sectional comparison indicates the presence of rank reversals of the top two commodities in ε = 0. But, for ε = 1 and ε = 1.25, rank reversals can be seen for the bottom two commodities. For the remaining values of ε = 1.5 and 2, the ranks are consistent.

## 6.4 LA-AIDS estimation

Keeping the restrictions in mind, we have estimated the coefficients of LA-AI demand system using our survey data. The model and its restrictions have been discussed in chapter 3 as well as in chapter 4. The equation is given by

$$w_i = \alpha_i + \sum_j \gamma^*_{ij} \ln\left(p_j\right) + \beta_i \ln\left(\frac{M}{P}\right)_k + \sum_k \delta_i d_{ik} + \varepsilon_i .$$

Here, the vector $d_i$ captures the demographic variables for commodity i and household k.

We report the regression first.(Table 6.30)

As far as economic variables are concerned, note that cereal and sugar consumption does not respond to the food budget. Consumption of salt and pulse decreases with income. However, consumption of oil increases with increasing food budget.

For demographic variables, an increase in family size increases cereal consumption but decreases pulse and oil consumption. Compared to the reference family of no child, families with one child reduces pulse and salt consumption (but the significance is weak) but increases the share of the food budget allocated to oil. Similarly, compared to a family of no child, households with more than one child allocate fewer shares to cereals, increases pulse (weak significance) and oil consumption. So, one unambiguous result is, with the increasing number of children, households allocate a higher share of the budget to oil.

**Table 6.30: LA-AI Estimation (pooled)**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | share_cer | share_pul | share_sug | share_salt | share_oil |
| Lpcer | 0.165*** | -0.0618*** | -2.36e-05 | -0.00666*** | -0.0964*** |
| | (0.0256) | (0.0121) | (0.00824) | (0.00181) | (0.0196) |
| Lppul | -0.0618*** | 0.106*** | -0.0218*** | -0.00151 | -0.0212* |
| | (0.0121) | (0.0104) | (0.00568) | (0.00142) | (0.0123) |
| Lpsug | -2.36e-05 | -0.0218*** | 0.0545*** | -0.00113 | -0.0315*** |
| | (0.00824) | (0.00568) | (0.00946) | (0.00229) | (0.0118) |
| Lpsalt | -0.00666*** | -0.00151 | -0.00113 | 0.0143*** | -0.00503 |
| | (0.00181) | (0.00142) | (0.00229) | (0.00232) | (0.00369) |
| Lpoil | -0.0964*** | -0.0212* | -0.0315*** | -0.00503 | .1540679*** |
| | (0.0196) | (0.0123) | (0.0118) | (0.00369) | (.0256009) |
| ln_pex | -0.0207 | -0.0730*** | -0.00634 | -0.00595*** | .1059997(***) |
| | (0.0222) | (0.0117) | (0.00694) | (0.00150) | (.0163183) |
| famsize | 0.0504*** | -0.0104*** | -0.00369 | 0.000157 | -.0364744*** |
| | (0.00724) | (0.00389) | (0.00226) | (0.000487) | (.0052915) |
| onech_dum | -0.0207 | -0.0142* | -0.00104 | -0.00163* | .0375473*** |
| | (0.0146) | (0.00800) | (0.00453) | (0.000981) | .0106259 |
| morech_dum | -0.0826*** | 0.0188* | -0.00404 | -0.00114 | .0690121*** |
| | (0.0195) | (0.0107) | (0.00612) | (0.00133) | (.0143093) |
| educode | -0.0169 | 0.000941 | 0.00995 | -0.000815 | .0067886 |
| | (0.0200) | (0.0110) | (0.00622) | (0.00134) | (.0145856) |
| relgcode | -0.00666 | -0.00435 | 0.00228 | -0.000168 | .0089049 |
| | (0.0134) | (0.00733) | (0.00416) | (0.000898) | (.0097392) |
| socgcode | 0.00473 | -0.00300 | 0.000471 | 8.77e-05 | -.0022854 |
| | (0.0122) | (0.00666) | (0.00379) | (0.000818) | .0088691 |
| lancode | 0.0156 | -0.0140** | 0.00508 | 0.00123 | -.0079258 |
| | (0.0118) | (0.00647) | (0.00367) | (0.000792) | (.0086064) |
| Constant | 0.624*** | 0.668*** | 0.142*** | 0.0692*** | -.5039024(***) |
| | (0.130) | (0.0678) | (0.0420) | (0.0101) | (.1008808) |
| Observations | 399 | 399 | 399 | 399 | 399 |
| R-squared | 0.307 | 0.508 | 0.134 | 0.292 | - |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Except for linguistic identity, none of the other demographic variables are significant. The data suggest that compared to non-Assamese households, Assamese-speaking households allocate a lower share of their food budget for pulse consumption.

### 6.4.1 Elasticity

In this section, we report the elasticities of the pooled data. We begin by reporting Marshallian price elasticities

**Table 6.31: Marshallian Price Elasticities**[89]

| **Commodity** | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.69** *** | -.102*** | .002 | -.011*** | -.159*** |
| SE | **(.059)** | (.0201487) | (.0137141) | (.003144) | (.0314435) |
| Pulse | -.14 | **-.1675725**** | -.1209768*** | -.0046982 | .069181*** |
| SE | (.1176259) | **(.0727779)** | (.0400709) | (.0101815) | .0238028 |
| Sugar | .0542205 | -.3117425*** | **-.1825372** | -.0157749 | -.4498532*** |
| SE | (.1631844) | (.08493) | **(.1397863)** | (.0340831) | (.171789) |
| Salt | -.2757643 | -.0580482 | -.0629614 | **.2341972** | -.3276093 |
| SE | (.2057628) | (.1226117) | (.1955629) | **(.1992192)** | (.3129348) |
| Oil | -.7784322*** | -.5489057*** | -.1906576*** | -.0309045 | **-.1335866** |
| SE | (.1285682) | (.103518) | (.0577581) | (.0182516) | **(.1332819)** |

Note: SE are the standard errors

Cereal and pulse are price inelastic. For the rest, own-price elasticity is not different from zero. Cross-price elasticities are more or less negative (significant cases), hence we can conclude that commodities exhibit the property of gross complements.

In the next table, we compute expenditure elasticity.

**Table 6.32: Expenditure Elasticities**

| **Commodity** | **Expenditure Elasticity** |
|---|---|
| Cereal | .9642185*** |
| SE | (.0384084) |
| Pulse | .4781377*** |
| SE | (.083777) |
| Sugar | .9056873*** |
| SE | (.1033606) |
| Salt | .4901859(***) |
| SE | (.12885) |
| Oil | 1.523169*** |
| SE | (.0805403) |

In the pooled model, oil products exhibit elasticity. For the rest, in order of decreasing magnitudes, the commodities are cereal, sugar, salt and pulses.

The following table computes compensated elasticities.

**Table 6.33: Compensated Elasticities**

| Commodity | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.1365208***** | .0331784 | .0671449*** | .0001587 | .0360388 |
| | **.0442873** | .0208541 | (.0142327) | .0031241 | .0339254 |
| Pulse | .1372185 | **-.1006767** | -.0888528** | .000878 | 051433 |
| | .0862477 | **.0740577** | .0406012 | .010153 | .0878634 |
| Sugar | .5782803*** | -.1850287** | **-.1216879** | -.0052124 | -.2663513 |
| | .122578 | .0845487 | **.1407739** | .0340587 | .1752053 |
| Salt | .007873 | .0105332 | -.0300278 | **.239914** | -.2282924 |
| | .1550047 | .1218014 | .1962082 | **.199253** | .316649 |
| Oil | .1029225 | .0355161 | -.0883222 | -.0131407 | **-.0369757** |
| | .096887 | .0606725 | .0580982 | .0182265 | **.1263552** |

[89] Diagonal elements are their own-price elasticities. Cross-price elasticities are to be read horizontally across each commodity. For example, if the price of pulse increases by 1% point, cereal consumption decreases by .102%

Here, we can pass on some comments on the difference between Marshallian and compensated price elasticities. After the removal of the income effect, almost all commodities, except cereal, are price inelastic. It also seems that cereal and sugar are net substitutes, while pulse and sugar are net complements. Other cross-price elasticities are not statistically significant.

### 6.4.2 Calculating Direction of Tax Reform

In the next table, we compute the marginal welfare cost of taxation for the pooled sample.[90] In the last row,

**Table 6.34: Marginal Welfare Cost of Taxation (pooled sample)**

| Item | $\varepsilon = 0$ | $\varepsilon = .5$ | $\varepsilon = 1$ | $\varepsilon = 1.25$ | $\varepsilon = 1.5$ | $\varepsilon = 2$ |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.0128 (5) | 0.4964 (5) | 0.2592 (5) | 0.1915 (5) | 0.1434 (5) | 0.0839 (5) |
| $\lambda_{pulses}$ | 1.0743(1) | 0.5618 (1) | 0.3155 (1) | 0.2425 (1) | 0.1894 (1) | 0.1213 (1) |
| $\lambda_{sugar}$ | 1.0553(2) | 0.5247 (3) | 0.2824 (3) | 0.2129 (3) | 0.1633 (3) | 0.1010 (3) |
| $\lambda_{salt}$ | 1.0459 (3) | 0.5374 (2) | 0.2953 (2) | 0.2241 (2) | 0.1726 (2) | 0.1073 (2) |
| $\lambda_{oil}$ | 1.0241(4) | 0.4990 (4) | 0.2622 (4) | 0.1951 (4) | 0.1476 (4) | 0.0887(4) |
| 'Top Two" | Pulse, sugar | Pulse, salt | Pulse, salt | Pulse, salt | Pulse, salt | Pulse salt |

We can see that for the pooled sample, the ranks of marginal welfare costs are stable for various values of ε except for $\varepsilon = 0$. The "top two" commodities are pulses and sugar for $\varepsilon = 0$, and pulses and salt for the rest and hence taxes on these commodities may be decreased.

[90] We know that it is policy-wise difficult to impose taxes on consumption patterns of a district (and more so for urban/rural pockets for a district). We present the analysis for sake of completeness.

***Rural Estimation***

**Table 6.35: LA-AI Estimation (Rural Sector)**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | share_cer | share_pul | share_sug | share_salt | share_oil |
| Lpcer | 0.128*** | -0.0596*** | 0.0155 | -0.0157*** | -0.0682** |
| | (0.0424) | (0.0217) | (0.0135) | (0.00458) | (0.0321) |
| Lppul | -0.0596*** | 0.146*** | -0.0281*** | -0.00573 | -0.0522** |
| | (0.0217) | (0.0188) | (0.00952) | (0.00361) | (0.0214) |
| Lpsug | 0.0155 | -0.0281*** | 0.0624*** | 0.00128 | -0.0511*** |
| | (0.0135) | (0.00952) | (0.0146) | (0.00505) | (0.0191) |
| Lpsalt | -0.0157*** | -0.00573 | 0.00128 | 0.0140*** | 0.00613 |
| | (0.00458) | (0.00361) | (0.00505) | (0.00495) | (0.00887) |
| Lpoil | -0.0682** | -0.0522** | -0.0511*** | 0.00613 | .165*** |
| | (0.0321) | (0.0214) | (0.0191) | (0.00887) | (.0444273) |
| ln_pex | -0.000121 | -0.0751*** | -0.0136 | -0.00117 | .09*** |
| | (0.0368) | (0.0209) | (0.0113) | (0.00377) | (.0263218) |
| famsize | 0.0573*** | -0.0157** | -0.00186 | -0.00162 | -.0381*** |
| | (0.0125) | (0.00722) | (0.00380) | (0.00126) | .00879 |
| onech_dum | 0.000387 | -0.0252** | -0.00506 | -0.00113 | .031** |
| | (0.0214) | (0.0127) | (0.00648) | (0.00214) | .0148862 |
| morech_dum | -0.0785*** | 0.0187 | -0.00757 | -0.000328 | .0677*** |
| | (0.0294) | (0.0174) | (0.00899) | (0.00298) | .0207268 |
| educode | -0.0830* | 0.0171 | 0.0350*** | -0.00220 | .0331 |
| | (0.0430) | (0.0257) | (0.0131) | (0.00431) | .0298 |
| relgcode | -0.0264 | -0.00246 | -0.00260 | 0.00277 | .0287 |
| | (0.0208) | (0.0124) | (0.00628) | (0.00207) | (.0144) |
| socgcode | 0.00989 | -0.000934 | -0.00614 | 0.00303 | -.006 |
| | (0.0183) | (0.0109) | (0.00558) | (0.00185) | (.0128) |
| lancode | 0.00907 | -0.0142 | 0.0131** | 0.000546 | -.008 |
| | (0.0207) | (0.0123) | (0.00625) | (0.00207) | (.0143) |
| Constant | 0.454** | 0.724*** | 0.201*** | 0.0340 | -.414** |
| | (0.210) | (0.118) | (0.0680) | (0.0256) | (.1637496) |
| Observations | 160 | 160 | 160 | 160 | 160 |
| R-squared | 0.407 | 0.578 | 0.194 | 0.303 | _ |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As far as economic variables are concerned, note that cereal, sugar and salt consumption do not respond to the food budget. Consumption of pulse and oil are responsive to the food budget.

For demographic variables, an increase in family size increases cereal consumption but decreases pulse and oil consumption. Compared to the reference family of no child, families with one child reduces pulse consumption as well as salt and sugar, but the significance is weak) but increases the share of the food budget allocated to oil. Similarly, compared to a family of no child, households with more than one child allocate fewer shares to cereals but increases oil consumption. So, one unambiguous result is, with the increasing number of children, households allocate a higher share of the budget to oil. Families with more education devote a lower amount of their budget to cereal but increase that of sugar.

The data suggest that compared to non-Assamese households, Assamese-speaking households allocate a higher share of their food budget for sugar consumption. Other demographic variables are not significant.

The next table presents the estimation for the urban sub-sample.

**Table 6.36: Regression for Urban Sample**

| | (1) | (2) | (3) | (4) | |
|---|---|---|---|---|---|
| VARIABLES | share_cer | share_pul | share_sug | share_salt | share_oil |
| | | | | | |
| Lpcer | 0.173*** | -0.0608*** | -0.00416 | -0.00325* | -0.105*** |
| | (0.0323) | (0.0144) | (0.0104) | (0.00182) | (0.0252) |
| Lppul | -0.0608*** | 0.0881*** | -0.0210*** | 8.38e-06 | -0.00627 |
| | (0.0144) | (0.0123) | (0.00701) | (0.00141) | (0.0149) |
| Lpsug | -0.00416 | -0.0210*** | 0.0499*** | -0.00312 | -0.0216 |
| | (0.0104) | (0.00701) | (0.0122) | (0.00239) | (0.0150) |
| Lpsalt | -0.00325* | 8.38e-06 | -0.00312 | 0.0106*** | -0.00428 |
| | (0.00182) | (0.00141) | (0.00239) | (0.00255) | (0.00377) |
| Lpoil | -0.105*** | -0.00627 | -0.0216 | -0.00428 | .1653*** |
| | (0.0252) | (0.0149) | (0.0150) | (0.00377) | (.0444) |
| ln_pex | -0.0310 | -0.0686*** | -0.00425 | -0.00761*** | .0899*** |
| | (0.0282) | (0.0142) | (0.00897) | (0.00155) | .0263 |
| famsize | 0.0463*** | -0.00842* | -0.00420 | 0.000721 | -.0381*** |
| | (0.00896) | (0.00459) | (0.00283) | (0.000488) | .008 |
| onech_dum | -0.0349* | -0.00580 | 0.00139 | -0.000885 | .0309** |
| | (0.0195) | (0.0102) | (0.00616) | (0.00107) | .0149 |
| morech_dum | -0.0893*** | 0.0230* | -0.00259 | -0.000571 | .0677*** |
| | (0.0261) | (0.0136) | (0.00831) | (0.00144) | .0207 |
| educode | 0.00467 | -0.00467 | 0.00661 | 0.00146 | .0331 |
| | (0.0249) | (0.0129) | (0.00787) | (0.00136) | .0298 |
| relgcode | 0.00689 | -0.00286 | 0.00382 | -0.00118 | .0287** |
| | (0.0173) | (0.00904) | (0.00549) | (0.000950) | .0144 |
| socgcode | 0.00329 | -0.00435 | 0.00323 | -0.000513 | -.00584 |
| | (0.0162) | (0.00841) | (0.00511) | (0.000883) | .0128 |
| lancode | 0.0198 | -0.0165** | 0.000629 | -6.86e-06 | -.00858 |
| | (0.0153) | (0.00796) | (0.00483) | (0.000835) | .0143 |
| Constant | 0.705*** | 0.618*** | 0.118** | 0.0722*** | -.4141 |
| | (0.168) | (0.0834) | (0.0543) | (0.0104) | .1637 |
| Observations | 239 | 239 | 239 | 239 | 239 |
| R-squared | 0.280 | 0.476 | 0.128 | 0.399 | - |

As far as economic variables are concerned, note that a higher (real) food budget reduces the consumption of pulse and salt, but increases consumption of oil

For demographic variables, an increase in family size increases cereal consumption but decreases pulse and oil consumption. Compared to the reference family of no child, the families with one child reduce cereal consumption but increases the share of the food budget allocated to oil. Similarly, compared to a family of no child, households with more than one child allocate fewer shares to cereals but increases pulse and oil consumption. So, one unambiguous result is, with the increasing number of children, households allocate a higher share of the budget to oil. Compared to non-Hindu households, Hindu households allocate a higher share on oil. The data suggest that compared to non-Assamese households, Assamese-speaking households allocate a lower share of their food budget for pulse consumption. Other demographic variables are not significant.

In the next table, we present the Marshallian elasticities. We begin with the rural population.

**Table 6.37: Marshallian Price Elasticities: Rural**

| **Commodity** | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.779***** | -.103 | .0268 | -.027*** | -.117** |
| | **(.0995)** | .0358 | .0223 | .00791 | .0509 |
| Pulse | -.115 | **.116** | -.1647** | -.165** | .0185 |
| | .214 | **(.132)** | .0670 | .0671 | .041 |
| Sugar | .347 | -.39 | **-.0581** | .0213 | -.719 |
| | .27 | .146 | **.216** | .07523 | .275 |
| Salt | -1.288** | -.4775 | .116 | **.205** | .5456 |
| | .529 | .3145 | .433 | **.424** | .7408 |
| Oil | -.5937*** | -.3989** | -.2818*** | .0250 | **-.094** |
| | .2134 | .1701 | .0941 | .0438 | **.232** |

Only cereals exhibit inelastic own-price elasticity. The corresponding values for other commodities are insignificant. Cereal exhibits the property of gross complements (where significant) to other commodities.

The corresponding table for the urban population is presented below

**Table 6.38: Marshallian Price Elasticities: Urban**

| **Commodity** | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.67***** | -.0976*** | -.0036 | -.0049 | -.1698*** |
| | **.0742** | .0244 | .0174 | .0031 | 0405 |
| Pulse | -.1509 | **-.302***** | -.1173** | .0057 | .088 |
| | 1398 | **.0866** | 0494 | .0101 | 0291 |
| Sugar | -.0253 | -.304*** | **-.254***** | -.0456 | -.307 |
| | .205 | .105 | **.179** | .0356 | .2199 |
| Salt | .0991 | .0919 | .2232 | **-.0803** | -.2352 |
| | .207 | .121 | .204 | **.219** | .322 |
| Oil | -.834*** | -.108 | -.143* | -.0276 | **-.214** |
| | .163 | .0751 | .0733 | -.0276 | **.165** |

In the urban sample, cereal, pulse and sugar are price elastic. Cereal is Marshallian complement for oil, pulse is Marshallian complement for cereal and sugar, sugar is Marshallian complement for pulse and oil (weak), while oil is complement with cereal.

In the next table, we collate the data from the above two tables to compare urban and rural Marshallian elasticities.

### 6.4.3 Comparison of Elasticities

**Table 6.39: Cross-sectional Comparison of Marshallian Elasticities: Kamrup District**

| | **Cereal** | | **Pulse** | | **Sugar** | | **Salt** | | **Oil** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| Cereal | **-.779*****| **-.67***** | -.103 | -.0976*** | .0268 | -.0036 | -.027*** | -.0049 | -.117** | -.1698*** |
| SE | **(.0995)** | **.0742** | .0358 | .0244 | .0223 | .0174 | .00791 | .0031 | .0509 | 0405 |
| Pulse | -.115 | -.1509 | **.116** | **-.302***** | -.1647** | -.1173** | -.165** | .0057 | .0185 | .088 |
| SE | .214 | 1398 | **(.132)** | **.0866** | .0670 | 0494 | .0671 | .0101 | .041 | 0291 |
| Sugar | .3473943 | -.0253 | -.3898251 | -.304*** | **-.0581** | **-.254***** | .021343 | -.0456 | -.71902 | -.307 |
| SE | .2700299 | .205 | .1425686 | .105 | **.216** | **.179** | .0752587 | .0356 | .275060 | .2199 |
| Salt | -1.288** | .0991 | -.4775 | .0919 | .116 | .2232 | **.205** | **-.0803** | .5456 | -.2352 |
| SE | .529 | .207 | .3145 | .121 | .433 | .204 | **.424** | **.219** | .7408 | .322 |
| Oil | -.5937*** | -.834*** | -.3989** | -.108 | -.2818*** | -.143* | .0250 | -.0276 | **-.094** | **-.214** |
| SE | .2134 | .163 | .1701 | .0751 | .0941 | .0733 | 0.000 | -.0276 | **.232** | **.165** |

In urban, centres, pulse and sugar are price inelastic and values are significantly different from zero. Cereal shows more price sensitivity in rural areas. The cross-price elasticity of cereal with oil is higher in urban areas. More or less, cross-price elasticities (where significant) are more prominent in urban areas.

In the next table, we present urban and rural expenditure elasticities

**Table 6.40: Cross-sectional Analysis of Expenditure Elasticities: Kamrup District**

| **Commodity** | **Rural** | **Urban** |
|---|---|---|
| Cereal | .9998*** | .9465*** |
| SE | .0635 | .0488 |
| Pulse | .463*** | .5094*** |
| SE | .149 | .1014 |
| Sugar | .7982*** | .9368*** |
| SE | .1675 | .1335 |
| Salt | .8999*** | .3477*** |
| SE | .3230 | .1327 |
| Oil | 1.4439*** | 1.55*** |
| SE | .1299 | .1051 |

Expenditure elasticities of cereal and salt are higher in rural areas. For the rest of the commodities, if there is economic growth that is spread evenly over the budget of the two commodities, rural consumption falls behind that of urban consumption.

Finally, we turn to compensated price elasticities.

**Table 6.41: Compensated Elasticities: Rural Sample**

| Commodity | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.20*** ** | . 0369 | .0939*** | -.015(*) | .0846 |
| SE | **.0732** | . .0374 | .023 | .0079 | .0553 |
| Pulse | .152 | **.180** | -.1335 | -.0293 | -.02931 |
| SE | .1547 | **.134** | .0680 | .0258 | .02583 |
| Sugar | .8092 | -.2781 | **-.0044** | .0306 | -.5572(*) |
| SE | .2001 | .1416 | **.217** | .0752 | .2840 |
| Salt | -.768(*) | -.351 | .176 | **.2152** | .727 |
| SE | .392 | .31 | .433 | **.424** | .760 |
| Oil | .2418 | -.1176 | -.1847* | -.3516 | **.0187** |
| SE | .158 | .1056 | .0941 | .041 | **.219** |

Only cereal is price elastic here. Sugar and cereal are Hicksian substitutes, while cereal and salt, as well as pulse and sugar, are Hicksian complements.

Now we present the Hicksian elasticities of the urban sample.

**Table 6.42: Compensated Elasticities: Urban Sample**

| Commodity | Cereal | Pulse | Sugar | Salt | Oil |
|---|---|---|---|---|---|
| Cereal | **-.1227*** ** | .0347 | .0599*** | .006* | .0219 |
| SE | **.0559** | .0249 | .018 | 00315 | .0435 |
| Pulse | .1438 | **-.2302** | -.0831* | .0117 | .1578 |
| SE | .1032 | **.0877** | .05013 | .01006 | .1067 |
| Sugar | .5167*** | -.1730* | **-.1907** | -.0347 | -.1181 |
| SE | .155 | .1044 | **.1812** | .0355 | .2229 |
| Salt | .3003(*) | .1406 | -.1999 | **-.0762** | -.1648 |
| SE | .1565 | .1207 | .2050 | **.2190** | .3234 |
| Oil | .0626 | .1089 | -.0391 | -.0094 | **-.123** |
| SE | .1242 | .0736 | .0739 | .0186 | **.157** |

In the urban sub-sample as well, cereal exhibits significance. Cereal-sugar and cereal-salt exhibit Hicksian substitutes. Sugar and pulse shows Hicksian complementarities in consumption.

As before, we present the cross-sectional comparison of Hicksian own-price elasticities.

**Table 6.43: Comparison Hicksian own-price elasticities**

| Commodity | Urban | Rural |
|---|---|---|
| Cereal | **-.1227***** | **-.20***** |
| SE | **.0559** | **.0732** |
| Pulse | **-.2302** | **.180** |
| SE | **.0877** | **.134** |
| Sugar | **-.1907** | **-.0044** |
| SE | **.1812** | **.217** |
| Salt | **-.0762** | **.2152** |
| SE | **.2190** | **.424** |
| Oil | **-.123** | **.0187** |
| SE | **.157** | **.219** |

Thus, (magnitude) rural own-price compensated elasticity for cereal is higher than that of urban. For the rest of the commodities, we cannot reject the null that the values are equal to zero.

Finally, we put the information together to compare marginal welfare costs

Here, we provide marginal welfare cost for the rural sector

**Table 6.44: Marginal welfare cost: Rural**

| **Item** | **ε = 0** | **ε = .5** | **ε = 1** | **ε = 1.25** | **ε = 1.5** | **ε = 2** |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.0049(4) | 0.5255 **(5)** | 0.2904 (5) | 0.2203 (5) | 0.1693 (5) | 0.1042 (5) |
| $\lambda_{pulses}$ | 1.0618(1) | 0.6037 (1) | 0.3690 (1) | 0.2960 (1) | 0.2413 (1) | 0.1679 (1) |
| $\lambda_{sugar}$ | 1.0511 (2) | 0.5621 (2) | 0.3235 (2) | 0.2518 (2) | 0.1991 (2) | 0.1303 (2) |
| $\lambda_{salt}$ | 0.9674(5) | 0.5360 **(4)** | 0.3136 **(3)** | 0.2450 (3) | **0.1941 (3)** | 0.1271 (3) |
| $\lambda_{oil}$ | 1.0350 (3) | 0.5486 (3) | 0.3102 **(4)** | 0.2388 (4) | 0.1868 (4) | 0.1196 (4) |
| Top Two Commodities | Pulse, Sugar | Pulse, Sugar | Pulse, Sugar | Pulse, Sugar | Pulse, Sugar | Pulse, Sugar |

Thus, there are alterations of ranks at ε=.5 and 1. After that, rankings are stable. The "top two" rule identifies the same set of commodities: taxes on pulse and sugar should be reduced, or subsidies can be enhanced.

Next, we present the urban values

**Table 6.45: Marginal Welfare Cost of Taxation: Urban**

| Item | ε = 0 | ε = .5 | ε = 1 | ε = 1.25 | ε = 1.5 | ε = 2 |
|---|---|---|---|---|---|---|
| $\lambda_{cereals}$ | 1.01552(5) | 0.550595(4) | 0.318474(4) | 0.247549(4) | 0.195045(5) | 0.125817(5) |
| $\lambda_{pulses}$ | 1.031174(3) | 0.588499(2) | 0.35715(1) | 0.284227(1) | 0.229248(1) | 0.154914(1) |
| $\lambda_{sugar}$ | 1.057531(2) | 0.578507(3) | 0.341907(3) | 0.270004(3) | 0.216832(3) | 0.146562(3) |
| $\lambda_{salt}$ | 1.079654(1) | 0.598038(1) | 0.355195(2) | 0.280211(2) | 0.224291(2) | 0.14972(2) |
| $\lambda_{oil}$ | 1.022193(4) | 0.547204(5) | 0.316061(5) | 0.246463(5) | 0.195292(4) | 0.128277(4) |
| Top Two Commodities | Sugar, salt | Pulses, salt | Pulses, salt | Pulses, salt | Pulses, salt | Pulses, salt |

There are no alterations at ε=1and 1.25. After that, the rankings are stable. The "top two" commodities remain salt and pulse for all except for ε = 0, "top two" commodities are sugar and salt where taxes should be reduced.

If we compare urban, rural and pooled samples using the LA-AIDS estimation, all of those identify pulse as the commodity on which tax may be reduced.

## 6.5 Estimation of Demography Augmented Working-Lesser Model

In this section, we investigate the effects of household budgets, demography[91], residence (that is urban and rural) and income status (that is, rich and poor by MPCE class) on Engle curves by exploiting our primary consumption survey. We estimate a demography-inclusive Engel curve to observe the importance of income and other demographic factors in various components of food consumption. Besides, we check whether the impacts of economic and demographic variables differ between urban/rural as well as rich/poor[92] population. In terms of policy, the study of demographic variables and expenditure elasticities can be used in figuring out income supplement (at least for the commodities which have a high calorie/other nutritional benefits). Further, linking consumption to demographic variables enable policymakers to go beyond economic determinants such as income as the only marker of consumption. Given the same level of income, if a group of households with certain common

[91] Such as family size and composition, household-level educational attainment, socio-demographic variables such as caste, religion and linguistic identity)

[92] Rich/poor is based on the poorest (and the richest) 30% of MPCE.

demographic characteristics 'fall behind' in food consumption; policymakers can go for group/household-specific in-kind transfers.

As we have already seen, consistent consumption data (total expenditure as well as consumption) was available for only a limited number of commodities. For the rest, we have expenditure data, but not consumption data. The paucity of data gives us two separate methodologies for estimating the demand pattern. The first is the estimation of a demand system for a limited number of commodities (with consistent price data and non-zero consumption), which was done in the previous section. Now, we would like to explore single equation exploration of the Engel curve through the Working –Leser model.[93] The model is described in the following canonical equation

$$w_i = \alpha_0 + \alpha_i \ln X + \sum_k \beta_{ik} z_k + \varepsilon_i \ldots (6.1) .$$

Here, $w_i$ is the share of food i in the budget, X is the total expenditure on food and $z_k$ are the other control variables.[94] Thus we employ the `demographic translation' ap proach introduced by Pollack and Wales (1981, ibid).[95] The model posits that food Expenditure $E_i$ is non-linear in budget X. Moreover, the marginal response of expenditure given a change in the food budget is also non-linear. The reference household here has the following characteristics: non-Hindu, non-general caste, a non-Assamese speaking household with no children.

The expenditure elasticity is given by

$$e_i = 1 + \frac{\alpha_i}{w_i} \ldots .(6.2a)$$

The model can be estimated separately for each of the food items. Elasticities are calculated at the sample mean, that is

$$e_i = 1 + \frac{\alpha_i}{\overline{w}_i} \ldots (6.2b)$$

Further, we want to see if the rural and urban estimates differ from each other. For this, we investigate, item by item, whether the coefficients of the subsamples (urban and rural) differ in a (statistically) significant manner.

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93 As already explained in Chapter 3, the primary work belongs to Working (1943) and Leser, 1963. Note that AIDS or QAIDS use this equation as their starting point (Deaton and Muelbauer, 1980). See, among others, Young and Hamdok (1994) for an application.

94 In some studies, the total expenditure on food (X) is replaced by M, expenditure on income. In the first case, we can figure out the expenditure elasticity (but income elasticity is not possible), but not necessarily the income elasticity. In the second case, we can figure out the income elasticity directly.

95 The intercept α is replaced by $\alpha_0 + \Sigma\gamma_k * dem_k$

The reason behind the exercise is the following. First, as already mentioned, urban and rural setups are a basic division followed by NSSO, India. In almost all empirical demand analyses, such division is maintained. Second, as a policy initiative, the efficacy of targeted food policy (in form of, say, food expenditure subsidy) depends crucially on the magnitude and sign of expenditure elasticity. We conjecture that both signs and magnitude may vary across food items as well as between urban and rural sub-samples. If that is the case, policies should be different among urban/rural centres as well as across the food items.

## 6.5.1 Running Regressions: Rural/Urban

We run the following regression for each variable

$$w_i = \alpha_0 + \alpha_i \ln(X) + \beta_{1i} * family\_size + \beta_{2i} * one\_child\_dum + \beta_{3i} * (more\_than\_one\_child\_dum)$$
$$+ \beta_{4i} * educ + \beta_{5i} * re\lg + \beta_{6i} * caste + \beta_{7i} * language + \varepsilon_i$$

The above regression will tell us whether individual α or β values are significant for urban and rural samples. However, it is possible to test if there is a statistically significant difference between the regression coefficients among these sub-samples. For example, we have to test whether (similarly for other estimated coefficients)

$$H_0 : \alpha_i^R = \alpha_i^U$$

Against

$$H_1 : \alpha_i^R \neq \alpha_i^U$$

Similarly, we can propose a series of tests for the $\beta_{ki}$ coefficients.[96] Rejecting the null implies that, at least in the context of the sample chosen, urban and rural characteristics play different roles in food consumption. The difference gets reflected in regression coefficients. Following the methodology of Clogg et. al (1995)[97], we perform a Wald test to see if the marginal effects are any differences between these two sub-samples.[98]

### *6.5.1 Regression Results and Discussion: Urban/Rural*

The relevant tables are in appendix 4. Here we present a short discussion.

**a) Cereal Consumption:** For all the sample units (pooled, urban and rural), families with higher food expenditure reduces the share of the budget allotted to cereals. Moreover, families with one child buy less cereal (compared to families with no children). In the rural

[96] It can be shown that $\alpha_i$ measures the difference between marginal spending on certain good and average spending on the same.

[97] *American Journal of Sociology* (1995). Also refer to Weesie J (1999), *The Stata Technical Bulletin*.

[98] For the Wald test to be performed, Stata requires that the regression is OLS.

sub-sample, higher education leads to lower purchase of cereals (again, as a share of the total budget).

**b) Pulse Consumption:** In the case of pulse consumption, families with higher food expenditure reduce the share of the budget allotted to cereals. For the urban sub-sample, Assamese speakers spend a lower percentage of their food budget on pulses. Rural samples also show similar effects, but the result is not statistically significant.

**c) Sugar Consumption** For both urban and rural sub-samples, the higher food budget lowers the percentage of expenditure allocated to sugar. Higher family size increases the said allocation, while families with more than one child allocate a lower share compared to families with no children.

**d) Salt Consumption:** For both urban and rural sub-samples, a higher income reduces the share of the food budget allotted to salt. Higher family size increases the share in the urban sub-sample (but the value is marginal). Education decreases salt share (the result seems driven by rural sub-sample) in the pooled sample, while being an Assamese speaking household weakly (both in terms of magnitude and statistical significance) increases salt share.

**e) Oil Consumption** For both urban and rural sub-samples, a higher income reduces oil consumption. A higher family size increases the share of oil in the budget. In urban samples, higher education (weakly) reduces the share of oil. In rural samples, families belonging to the majority religion allocate a higher share of the budget to oil.

**f) Spice Consumption:** For both urban and rural sub-samples, a higher food budget reduces spice consumption. A higher family size increases the share of spices. Families with more than one child reduce their spice consumption (relative to all other foods) compared to families with no children. Hindu families also spend a lower share of the budget compared to non-Hindus. In urban set-up only, Assamese -families spend a higher share of their budget on spices, the result is only weakly significant.

**g) Egg-Fish-Meat (EFM Consumption)**: For animal proteins, families with a higher food budget allocate a higher proportion of the budget towards EFM.[99] Households with higher educational achievements and belonging to the majority religion allocate a lower proportion of their budget towards EFM. In the case of rural sub-samples, higher caste families allocate

[99] Indicating that these are, in fact, normal goods.

less budget share to EFM (the result is consistent for urban as well, but the coefficient is not statistically significant). The majority of language speakers (Assamese) relatively spend more in the pooled sample. However, the significance is weak.

**h) Milk Consumption:** Consumption of milk goes down with income only in the case of urban sub-samples. In the rural and pooled sample units, families with one child (weakly significant) and more children (strongly significant) allocate a higher share of the budget to milk. In the urban sample, households in general caste allocate a higher proportion of their budgets (compared to a family, not in general caste).

**i) Fruit Consumption** As far as fruit consumption is concerned, families with a higher food expenditure allocate a lower share of fruits in the total budget. Urban households also follow the pattern, but the effect is not significant. In urban households, families with one child and more than one child spend a higher fraction of the budget towards fruit. Thus, at least in the context of urban households, fruits are "children good". In the urban setup, a higher family size lowers relative expenditure on fruits.

As far as differential impacts are considered, the effect of family size and more than one child is significantly different between urban and rural households. The impact of education also differs, but it is weakly significant.

**j) Vegetable Consumption** For vegetables, effect of the food budget is not significant. Both in urban and rural households, higher family size reduces share in the budget (weakly significant in rural samples). The effect of education (and majority language dummy) is positive (negative) in the pooled sample, but not significant in either of the subsamples. Hindu, as well as general caste families in rural sample units devote a higher share of the budget to vegetables compared to others.

Between urban and rural samples, religion dummy and caste dummies have significant differences.

**k) PTI Consumption:** For the urban sample, the budget share spent on pan, tobacco and other intoxicants (PTI) increases with the food budget. For both rural and urban samples, higher family size decreases relative spending. Surprisingly, rural families with more than one child spend a higher percentage of the food budget compared to rural families with no children. In the urban sample, higher educational attainment lowers relative expenditure. For rural Hindu families, relative expenditure on PTI is higher (but the significance is weak). In the pooled sample, families belonging to the general caste spend a lower proportion of their budget, although the statistical significance is weak. However, the coefficient is not significant in either of the sub-samples.

There is no significant difference between the effect of the different explanatory variables among urban and rural sub-samples.

**l) Beverages Consumption:** As far as the percentage share of beverages is concerned, households with higher income tend to allocate more. The effect is weakly significant in rural areas. In rural areas, families with a higher number of members allocate a lower share to beverages. Again, rural families belonging to the Hindu faith allocate a higher share of their budget to beverages compared to non-Hindu families.

### *6.11.2 Urban-Rural Differences in Coefficients*

We have already seen that the economic and the demographic variables do have differential impacts on consumption for urban, rural and pooled samples. The question is, however, to what extent these impacts are different. This is important in many respects. Pooled regression uses all data points (vis-à-vis truncated regressions that use only urban or only rural data). If consumption behaviour is not different between pooled and urban/rural (or between urban and rural), then one can rely on pooled regression as a reasonable guide for positive and normative guide for understanding consumption.

In the following tables, we take up the issue one by one. The focus is on the identical impact of the explanatory variables. We begin with the urban/rural table. The significant values of $\chi^2$ statistic are highlighted.

**Table 6.46[100]: Testing for Difference between Urban and Rural Coefficients**

(Null: There is no difference between Urban and Rural Coefficients)

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | 0.43 | 2.64 | 0.07 | 1.33 | 0.21 | 0.25 | 3.06 (*) | 0.29 | 0.29 | 0.37 | 1.27 | 0.01 |
| p value | 0.5112 | 0.1041 | 0.7930 | 0.2489 | 0.6429 | 0.6179 | 0.0805 | 0.5880 | 0.5880 | 0.5403 | 0.2596 | 0.9181 |
| famsize | 2.87(*) | 0.39 | 0.52 | 0.02 | 0.12 | 0.37 | 1.99 | 1.47 | 7.60(***) | .37 | 0.00 | 1.16 |
| p value | 0.0905 | 0.5340 | 0.4702 | 0.8935 | 0.7324 | 0.5420 | 0.1588 | 0.2255 | 0.0058 | 0.5431 | 0.9797 | 0.2814 |
| onech_dum | 0.47 | 1.03 | 0.24 | 0.57 | 0.98 | 0.20 | 0.97 | 0.59 | 0.68 | 1.01 | 1.08 | 0.09 |
| p value | 0.4937 | 0.3090 | 0.6213 | 0.4504 | 0.3229 | 0.6586 | 0.3237 | 0.4417 | 0.4111 | 0.3151 | 0.2984 | 0.8022 |
| morech_dum | 0.25 | 0.02 | 0.04 | 2.58 | 0.21 | 0.18 | 0.04 | 7.42(***) | 8.80(***) | 2.40 | 0.44 | 0.06 |
| p value | 0.6151 | 0.8829 | 0.8422 | 0.1085 | 0.6485 | 0.6744 | 0.8344 | 0.0064 | 0.0030 | 0.1211 | 0.5061 | 0.8014 |
| educode | 9.11(***) | 2.14 | 0.04 | 3.05 (*) | 0.07 | 0.14 | 3.54(*) | 0.03 | 3.16(*) | 0.12 | 2.58 | 0.06 |
| p value | 0.0025 | 0.1437 | 0.8349 | 0.0806 | 0.7957 | 0.7074 | 0.0600 | 0.8572 | 0.0754(*) | 0.7324 | 0.1085 | 0.8014 |
| relgcode | 0.48 | 0.00 | 0.48 | 2.82(*) | 2.30 | 1.38 | 8.90(***) | 2.77(*) | 0.43 | 5.06(**) | 0.68 | 9.31 (***) |
| p value | 0.4872 | 0.9489 | 0.4862 | 0.0931 | 0.1293 | 0.2399 | 0.0029 | 0.0963 | 0.5122 | 0.0245 | 0.4088 | 0.0023 |
| socgcode | 0.29 | 0.00 | 1.81 | 1.79 | 0.39 | 2.91(*) | 4.66(**) | 2.67 | 0.11 | 18.72(***) | 0.00 | 0.26 |
| p value | 0.5889 | 0.9565 | 0.1782 | 0.1808 | 0.5320 | 0.0879 | 0.0309 | 0.1020 | 0.7376 | 0.0000 | .9465 | 0.6071 |
| lancode | 0.74 | 0.17 | 2.67 | 1.50 | 0.25 | 0.00 | 0.01 | 0.07 | 0.15 | 1.13 | 1.58 | 0.01 |
| p value | 0.3909 | 0.6759 | 0.1024 | 0.2207 | 0.6184 | 0.9722 | 0.9382 | 0.7944 | 0.6967 | 0.2883 | 0.2093 | 0.9183 |

[100] The numbers presented against each variable (odd rows) are the chi-square values of the test statistic.

**Food Budget:** For food budget, the corresponding coefficient is not statistically significant (save for consumption of EFM, where it is shows weak significance, rural samples showing higher sensitiveness). From here, we can conclude that at least, as far as income is concerned, urban and rural sub-samples do not behave differently.

**Family Size** Between urban and rural samples, the effect of family size is significantly different only in fruit consumption (rural samples show higher sensitiveness), and weakly significant in cereal consumption (urban households display higher sensitiveness).

**Families with One Child** In relation to families with no children, the effect of the dummy characterizing households with only one child is similar across urban and rural sub-samples overall categories of food.

**Families with more than one child:** In comparison to households with no children, the effect of the dummy characterizing households more than one child is different across urban and rural subsamples in case of fruit (urban families are more responsive) and milk consumption (rural families are more responsive).

**Education** Effect of education is significantly different in the case of cereal consumption (rural families cut down budget more sharply than urban families). The difference is weakly significant in the case of EFM (urban families reduce budget allocation more sharply than rural households)

**Religion:** Effect of religion (from the reference households of non-Hindu to Hindu households) is significantly different in cases of EFM (the urban effect is higher than rural effect), vegetable (the rural effect is higher) and beverages (rural effects are higher) consumptions, and is weakly significant in milk (the urban effect is positive, the rural effect is negative) consumption.

**Caste** The effects of caste are significantly different between urban and rural sub-samples in case of EFM (so called "upper" caste households reduce their consumption more sharply for the rural), and vegetables (so-called "upper" caste households increase their consumption more sharply for the rural) consumption.

**Language:** There is no difference in households speaking Assamese vis-à-vis non-Assamese speakers.

To sum up, we can say that the effect of food budget (two commodities) is similar across the sub-samples, but demographic factors such as family size (two commodities) and composition (two commodities), household education (two commodities), religious (four commodities) and caste alignments (two commodities) create a difference in consumption pattern (the intercept of Engle curve) for many commodities. The effects of these variables are not similar across food items. Thus demography not only affects consumption, but the interaction of demography and residence also affects consumption in different ways.

In the next two tables, we compare urban and rural with pooled regression results

The next two tables present the differences in Urban/ pooled and rural/pooled respectively. The significant values of $\chi^2$ statistic are highlighted. We do not attempt to explain the tables in words but summarize our key findings in the later two tables.

**Table 6.47**[101]

**Testing for Difference between Urban and Pooled Coefficients**

(Null: There is no difference between Urban and Pooled Coefficients)

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | 1.00 | 2.46 | 0.00 | 0.55 | 0.00 | 0.06 | 1.64 | 0.10 | 0.64 | 0.34 | 1.28 | 0.06 |
| p value | 0.3173 | 0.1169 | 0.9535 | 0.4592 | 0.9440 | 0.808 | 0.2000 | 0.7504 | 0.4251 | 0.5593 | 0.2573 | 0.8085 |
| famsize | 1.76 | 0.11 | 0.17 | 0.04 | 0.01 | 0.46 | 1.49 | 1.41 | 6.99*** | 0.25 | 0.02 | 1.44 |
| p value | 0.1842 | 0.7451 | 0.6774 | 0.8435 | 0.9192 | 0.498 | 0.2229 | 0.2351 | 0.0082 | 0.6178 | 0.8857 | 0.2299 |
| onech_dum | 0.62 | 1.22 | 0.18 | 1.14 | 0.61 | 0.22 | 0.88 | 0.91 | 1.05 | 0.04 | 0.93 | 0.16 |
| p value | 0.4293 | 0.2690 | 0.6700 | 0.2848 | 0.4361 | 0.6427 | 0.3481 | 0.3396 | 0.3053 | 0.8476 | 0.3336 | 0.6918 |
| morech_dum | 0.01 | 0.14 | 0.00 | 2.64 | 0.10 | 0.14 | 0.14 | 6.79*** | 7.71*** | 0.01 | 0.35 | 0.10 |
| p value | 0.9367 | 0.7052 | 0.9772 | 0.1043 | 0.7484 | 0.7125 | 0.7079 | 0.0092 | 0.0055 | 0.9159 | 0.5535 | 0.7480 |
| educode | 4.77** | 1.59 | 0.13 | 8.92*** | 1.55 | 2.06 | 1.27 | 0.27 | 2.03 | 1.17 | 2.97* | 1.11 |
| p value | 0.0289 | 0.2067 | 0.7182 | 0.0028 | 0.2131 | 0.1514 | 0.2594 | 0.6040 | 0.1545 | 0.2803 | 0.0851 | 0.2919 |
| relgcode | 1.03 | 0.06 | 0.17 | 1.20 | 3.32* | 1.01 | 5.84** | 2.19 | 0.40 | 2.05 | 0.07 | 7.69*** |
| p value | 0.3112 | 0.8108 | 0.6757 | 0.2725 | 0.0682 | 0.3160 | 0.0156 | 0.1390 | 0.5290 | 0.1522 | 0.7906 | 0.0055 |
| socgcode | 0.19 | 0.00 | 1.59 | 0.32 | 0.13 | 4.60** | 2.68 | 2.38 | 0.03 | 13.21*** | 0.34 | 0.97 |
| p value | 0.6615 | 0.9741 | 0.2072 | 0.5730 | 0.7195 | 0.0319 | 0.1016 | 0.1230 | 0.8541 | 0.0003 | 0.5586 | 0.3246 |
| lancode | 0.43 | 0.25 | 1.94 | 5.17** | 0.08 | 0.69 | 0.03 | 0.00 | 0.14 | 0.18 | 0.73 | 0.81 |
| p value | 0.5142 | 0.6158 | 0.1641 | 0.023 | 0.7788 | 0.4077 | 0.8573 | 0.9732 | 0.7092 | 0.6710 | 0.3927 | 0.3687 |

[101] The numbers presented against each variable (odd rows) are the chi-square values of the test statistic.

**Table 6.48**[102]

**Testing for Difference between Rural and Pooled Coefficients**

(Null: There is no difference between Rural and Pooled Coefficients)

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | 0.11 | 2.51 | 0.17 | 1.79 | 0.56 | 0.47 | 3.90** | 0.46 | 0.57 | 0.97 | 1.16 | 0.13 |
| p value | 0.7369 | 0.1133 | 0.6793 | 0.1809 | 0.4523 | 0.4916 | 0.0484 | 0.4974 | 0.4495 | 0.3247 | 0.2805 | 0.7219 |
| famsize | 3.35* | 0.60 | 0.78 | 0.01 | 0.24 | 0.27 | 2.13 | 1.41 | 6.68*** | 0.07 | 0.00 | 0.92 |
| p value | 0.0670 | 0.4403 | 0.3760 | 0.9289 | 0.6231 | 0.6017 | 0.1449 | 0.2357 | 0.0098 | 0.7974 | 0.9596 | 0.3366 |
| onech_dum | 0.34 | 0.85 | 0.29 | 0.22 | 1.22 | 0.17 | 0.96 | 0.39 | 0.41 | 0.10 | 1.12 | 0.05 |
| p value | 0.5589 | 0.3576 | 0.5920 | 0.6363 | 0.2699 | 0.6787 | 0.3259 | 0.5347 | 0.5225 | 0.7534 | 0.2902 | 0.8260 |
| morech_dum | 0.58 | 0.00 | 0.10 | 2.20 | 0.30 | 0.19 | 0.01 | 6.99*** | 8.29*** | 0.01 | 0.49 | 0.04 |
| p value | 0.4444 | 0.9828 | 0.7468 | 0.1380 | 0.5857 | 0.6615 | 0.9345 | 0.0082 | 0.0040 | 0.9287 | 0.4844 | 0.8497 |
| educode | 8.87*** | 1.99 | 0.02 | 1.37 | 0.05 | 0.00 | 3.72* | 0.00 | 3.19* | 0.29 | 1.96 | 0.00 |
| p value | 0.0029 | 0.1587 | 0.8885 | 0.2424 | 0.8182 | 0.9828 | 0.0539 | 0.9509 | 0.0742 | 0.5903 | 0.1616 | 0.9822 |
| relgcode | 0.23 | 0.06 | 0.70 | 3.56* | 1.53 | 1.57 | 9.58*** | 2.80* | 0.41 | 3.12* | 1.27 | 9.19*** |
| p value | 0.6348 | 0.8128 | 0.4026 | 0.0593 | 0.2157 | 0.2104 | 0.0020 | 0.0945 | 0.5210 | 0.0774 | 0.2598 | 0.0024 |
| socgcode | 0.33 | 0.01 | 1.83 | 3.00* | 0.57 | 1.74 | 5.52** | 2.55 | 0.17 | 12.23*** | 0.10 | 0.02 |
| p value | 0.5667 | 0.9105 | 0.1758 | 0.0834 | 0.4507 | 0.1877 | 0.0188 | 0.1101 | 0.6779 | 0.0005 | 0.7477 | 0.8752 |
| lancode | 0.81 | 0.13 | 2.77* | 0.27 | 0.94 | 0.24 | 0.00 | 0.13 | 0.13 | 0.10 | 1.80 | 0.08 |
| p value | 0.3669 | 0.7216 | 0.0958 | 0.6024 | 0.3315 | 0.6216 | 0.9840 | 0.7190 | 0.7160 | 0.7573 | 0.1796 | 0.7739 |

To sum up, we use the following table to focus on the differences. In each row, we report the variables that cause differential impact with respect to the pooled sample. Only in those consumption categories, one should analyse as per the coefficient of the sub-samples, rather than the full sample.

[102] The numbers presented against each variable (odd rows) are the chi-square values of the test statistic.

**Table 6.49: Differences: Independent Variable Perspective**

| Variables | Impact is statistically different on (urban/pooled) | Differential impact is significant on (rural/pooled) | Differential impact is significant on (rural/urban) |
|---|---|---|---|
| Food Budget | None | EFM | EFM (weak) |
| Family Size | Fruit | Cereal(weak) ,Fruit | Cereal (weak), Fruit |
| Families with one Child | None | None | None |
| Families with More Child | Milk, Fruit | Milk, Fruit | Milk, Fruit |
| Education | Cereal, Salt, PTI (weak) | Cereal,EFM (weak),Fruit (weak) | Cereal, EFM(weak), Fruit (weak) |
| Religion | Oil (weak), EFM, Beverages | Salt(weak), Milk (weak), EFM, Veg(weak), Beverage | Salt (weak), EFM, Milk (weak), Vegetables, Beverage |
| Caste | Spice, Veg | Salt (weak), EFM, Veg | Spice(weak),EFM, Veg |
| Language | Salt | Sugar (weak) | None |

Economic intuition[103] suggests that the subsamples show different properties compared to the pooled sample To wit, one expects that each variable should impact the subsamples differently: thus generating statistically different patterns. Yet, the effect of income is almost the same across all commodities. The effect of dummy for one child is the same across urban/pooled and rural/pooled. In other cases, surprisingly, the effect is identical for the majority of the food items. The most important marker (in terms of the number of food items) seems to be religious identity.

Now we flip the table from consumption perspective.

[103] In contrast to the statistical null hypothesis.

**Table 6.50: Differences: Food Item Perspective**

| Food Items | Statistically differential Impact is Caused by (Urban and Pooled) | Statistically differential Impact is Caused by (Rural and Pooled) | Statistically differential Impact is Caused by (Rural and Urban) |
|---|---|---|---|
| **Cereal** | Education | Family size, Education | Family size, Education |
| **Pulse** | Identical | Identical | Identical |
| **Sugar** | Identical | Language | Identical |
| **Salt** | Education, Language | Religion, Caste | Education, Religion |
| **Oil** | Religion | Identical | Identical |
| **Spices** | Caste | Identical | Caste |
| **EFM** | Religion | Income, Religion, Cast | Income, education, religion, caste, |
| **Milk** | Families with More than one Child | Families with More than one Child, Religion | More than one child, Education |
| **Fruits** | Family size, more than one child | Family size, more than one size, education | Family size, more than one size, education |
| **Vegetable** | Religion, Caste | Religion | Religion, Caste |
| **PTI** | Education | Identical | Identical |
| **Beverages** | Religion | Religion | Religion |

Here again, notice that the Engle curve for pulse for the pooled sample is identical with both sub-samples. The Engle curve of sugar for the population is identical to that of the urban sub-sample, while that of oil, spice and PTI are identical with corresponding Engle curves from rural data. If we adopt the rule of thumb that for the consumption items, we will adopt pooled coefficients for positive/normative purpose only if the consumption is non-identical with respect to maximum one independent variable (and/or one location), then we conclude that for food items such as pulse, sugar, oil, spice and PTI,[104] one can use the pooled regression for positive as well as a normative understanding of consumption.

[104] For example, pulse consumption is identical between urban/pooled and rural/pooled. PTI consumption is identical between rural/pooled, and varies only across one dimension (religion) between urban/pooled. Hence one can use the Engel curve from pooled data for such commodities. This rule of thumb is, of course, completely subjective in nature.

### 6.5.3 Expenditure Elasticities

For economists, the effect of income is summarized more closely. As already noted above, once we get the values of $\alpha_i$, we can readily calculate the expenditure elasticity. The elasticity is calculated at the sample mean, i.e. at mean expenditure share for each food item.

**Table 6.51: Expenditure Elasticities**

| Food Category | Pooled Sample | Rural | Urban |
|---|---|---|---|
| **Cereal** | 0.43 *** | 0.45 *** | 0.38 *** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Pulses** | 0.09 | -0.05 | 0.19 * |
| **p value** | 0.21 | 0.68 | 0.06 |
| **Sugar** | 0.43*** | 0.40*** | 0.44 *** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Salt** | 0.33 *** | 0.33 ** | 0.29 *** |
| **p value** | 0.00 | 0.02 | 0.00 |
| **Oil** | 0.70 *** | 0.62*** | 0.72*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Spices** | 0.38 *** | 0.41*** | 0.38*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **EFM** | 1.69 *** | 1.81*** | 1.63*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Milk** | 0.83*** | 0.90*** | 0.80*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Fruit** | 0.76 *** | 0.68*** | 0.83*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Veg** | 0.94 *** | 0.84*** | 0.98*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **PTI** | 1.41*** | 1.17*** | 1.61*** |
| **p value** | 0.00 | 0.00 | 0.00 |
| **Beverages** | 1.43*** | 1.35*** | 1.42*** |
| **p value** | 0.00 | 0.00 | 0.00 |

Note that expenditure elasticities show a great variance. For almost all commodities, expenditure elasticities are a fraction, implying that if the food budget increases by 1%, less than 1% of the incremental budget is spent on that commodity. Food items are mostly necessities, not luxuries. Surprisingly, the elasticity of pulse is not significantly different from zero[105] (and is only weakly significant in urban samples). Among the necessities, salt has the lowest (and surprisingly, significant) elasticity and vegetables have the highest elasticity value. Three food categories show higher values (>1) expenditure elasticities: EFM (animal

[105] But note that pulse is responsive to food budget.

protein), PTI and Beverages. This corresponds to the fact that these items are luxuries for both sub-samples.

The following table readily provides us the categories along which urban and rural consumptions show higher responsiveness

| Urban More Responsive | Rural More Responsive |
|---|---|
| Pulses, Sugar, Oil, Fruit, Vegetable, PTI, Beverages | Cereal, Salt, Spices, Milk, EFM |

If we compare the magnitude of the elasticities (than explicit testing), some observations are in order. Discounting PTI and beverages, a proportional increase in food budget (say, caused by an overall positive economic shock, the benefits of which are spread equally) would imply that rural households will "fall behind" in Pulse, Sugar, Oil, Fruit and vegetable consumptions. The disparity will be exacerbated if the benefits are distributed in an uneven fashion between urban and rural centres.

Although the results are more or less consistent across urban and rural samples, we run a formal test to see if elasticities are the same. Our null is

$$H_0 : \frac{\alpha_i^j}{\bar{w}_i^j} - \frac{\alpha_i^k}{\bar{w}_i^k} = 0$$

Against

$$H_1 : \frac{\alpha_i^j}{\bar{w}_i^j} - \frac{\alpha_i^k}{\bar{w}_i^k} \neq 0$$

As before, k, j= urban, rural and pooled, j≠ k.

Given that budget shares at mean are just scalar numbers, the test is akin to the Wald test.

**Table 6.52: Comparison of Expenditure elasticities: Urban, Rural and Pooled**

| Commodities | Urban and Rural | Pooled and Rural | Pooled and Urban |
|---|---|---|---|
| Cereal | 0.40 | 0.10 | 0.96 |
| p value | 0.5260 | 0.7542 | 0.3266 |
| Pulse | 1.56 | 1.40 | 1.54 |
| p value | 0.2116 | 0.2360 | 0.2146 |
| Sugar | .05 | 0.14 | 0.00 |
| p value | (0.8193) | 0.7050 | 0.9767 |
| salt | 0.09 | 0.00 | 0.35 |
| p value | 0.7587 | 0.9962 | 0.5542 |
| Oil | 0.53 | 1.02 | 0.08 |
| p value | (0.4672) | 0.3120 | 0.7821 |
| Spice | 0.05 | 0.15 | 0.00 |
| p value | 0.8161 | 0.6940 | 0.9875 |
| EFM | 1.71 | 2.36 | 0.83 |
| p value | (0.1910) | 0.1246 | 0.3627 |
| Milk | 0.36 | 0.56 | 0.14 |
| p value | 0.5462 | 0.4551 | 0.7042 |
| Fruit | 0.66 | 0.57 | 0.63 |
| p value | 0.4154 | 0.4514 | 0.4266 |
| Veg | 0.91 | 1.18 | 0.43 |
| p value | 0.3389 | 0.2782 | 0.5124 |
| PTI | 1.35 | 1.24 | 1.35 |
| p value | 0.2457 | 0.2654 | 0.2449 |
| Beverage | 0.07 | 0.28 | 0.01 |
| p value | (0.7968) | 0.5952 | 0.9303 |

From here, we document the differences in the following table

**Table 6.53**
**Statistically Significant Difference in Food Budget Expenditure Elasticity**

| Commodities | Urban and Rural | Rural and Pooled | Urban and Pooled |
|---|---|---|---|
| Cereal | No | No | No |
| Pulse | No | No | No |
| Sugar | No | No | No |
| Salt | No | No | No |
| Oil | No | No | No |
| Spice | No | No | No |
| EFM | No | No | No |
| Milk | No | No | No |
| Fruit | No | No | No |
| Veg | No | No | No |
| PTI | No | No | No |
| Beverages | No | No | No |

Thus, the differences between expenditure elasticities at mean are not statistically significant. Hence we propose that, as far as food policies based on expenditure elasticities are concerned, (i) there is no need to differentiate between urban and rural policies (ii) the pooled elasticity is a reasonable guide for implementing such policies. If we assume that food support policy should be done through subsidized food expenditure only (in form of say, cash vouchers or food coupons or expenditures targeted towards food only), no separate policy is required for urban and rural households.

Thus it may be concluded that after investigating the consumption pattern of selected food groups, urban and rural elasticities differ across the place of residence as well as across food grains. If we, at this moment, abstract away from salt, PTI, beverages and spice consumption, the sample suggests that rural households are comparatively more responsive to cereal, EFM and milk consumption, while urban households are more responsive to pulse, sugar, oil, fruit and vegetable consumption. While cereals and sugar are the main sources of carbohydrates, other food items are the major sources of protein (EFM, Milk, and pulse), healthy fat (oils) and vitamins and other micronutrients (fruit and vegetables). Although the data suggest that the differences are not statistically significant, nevertheless, a financially constrained authority that aims to boost consumption may target either urban or rural centres for the issuance of food coupons.[106] Moreover, as demographic factors play a role, households can also be targeted along demographic lines.

## 6.6 Engle Curve Analysis of Rich/ Poor Consumption

In this section, we compare consumption behaviours of the poorest 30% (MPCE < 4810) vis-à-vis richest 30% (MPCE >8900).[107] As before, we start with pooled regression (then obtaining the regression coefficients for poor and rich, respectively), before moving into discussing the differences between the consumption patterns.

Unlike the previous case, in this section, we have added residence (urban/rural) as a control (dummy) variable to see if the consumption pattern of poor and rich interacts with the place of residence. The variable assumes a value of zero (one) for rural (urban) households.

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[106] See Basu (2011) and Kotwal (2015) where they argue that food coupons should replace the current public distribution system in India.

[107] The poor-rich classification is done by using MPCE of each household. That is, we use the total expenditure of the household, not only food expenditure.

In the next section, we briefly report our regression results commodity by commodity. The relevant tables are reported in appendix 6A. First, we will present the observations in the pooled sample, and followed by rich and poor subsamples, respectively.

### 6.6.1 Regression Results: Poor/Rich Sub-samples

**Cereal:** Pooled, poor and rich groups reduce their consumption given an increase in budget. However, for the poorest household, the reduction is sharper than the urban household. Family size increases cereal consumption in all subsets (including pooled), but the poor increase is almost twice that of the rich. With increasing number of children, poor households (and the pooled group) reduce their share of cereals, but the rich do not. For the poor households, upper-caste families allocate more of their budget to cereal (although the effect is not significant).

**Pulse:** With increased income, pooled, poor and rich allocate lower budget share to pulse. In response to higher family size, poorer households reduce budget share, but richer households increase budget share. Families with more than one child purchase more pulse for poorer households. In the same class, families with higher education levels increase their pulse consumption. People from higher castes allocate lower budget share to pulse consumption. For the rich and pooled households, Assamese speakers consume less.

**Sugar**: For the poorest 30%, sugar consumption does not depend on anything else except education (highly educated families spent less on sugar). In the case of rich households, sugar consumption decreases with the budget and increases with family size. Families with more children allocate less. For the pooled sample, sugar consumption decreases with income and dummy indication more than one child. It increases with family size.

**Salt:** For poor and pooled samples, consumption decreases with income. Urban poor consumes less than rural. For rich families, salt declines with the budget. The reduction is sharper for poor families. For the pooled sample, salt consumption increases with family size, and reduces for families with more than one child as well as for the urban households.

**Oil:** For poor families, reduces with income, but increases with family size and reduces with more than one child. Families belonging to the Hindu religion consume more oil. For rich households, oil consumption decreases with income but increases with family size. Urban rich consume more than rural rich. For the pooled set, consumption of oil decreases with income and education but increases with family size. Urban dwellers relatively spend more of their budget on salt.

**Spice:** for poor families, spice consumption reduces with income, more than one child and

Families belonging to the Hindu religion consume less spice. For rich families, spice consumption decreases with income, increases with family size, one child, and education. For the pooled sample, consumption decreases with income, for households with more than one child and Hindus. It increases with family size and for households speaking Assamese as well as for those who live in urban areas.

**EFM:** for poor families, EFM consumption increases with income, decreases with family size, increases with more children, and decreases with education, Hindu religion, and higher caste. Urban poor consume more. For rich families, EFM consumption increases more with income, reduces with Hindu religion, upper caste. For the pooled sample, consumption increases with income and for Assamese- speaking households. Consumption decreases with education and for Hindu as well as general caste households.

**Milk**: For poorer families, milk consumption is unresponsive to income, increases with one child and more than one child. For rich families, none of the factors are significant. For pooled sample, consumption decreases with income. It increases for households with children.

**Fruits:** For poor households, consumption decreases weakly with income, increases with education and Hindu religion. For rich households, fruit consumption decreases with income and increases with the Hindu religion. For the pooled sample, consumption decreases with income. It increases with education and the number of children. Hindu households spend a larger budget share.

**Vegetables:** For poor households, consumption decreases with higher family size increases with more than one child. For the rich, consumption decreases with one child dummy and upper-caste consumes more. For the pooled sample, consumption decreases with family size and for households speaking Assamese. Budget share increases with education and for households characterized by Hindu religion and upper caste.

**PTI:** Urban poor consume less than the rural counterpart. For the richer households, consumption increases with income, and education. For the pooled sample, consumption increases with income and education as well as for the households with more than one child. Budget share decreases with family size and for households belonging to upper caste.

**Beverages:** For poor households, decreases with more child dummy but the majority religion spend more. For rich households, beverages consumption increases with income and majority religion. For pooled sample, consumption increase with income and for households belonging to the majority religion. However, it decreases with family size.

### 6.6.2 Differences in Coefficients: Poor, Rich and Pooled

In this section, we test the difference in coefficients. Our null hypothesis is

$$H_0 : \alpha_i^j = \alpha_i^k$$

Against

$$H_0 : \alpha_i^j = \alpha_i^k$$

.Here, k, j= poor, rich and pooled, k ≠ j.

**Table 6.54: Testing for Equality of Coefficients: Poor and Rich**

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | 10.69*** | 0.63 | 0.42 | 1.86 | 5.39 ** | 0.06 | 8.76*** | 0.43 | 0.07 | 1.45 | 2.69 | 4.14** |
| p value | 0.0011 | 0.4285 | 0.5160 | 0.1723 | 0.0202 | 0.8004 | 0.0031 | 0.5109 | 0.7857 | 0.2280 | 0.1008 | 0.0418 |
| famsize | 8.60** | 12.94*** | 1.30 | 1.61 | 0.15 | 0.00 | 0.09 | 0.00 | 0.03 | 2.70 | 0.23 | 0.74 |
| p value | 0.0034 | 0.0003 | 0.2549 | 0.2043 | 0.6996 | 0.9831 | 0.7660 | 0.9908 | 0.8667 | 0.1006 | 0.6314 | 0.3884 |
| onech_dum | 11.48*** | 1.17 | 0.01 | 0.18 | 4.88** | 4.29** | 0.01 | 0.01 | 0.30 | 2.88* | 0.58 | 0.91 |
| p value | 0.0007 | 0.2804 | 0.9260 | 0.6703 | 0.0272 | 0.0384 | 0.9062 | 0.9233 | 0.5851 | 0.0897 | 0.4457 | 0.3410 |
| morech_dum | 19.75*** | 4.50** | 0.01 | 1.59 | 0.67 | 5.50** | 0.01 | 0.84 | 0.74 | 5.36** | 0.00 | 0.98 |
| p value | 0.0000 | 0.0338 | 0.9085 | 0.2069 | 0.4134 | 0.0190 | 0.9097 | 0.3605 | 0.3904 | 0.0206 | 0.9609 | 0.3212 |
| educode | 1.80 | 8.28*** | 4.23** | 0.61 | 0.77 | 4.79** | 0.79 | 5.71** | 0.39 | 0.52 | 2.50 | 0.20 |
| p value | 0.1795 | 0.0040 | 0.0397 | 0.4355 | 0.3809 | 0.0286 | 0.3739 | 0.0169 | 0.5312 | 0.4697 | 0.1140 | 0.6551 |
| relgcode | 1.76 | 0.20 | 0.18 | 0.17 | 0.13 | 9.81*** | 1.30 | 0.03 | 9.08*** | 0.02 | 0.34 | 0.11 |
| p value | 0.1843 | 0.6536 | 0.6690 | 0.6793 | 0.7204 | 0.0017 | 0.2535 | 0.8742 | 0.0026 | 0.8867 | 0.5606 | 0.7366 |
| socgcode | 3.57* | 1.92 | 0.09 | 0.39 | 0.09 | 0.69 | 0.01 | 1.27 | 4.27** | 3.62* | 0.63 | 0.69 |
| p value | 0.0587 | 0.1655 | 0.7678 | 0.5318 | 0.7642 | 0.4077 | 0.9171 | 0.2596 | 0.0387 | 0.0572 | 0.4290 | 0.4078 |
| lancode | 0.06 | 0.00 | 0.47 | 0.12 | 0.06 | 0.66 | 0.01 | 0.07 | 0.01 | 0.21 | 0.14 | 0.02 |
| p value | 0.8112 | 0.9845 | 0.4948 | 0.7292 | 0.8016 | 0.4163 | 0.9049 | 0.7956 | 0.9178 | 0.6481 | 0.7037 | 0.8792 |
| rescode | 0.26 | 2.21 | 1.15 | 1.66 | 0.81 | 0.49 | 4.50** | 0.12 | 0.00 | 0.06 | 1.55 | 0.63 |
| p value | 0.6098 | 0.1371 | 0.2828 | 0.1980 | 0.3685 | 0.4840 | 0.0340 | 0.7331 | 0.9900 | 0.8143 | 0.2130 | 0.4259 |

Considering the table, we consider the variables one by one.

**Food Budget:** The effect of the food budget is significantly different between poor and rich in our sample in case of cereals (poor cut down budgets sharply than rich), oil (poorly cut down budget sharply than rich), EFM (poor increase their consumption more sharply than rich) and beverages (rich increases their consumption, while for poor it is unresponsive to food budget).

**Family Size:** The effect of family size is significantly different between poor and rich in our sample in the case of cereals (poor increases consumption more sharply than the rich) as well as pulses (rich increase, while poor decrease consumption).

**Families with One Child** Compared to the reference household of no children poor households with one child reduces cereal consumption more than the rich, (poor reduces consumption, but rich households do not), oil (rich households with one child increase and poor households with one child decrease consumption), spices (poor households with one child decrease and rich households with one child increase) as well as vegetable consumption (poor households with one child increase but rich households with one child decrease)

**Families with More than One Child** Compared to the reference household of no children, having more than one child differentially impacts relative budget share in cereals (poor reduces consumption, sharper than rich), pulses (rich increase and poor increases consumption but rich are unresponsive), spices (poor reduces consumption sharply than rich ) as well as vegetable consumption (poor increase but rich decrease).

**Education** Pulse (poor increase, but rich decrease consumption), sugar (poor increase more than rich) Spice (poor decrease consumption, but rich increase) and Milk (poor increase, but reach decrease consumption.

**Religion:** As we have already noticed, non-Hindu households are references. Compared to the reference households, Spice (poor decrease, but rich increase) and Fruit (poor increase, but rich decrease) consumptions are different between rich and poor.

**Caste:** Cereal (rural upper caste households increase, but rich upper caste households decrease consumption compared to the reference), Fruit (poor upper caste households increase, but rich upper caste households decrease), Vegetables (both poor and rich upper-caste households increase, but for rich, the increase is much sharper)

**Language:** Language does not induce any significant change in behaviour.

**Residence:** Residence (urban/rural) factors only in EFM consumption. Compared to their rural counterparts, poor urban households increase their consumption, while rich urban households decrease consumption

Now we turn towards the comparison between pooled/poor and pooled urban. As before, we will summarize the results later

**Table 6.55: Testing for Equality of Coefficients: Pooled and Poor**

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | 8.77*** | 1.86 | 0.88 | 0.12 | 8.82** | 0.65 | 9.37** | 3.62** | 1.39 | 0.44 | 2.32 | 7.72*** |
| p value | 0.0031 | 0.1721 | 0.3472 | 0.7299 | 0.0030 | 0.4210 | 0.0022 | 0.0569 | 0.2382 | 0.5090 | 0.1276 | 0.0055 |
| famsize | 5.86** | 13.51*** | 1.83 | 0.00 | 3.63* | 0.31 | 4.56** | 2.28 | 4.76** | 0.66 | 2.19 | 0.95 |
| p value | 0.0155 | 0.0002 | 0.1763 | 0.9463 | 0.0569 | 0.5767 | 0.0328 | 0.56 | 0.0291 | 0.4176 | 0.1391 | 0.3287 |
| onech_dum | 14.70*** | 1.22 | 0.15 | 1.60 | 8.01*** | 2.33 | 2.61 | 0.4549 | 0.53 | 1.09 | 3.19* | 4.08** |
| p value | 0.0001 | 0.2693 | 0.6956 | 0.2058 | 0.0047 | 0.1266 | 0.1064 | 1.73 | 0.4648 | 0.2959 | 0.0743 | 0.0435 |
| morech_dum | 13.66*** | 3.20** | 0.00 | 0.51 | 4.70** | 2.86* | 4.49** | 0.1878 | 9.22** | 4.37** | 0.08 | 0.01 |
| p value | 0.0002 | 0.0737 | 0.9941 | 0.4748 | 0.0302 | 0.0907 | 0.0341 | 0.1878 | 0.0024 | 0.0366 | 0.7827 | 0.9399 |
| educode | 0.20 | 7.59*** | 7.32*** | 0.03 | 3.84 | 0.90 | 1.49 | 9.60*** | 0.08 | 0.19 | 3.66* | 1.05 |
| p value | 0.6510 | 0.0059 | 0.0068 | 0.8583 | 0.0501 | 0.3424 | 0.2223 | 0.0019 | 0.7767 | 0.6619 | 0.0558 | 0.3057 |
| relgcode | 1.64 | 0.08 | 0.08 | 0.27 | 0.85 | 3.14** | 5.03 | .06 | 2.57 | 0.00 | 0.24 | 0.01 |
| p value | 0.2001 | 0.7833 | 0.7781 | 0.6006 | 0.3578 | 0.0763 | 0.96 | 0.8109 | 0.1092 | 0.9627 | 0.6230 | 0.9197 |
| socgcode | 3.22* | 5.29** | 0.32 | 1.98 | 0.30 | 0.22 | 0.3267 | 2.09 | 1.46 | 0.21 | 0.66 | 1.03 |
| p value | 0.0725 | 0.0215 | 0.5700 | 0.1597 | 0.5864 | 0.6368 | 0.3267 | 0.1481 | 0.2273 | 0.6472 | 0.4154 | 0.3091 |
| lancode | 0.81 | 0.14 | 2.02 | 0.03 | 1.16 | 2.07 | 0.03 | 0.03 | 0.22 | 1.95 | 0.08 | 0.11 |
| p value | 0.3687 | 0.7122 | 0.1551 | 0.8552 | 0.2813 | 0.1499 | 0.8517 | 0.8661 | 0.6374 | 0.1625 | 0.7746 | 0.7405 |
| rescode | 0.07 | 2.70 | 2.88* | 0.08 | 1.06 | 0.08 | 5.90** | 0.02 | 0.58 | 0.08 | 2.19 | 0.93 |
| p value | 0.7913 | 0.1006 | 0.0899 | 0.7727 | 0.3030 | 0.7728 | 0.0152 | 0.8761 | 0.4457 | 0.7833 | 0.1392 | 0.3360 |

Next, we focus on rich and pooled

**Table 6.56**

**Testing for Equality of Coefficients: Pooled and Rich**

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | 5.09** | 0.37 | 0.05 | 6.04** | 0.00 | 0.74 | 1.88 | 2.77* | 3.54* | 1.62 | 1.27 | 0.00 |
| p value | 0.0240 | 0.5421 | 0.8262 | 0.0140 | 0.9969 | 0.3891 | 0.1704 | 0.0961 | 0.0599 | 0.2029 | 0.2589 | 0.9940 |
| famsize | 5.12** | 3.21* | 0.02** | 4.57** | 1.41 | 1.16 | 1.87 | 3.00* | 3.13* | 2.26 | 0.15 | 3.21* |
| p value | 0.0236 | 0.0731 | 0.04 | 0.0326 | 0.2354 | 0.2816 | 0.1713 | 0.0832 | 0.0769 | 0.1327 | 0.6987 | 0.0730 |
| onech_dum | 2.63 | 0.48 | 0.8417** | 0.29 | 0.63 | 3.72* | 0.58 | 0.17 | 1.56 | 2.45 | 0.03 | 0.03 |
| p value | 0.1050 | 0.4904 | 0.03 | 0.5924 | 0.4268 | 0.0537 | 0.4467 | 0.6766 | 0.2121 | 0.1172 | 0.8659 | 0.8631 |
| morech_dum | 8.76*** | 1.74 | 0.01 | 1.28 | 0.31 | 4.72** | 1.65 | 0.02 | 1.38 | 2.64 | 0.05 | 1.40 |
| p value | 0.0031 | 0.1873 | 0.9300 | 0.2573 | 0.5807 | 0.0298 | 0.1994 | 0.9000 | 0.2399 | 0.1041 | 0.8250 | 0.2367 |
| educode | 4.84** | 2.49 | 0.20 | 1.52 | 0.75 | 11.05*** | 0.05 | 0.38 | 0.64 | 2.42 | 0.69 | 0.11 |
| p value | 0.0278 | 0.1147 | 0.20 | 0.2169 | 0.3875 | 0.0009 | 0.8296 | 0.5389 | 0.4240 | 0.1194 | 0.4056 | 0.7396 |
| relgcode | 0.83 | 0.17 | 0.20 | 0.01 | 0.28 | 12.53*** | 0.05 | 0.27 | 11.58*** | 0.03 | 1.64 | 0.36 |
| p value | 0.3632 | 0.6785 | 0.6514 | 0.9284 | 0.5978 | 0.0004 | 0.8213 | 0.6051 | 0.0007 | 0.8555 | 0.2004 | 0.5468 |
| socgcode | 1.59 | 0.09 | 0.03 | 0.52 | 0.01 | 0.79 | 0.84 | 0.17 | 4.72** | 5.91** | 0.32 | 3.94** |
| p value | 0.2072 | 0.7648 | 0.8708 | 0.4703 | 0.9154 | 0.3746 | 0.3599 | 0.6767 | 0.0299 | 0.015 | 0.5692 | 0.0471 |
| lancode | 0.50 | 0.21 | 0.12 | 0.17 | 0.44 | 0.05 | 0.10 | 0.07 | 0.29 | 0.26 | 0.13 | 0.00 |
| p value | 0.4786 | 0.6459 | 0.7304 | 0.6777 | 0.5050 | 0.8171 | 0.7556 | 0.7971 | 0.5872 | 0.6111 | 0.719 | 0.9812 |
| rescode | 1.40 | 0.62 | 0.01 | 2.85* | 0.10 | 1.92 | 1.50 | 0.15 | 0.23 | 0.02 | 0.75 | 2.96* |
| p value | 0.2359 | 0.4300 | 0.9237 | 0.0911 | 0.7527 | 0.1657 | 0.2200 | 0.6997 | 0.6282 | 0.8917 | 0.3877 | 0.0852 |

As before, we summarize the discussion in the following table.

**Table 6.57: Differences: Independent Variable Perspective**

| Variables | Impact is statistically different on (rich/pooled) | Impact is statistically different on (poor/pooled) | Impact is statistically different on (poor/rich) |
|---|---|---|---|
| Food budget | Cereal, Milk, Fruit (weak) | Cereal, Oil, EFM, Milk, Beverage | Cereal, Oil, EFM, Beverage |
| Family Size | Cereal, Pulse (weak), Sugar, Salt, Milk (weak), Fruit (weak), Beverage (weak) | Cereal, Pulse, Oil (weak), EFM, Fruit | Cereal, Pulse |
| Families with one Child | Sugar, Spice(weak) | Cereal, Oil, PTI (weak), Beverage | Cereal, Oil, Spice, Veg(weak) |
| Families with More Child | Cereal, Spice | Cereal, Pulse, Oil, Spice (weak), EFM, Veg | Cereal, Pulse, Spice, Veg |
| Education | Cereal, Spice | Pulse, Sugar, EFM, PTI (weak) | Pulse, Sugar, Spice, Milk |
| Religion | Spice, Fruit | Spice | Spice, Veg |
| Caste | Fruit, Vegetables, Beverage | Cereal (weak), Pulse | Cereal (weak), Fruit, Vegetables (weak) |
| Language | Identical | Identical | Identical |
| Residence | Salt (weak), Beverage (weak) | Sugar (weak), Spice | EFM |

Thus, if we are interested in observing the effect of independent variables, it is better to focus on individual sub-samples rather than the pooled sample. It is not surprising that the effect of economic (income) or the demographic variable that may have a close connection with the economic position of a family (family size, number of children, education) to be different.[108] However, religion, caste and language play a role and interact with income status. This also

[108] The pooled sample consists of 400 data points, while the sub-samples are only 120 observations each. Hence one expects greater variation, than, say, the urban/rural analysis.

reveals, inter alia, how different economic and socio-demographic factors affect the richest and poorest at par with the general population

Now we flip the table from the consumption perspective.

**Table 6.58: Differences: Food Item Perspective**

| Food Items | Statistically differential Impact is Caused by (Rich and Pooled) | Statistically differential Impact is Caused by (Pooled and Poor) |
|---|---|---|
| **Cereal** | Income, Family size, More than one Child, Education | Income, Family size, One child, More than one child, caste. |
| **Pulse** | Family size | Family size, More than one child, Education, Caste |
| **Sugar** | Family size, More than one child | Education, Residence |
| **Salt** | Income, Family size, residence | Identical |
| **Oil** | Identical | Income, Family size, one child, More than one Child |
| **Spices** | One child, Education, Religion | More Child, Religion |
| **EFM** | Identical | Income, Family size, More than one child, Residence |
| **Milk** | Income, Family size | Income, Education |
| **Fruits** | Income, Family size, religion, caste | Family size, More than one child |
| **Vegetable** | Caste | More than one child |
| **PTI** | Identical | One child, education |
| **Beverages** | Family size, caste, residence | Income, One child |

Thus, in the general population, the Engle curves for oil, EFM and PTI are driven by the richest households, while that of salt reflects the preferences of the poor households. As expected, the difference (between pooled and corresponding subsamples) is more prominent than urban/rural division. For both positive as well as normative analysis, it is better to focus on sub-samples than the pooled one.[109]

### 6.6.3 Expenditure Elasticities

In this section, we compute and compare the expenditure elasticities.

**Table 6.59**
**Computation of Expenditure Elasticities at Sample Mean[110]**

| Commodities | Rich | Poor | Pooled |
|---|---|---|---|
| Cereal | .45*** | .273* | .433*** |
| p value | 0.000 | 0.057 | 0.000 |
| Pulse | .011 | .467*** | .094 |
| p value | 0.930 | 0.010 | 0.207 |
| Sugar | .387*** | .699*** | .435*** |
| p value | 0.010 | 0.002 | 0.000 |
| Salt | .465*** | .419** | .342 |
| p value | 0.000 | 0.027 | 0.000 |
| Oil | .668*** | .197 | .696*** |
| p value | 0.00 | 0.268 | 0.000 |
| Spice | .302** | .616*** | .375*** |
| p value | 0.027 | 0.002 | 0.000 |
| EFM | 1.523*** | 2.346*** | 1.689*** |
| p value | 0.000 | 0.000 | 0.000 |
| Milk | 1.032*** | 1.178*** | .828*** |
| p value | 0.000 | 0.000 | 0.000 |
| Veg | .781*** | 1.041*** | .765*** |
| p value | 0.000 | 0.000 | 0.000 |
| Fruit | .557*** | .4528 | .935*** |
| p value | 0.001 | 0.141 | 0.000 |
| PTI | 1.492*** | .967** | 1.415*** |
| p value | 0.000 | 0.023 | 0.000 |
| Beverages | 1.4007*** | .7199*** | 1.43*** |
| p value | 0.000 | 0.007 | 0.000 |

For the rich households, EFM, milk, PTI and beverages exhibit expenditure elasticities that are higher than unity. The expenditure elasticity of pulse is not significant. For the poor households, EFM, milk and vegetables exhibit expenditure elasticities that are more than unity. Expenditure elasticities of fruit and oil consumption are not significant. However, the last column reveals that between poor and rich, only the expenditure elasticities of pulse, oil, EFM and beverages are statistically different. Thus, we conclude that as far as poor and rich are concerned, the effect of the budget is different in the case of oils, pulse, EFM and beverages.

[109] However, the difference will be less if we include, say, the poorest 40% and the richest 40%.
[110] In the second, third and fourth columns, the p values refer to t statistic.

| Rich Households more Responsive | Poor Households more responsive |
|---|---|
| Cereal, Salt (almost same), Oil, Milk (almost same), Fruit, PTI, Beverages | Pulse, Sugar, Spice, Veg, EFM |

If we compare the magnitude of the elasticities (than explicit testing), some observations are in order. Discounting PTI and beverages, a proportional increase in food budget (say, caused by an overall positive economic shock, the benefits of which are spread equally) would imply that poor households will "fall behind" in Cereal, Oil and Fruit consumptions. The disparity will be exacerbated if the benefits are distributed in an uneven fashion.

Now we compare the expenditure elasticity coefficients

**Table 6.60: Comparison of Expenditure elasticities: Rich, Poor and Pooled[111]**

| Commodities | Poor and Rich | Pooled and poor | Pooled and rich |
|---|---|---|---|
| Cereal | 1.44 | 2.71* | 0.04 |
| p value | 0.2305 | 0.0997 | 0.8439 |
| Pulse | 4.20** | 5.77** | 0.46 |
| p value | 0.0405 | 0.0163 | 0.4971 |
| Sugar | 1.50 | 2.08 | 0.12 |
| p value | 0.2211 | 0.1497 | 0.7336 |
| salt | 0.05 | 0.26 | 1.18 |
| p value | 0.8149 | 0.6086 | 0.2764 |
| Oil | 4.26** | 8.37*** | 0.08 |
| p value | 0.0389 | 0.0038 | 0.7804 |
| Spice | 2.02 | 2.58 | 0.31 |
| p value | 0.1552 | 0.1084 | 0.5756 |
| EFM | 14.58*** | 14.26*** | 3.48* |
| p value | 0.0001 | 0.0002 | 0.0622 |
| Milk | 0.34 | 3.88** | 2.17 |
| p value | 0.5602 | 0.0489 | 0.1404 |
| Fruit | 1.31 | 1.85 | 2.39 |
| p value | 0.2518 | 0.1741 | 0.1224 |
| Veg | 0.13 | 0.41 | 1.55 |
| p value | 0.7142 | 0.5229 | 0.2136 |
| PTI | 1.64 | 1.63 | 0.24 |
| p value | 0.2002 | 0.2017 | 0.6223 |
| Beverage | 3.75** | 6.50*** | 0.03 |
| p value | 0.0529 | 0.0108 | 0.8601 |

[111] P values refer to chi square statistic

From here, we document the differences in the following table

**Table 6.61**
**Statistically Significant Difference in Food Budget Expenditure Elasticity**

| Commodities | Poor and Rich | Rich and Pooled | Poor and Pooled |
|---|---|---|---|
| Cereal | No | No | Yes (weak) |
| Pulse | Yes | No | Yes |
| Sugar | No | No | No |
| Salt | No | No | No |
| Oil | Yes | No | Yes |
| Spice | No | No | No |
| EFM | Yes | Yes (weak) | Yes |
| Milk | No | No | Yes |
| Fruit | No | No | No |
| Veg | No | No | No |
| PTI | No | No | No |
| Beverages | Yes | No | Yes |

The above table can guide us to what extent elasticity measures derived from pooled regression can be used as a policy guide. The logic is, again, simple. If the respective elasticities for poor and rich are similar (the difference is not significant), then it calls for uniform policy across different economic classes. Such uniform policy may be determined by the elasticity calculated through the pooled data.

Given this preliminary, we can say that uniform policies (based on pooled data) can be applied for cereals, sugar, salt (esp. iodized salt) spice, fruit and vegetables.[112] For pulse, Oil, EFM and milk differential policies should be adopted. In the case of milk, although there is no difference between rich and poor (thus calling for uniform policy) or rich and pooled elasticities, poor and pooled elasticities are different (hence adopting pooled elasticity for policy may not be a good idea).

## 6.7 Conclusion

In this chapter, we have used our survey data to analyse demand patterns for two contiguous districts of Assam: Kamrup Metropolitan (Guwahati City) and Kamrup District. Due to the limitation of data, price is available for only a subset of the commodities. We ran two

[112] We assume that PTI and Beverages are outside the ambit of food policy

different estimation strategies.

First, we have estimated complete demand systems based on the limited subset of commodities. The estimation procedures include both LES and LA-AIDS. The focuses are on the effects of demographic variables, the elasticities as well as marginal welfare cost of taxation. We carry out the analysis for two sub-samples, viz. rural and urban.[113] As in chapter 4, we have compared the estimates/policy implications across rural/urban consumption categories.

In the second part of the chapter, we run an Engle curve analysis on all commodities, the independent variables being family food budget and various demographic factors. The focus is on the impacts of socioeconomic variables as well as expenditure elasticity. The estimation strategy allows for effect-comparisons of the demographic factors (and relevant elasticities) across the pooled data and various sub-samples. We consider two sub-samples here. One is the urban/rural (as in the case of complete demand) and another is poor/rich (top bottom 30% of MPCE classes). In general, one expects that the subsamples (urban/rural/rich/poor) to be different from their pooled counterparts. Yet, surprisingly, the impact of many variables on the pooled Engel curve is identical to that with the subsamples, thus making the pooled curve a good approximation for overall behaviour. The consistency of the subsamples with the pooled sample is higher in the case of urban/rural division than in the case of poor/rich division. This is however expected as the poor/rich (120 each) division contains fewer data points than urban/rural (240/160) division. Consequently, if a food policy targets urban/rural separately, our survey more or less conforms to an adaptation of universal application (based on, say, the pooled data). However, if the food policy targets rich and poor separately, then a more nuanced approach is required.

[113] Note that the issue of tax reform has limited application in the context of a district analysis, and more so in the context of urban/rural subsamples within the same district. Nevertheless, the analysis is presented for

## Appendix 6A

### Table 6.62A

### Summary of Explanatory Variables: Rural (n=160)

| Variable | Mean /Proportion (R) | Mean /Proportion (U) | SD (R) | SD(U) | MEDIAN (R) | Median (U) |
|---|---|---|---|---|---|---|
| Food Budget | 9285.08 | 10023.71 | 4483.64 | 4968.13 | 7987.5 | 8518.5 |
| Family Size | 3.78 | 3.92 | 1.51 | 1.56 | 4 | 4 |
| Education | .154 | .37 | .2043807 | .307 | 0[114] | .33 |
| One Child Dummy | .39 | .45 | - | - | - | - |
| More Child Dummy | .28 | .44 | - | - | - | - |
| Religion Dummy | .71 | .72 | - | - | - | - |
| Caste Dummy | .48 | .65 | | - | - | - |
| Language Dummy | .74 | .45 | | - | - | - |

[114] 0 implies education is less than or equal to 10th standard.

**Summary Statistics of Groups: Rich/Poor**

**Table 6.63A Consumption**

| Food Items (budget share) | **Mean (P)** | **Mean (R)** | **SD (P)** | **SD (R)** | **Median (P)** | **Median (R)** |
|---|---|---|---|---|---|---|
| Cereal | 0.209 | 0.117 | 0.097 | 0.056 | 0.182 | 0.109 |
| Pulse | 0.042 | 0.03 | 0.027 | 0.02 | 0.035 | 0.026 |
| Sugar | 0.021 | 0.015 | 0.013 | 0.011 | 0.017 | 0.014 |
| Salt | 0.004 | 0.002 | 0.002 | 0.001 | 0.003 | 0.002 |
| Oil | 0.056 | 0.049 | 0.03 | 0.026 | 0.049 | 0.043 |
| Spice | 0.031 | 0.019 | 0.018 | 0.013 | 0.029 | 0.017 |
| EFM | 0.192 | 0.239 | 0.132 | 0.15 | 0.176 | 0.242 |
| Milk | 0.127 | 0.101 | 0.084 | 0.082 | 0.134 | 0.086 |
| Fruit | 0.058 | 0.084 | 0.052 | 0.063 | 0.044 | 0.074 |
| Veg | 0.149 | 0.17 | 0.089 | 0.115 | 0.129 | 0.145 |
| PTI | 0.063 | 0.115 | 0.075 | 0.128 | 0.047 | 0.064 |
| Beverages | 0.046 | 0.058 | 0.035 | 0.05 | 0.038 | 0.044 |

## Table 6.64A

## Summary of Explanatory Variables: Poor/Rich

| Variable | Mean /Proportion (P) | Mean /Proportion (R) | SD (P) | SD (R) | MEDIAN (P) | MEDIAN (R) |
|---|---|---|---|---|---|---|
| Food Budget | 7958.76 | 11215.73 | 3317.53 | 5777.121 | 7198 | 10207.75 |
| Family Size | 4.25 | 3.45 | 1.58 | 1.51 | 4 | 4 |
| Education | .181 | . 447 | .244 | .313 | 0[115] | .33 |
| One Child Dummy | .43 | .43 | - | - | - | - |
| More Child Dummy | .38 | .32 | - | - | - | - |
| Religion Dummy | .708 | .71 | - | - | - | - |
| Caste Dummy | .53 | .608 | - | - | - | - |
| Language Dummy | .61 | .566 | - | - | - | - |
| Residence Dummy | .5 | .71 | - | - | - | - |

[115] 0 implies education is less than or equal to 10th standard.

## Table 6.65A: Regression Results: Urban/Rural: Pooled Sample

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | -0.0901*** | -0.0318*** | -0.0867*** | -0.00996*** | -0.0160*** | -0.0156*** | 0.154*** | -0.0205* | -0.0161** | -0.00984 | 0.0341*** | 0.0232*** |
| | (0.00901) | (0.00261) | (0.0128) | (0.00158) | (0.00420) | (0.00191) | (0.0154) | (0.0105) | (0.00751) | (0.0133) | (0.0125) | (0.00622) |
| famsize | 0.0392*** | 0.000854 | 0.0482*** | 0.00171*** | 0.00421*** | 0.00335*** | -0.00720 | -0.00121 | -0.00372 | -0.0146*** | -0.0171*** | -0.00570*** |
| | (0.00305) | (0.000886) | (0.00462) | (0.000535) | (0.00142) | (0.000646) | (0.00521) | (0.00356) | (0.00254) | (0.00451) | (0.00424) | (0.00211) |
| onech_dum | -0.0232*** | -0.00373 | -0.0171** | -0.00238 | 0.00571 | 0.000712 | 0.00314 | 0.0208** | 0.0140* | -0.00589 | -0.00840 | -0.000408 |
| | (0.00861) | (0.00250) | (0.0125) | (0.00151) | (0.00401) | (0.00182) | (0.0147) | (0.0100) | (0.00717) | (0.0127) | (0.0120) | (0.00594) |
| morech_dum | -0.0835*** | 0.00355 | -0.0934*** | -0.00746*** | -0.00415 | -0.00972*** | 0.0135 | 0.0386*** | 0.0179** | 0.00281 | 0.0357** | -0.00677 |
| | (0.0107) | (0.00311) | (0.0154) | (0.00187) | (0.00499) | (0.00227) | (0.0182) | (0.0125) | (0.00892) | (0.0158) | (0.0149) | (0.00738) |
| educode | -0.00987 | 0.00171 | -0.0690*** | 0.00210 | -0.00726 | 0.000677 | -0.0786*** | -0.0231 | 0.0249** | 0.0444** | 0.0469*** | -0.00125 |
| | (0.0120) | (0.00350) | (0.0250) | (0.00211) | (0.00562) | (0.00255) | (0.0205) | (0.0140) | (0.0100) | (0.0178) | (0.0168) | (0.00831) |
| relgcode | 0.0119 | 0.000384 | 0.0169 | 0.00175 | 0.00646* | -0.00656*** | -0.0760*** | -0.00381 | 0.0111* | 0.0244** | 0.0170 | 0.0134** |
| | (0.00792) | (0.00230) | (0.0122) | (0.00139) | (0.00369) | (0.00168) | (0.0135) | (0.00923) | (0.00660) | (0.0117) | (0.0110) | (0.00546) |
| socgcode | 0.00947 | -0.000375 | 0.0144 | 0.00157 | 0.00161 | 0.00102 | -0.0365*** | 0.0134 | 0.00210 | 0.0327*** | -0.0191* | -0.00583 |
| | (0.00724) | (0.00210) | (0.0107) | (0.00127) | (0.00337) | (0.00153) | (0.0123) | (0.00844) | (0.00603) | (0.0107) | (0.0101) | (0.00499) |
| lancode | -0.00252 | -0.00407** | 0.00685 | 0.000372 | -0.00163 | 0.00220 | 0.0231* | 0.00784 | 0.00430 | -0.0232** | -0.00625 | -0.000555 |
| | (0.00703) | (0.00204) | (0.0121) | (0.00123) | (0.00328) | (0.00149) | (0.0120) | (0.00820) | (0.00586) | (0.0104) | (0.00977) | (0.00485) |
| Constant | 0.848*** | 0.323** | 0.779*** | 0.101*** | 0.178*** | 0.159*** | -1.070*** | 0.288*** | 0.199*** | 0.270** | -0.178* | -0.138** |
| | (0.0772) | (0.0224) | (0.107) | (0.0135) | (0.0360) | (0.0163) | (0.132) | (0.0900) | (0.0643) | (0.114) | (0.107) | (0.0532) |
| R-squared | 0.340 | 0.333 | 0.457 | 0.135 | 0.064 | 0.237 | 0.298 | 0.058 | 0.052 | 0.107 | 0.095 | 0.075 |

## Table 6.66A: Urban Sub-sample

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | -0.0982*** | -0.0278*** | -0.00989*** | -0.00174*** | -0.0157** | -0.0161*** | 0.136*** | -0.0233* | -0.0114 | -0.00337 | 0.0498*** | 0.0217*** |
| | (0.0127) | (0.00338) | (0.00222) | (0.000176) | (0.00627) | (0.00256) | (0.0208) | (0.0140) | (0.0106) | (0.0182) | (0.0171) | (0.00788) |
| famsize | 0.0355*** | 0.00106 | 0.00156** | 0.000240*** | 0.00410** | 0.00308*** | -0.00163 | 0.00228 | -0.00859** | -0.0163*** | -0.0176*** | -0.00371 |
| | (0.00405) | (0.00108) | (0.000711) | (5.62e-05) | (0.00201) | (0.000819) | (0.00664) | (0.00448) | (0.00340) | (0.00584) | (0.00548) | (0.00252) |
| onech_dum | -0.0290** | -0.00136 | -0.00178 | -6.23e-05 | 0.00816 | -3.15e-05 | 0.0149 | 0.0131 | 0.0199** | -0.00799 | -0.0173 | 0.00153 |
| | (0.0116) | (0.00311) | (0.00204) | (0.000161) | (0.00576) | (0.00235) | (0.0191) | (0.0129) | (0.00976) | (0.0168) | (0.0157) | (0.00724) |
| morech_dum | -0.0828*** | 0.00447 | -0.00742*** | -0.000113 | -0.00288 | -0.00905*** | 0.0193 | 0.0134 | 0.0378*** | 0.00411 | 0.0281 | -0.00499 |
| | (0.0146) | (0.00389) | (0.00256) | (0.000202) | (0.00721) | (0.00294) | (0.0239) | (0.0161) | (0.0122) | (0.0210) | (0.0197) | (0.00906) |
| educode | 0.00689 | -0.00106 | 0.00255 | 2.72e-05 | -0.0126* | -0.00201 | -0.0944*** | -0.0184 | 0.0145 | 0.0323 | 0.0674*** | 0.00478 |
| | (0.0152) | (0.00406) | (0.00267) | (0.000211) | (0.00753) | (0.00307) | (0.0249) | (0.0168) | (0.0128) | (0.0219) | (0.0206) | (0.00946) |
| relgcode | 0.00581 | 0.000842 | 0.00218 | -8.70e-05 | 0.00171 | -0.00498** | -0.0508*** | 0.00658 | 0.00765 | 0.0128 | 0.0149 | 0.00340 |
| | (0.0105) | (0.00280) | (0.00184) | (0.000145) | (0.00519) | (0.00212) | (0.0172) | (0.0116) | (0.00879) | (0.0151) | (0.0142) | (0.00652) |
| socgcode | 0.00689 | -0.000316 | 0.00280 | -0.000117 | 0.00252 | -0.00176 | -0.0202 | 0.0238** | 0.00304 | -0.000984 | -0.0141 | -0.00160 |
| | (0.00979) | (0.00261) | (0.00172) | (0.000136) | (0.00485) | (0.00198) | (0.0161) | (0.0108) | (0.00822) | (0.0141) | (0.0132) | (0.00609) |
| lancode | -0.00595 | -0.00483** | -0.000923 | 9.67e-07 | -0.000868 | 0.00318* | 0.0215 | 0.00805 | 0.00265 | -0.0197 | 0.000732 | -0.00379 |
| | (0.00927) | (0.00247) | (0.00163) | (0.000129) | (0.00459) | (0.00187) | (0.0152) | (0.0103) | (0.00778) | (0.0134) | (0.0125) | (0.00577) |
| Constant | 0.940*** | 0.285** | 0.100*** | 0.0176*** | 0.182*** | 0.167*** | -0.952*** | 0.293** | 0.172* | 0.257 | -0.330** | -0.132* |
| | (0.110) | (0.0293) | (0.0192) | (0.00152) | (0.0543) | (0.0222) | (0.180) | (0.121) | (0.0920) | (0.158) | (0.148) | (0.0682) |
| R-squared | 0.304 | 0.283 | 0.135 | 0.314 | 0.068 | 0.224 | 0.263 | 0.051 | 0.073 | 0.077 | 0.137 | 0.047 |

## Table 6.67A: Rural Sub-sample

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruit | Veg | PTI | Beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | -0.0867*** | -0.0368*** | -0.0106*** | -0.00230*** | -0.0192*** | -0.0141*** | 0.192*** | -0.0124 | -0.0217** | -0.0225 | 0.0146 | 0.0202* |
| | (0.0128) | (0.00429) | (0.00232) | (0.000509) | (0.00529) | (0.00295) | (0.0232) | (0.0165) | (0.0104) | (0.0196) | (0.0190) | (0.0103) |
| famsize | 0.0482*** | 4.11e-05 | 0.00221*** | 0.000221 | 0.00497** | 0.00369*** | -0.0171** | -0.00695 | 0.00377 | -0.0132* | -0.0173** | -0.00845** |
| | (0.00462) | (0.00155) | (0.000839) | (0.000184) | (0.00192) | (0.00107) | (0.00842) | (0.00598) | (0.00378) | (0.00710) | (0.00688) | (0.00374) |
| onech_dum | -0.0171** | -0.00642 | -0.00341 | -0.000453 | 0.000593 | 0.00169 | -0.0144 | 0.0282* | 0.00875 | -0.000974 | 0.00546 | -0.00192 |
| | (0.0125) | (0.00419) | (0.00226) | (0.000497) | (0.00517) | (0.00288) | (0.0227) | (0.0161) | (0.0102) | (0.0192) | (0.0186) | (0.0101) |
| morech_dum | -0.0934*** | 0.00362 | -0.00810*** | -0.00110* | -0.00704 | -0.0108*** | 0.0118 | 0.0746*** | -0.0108 | 0.00134 | 0.0482** | -0.00828 |
| | (0.0154) | (0.00518) | (0.00280) | (0.000614) | (0.00639) | (0.00356) | (0.0281) | (0.0199) | (0.0126) | (0.0237) | (0.0229) | (0.0125) |
| educode | -0.0690*** | 0.0111 | 0.00157 | -0.00145 | -0.00935 | 0.000805 | -0.00239 | -0.0249 | 0.0694*** | 0.0270 | -0.00200 | -0.000845 |
| | (0.0250) | (0.00840) | (0.00453) | (0.000995) | (0.0104) | (0.00576) | (0.0455) | (0.0323) | (0.0204) | (0.0384) | (0.0372) | (0.0202) |
| relgcode | 0.0169 | 0.00117 | 0.000329 | 0.000670 | 0.0118** | -0.00964*** | -0.127*** | -0.0237 | 0.0172* | 0.0490*** | 0.0318* | 0.0314*** |
| | (0.0122) | (0.00410) | (0.00221) | (0.000486) | (0.00506) | (0.00282) | (0.0222) | (0.0158) | (0.00998) | (0.0187) | (0.0182) | (0.00987) |
| socgcode | 0.0144 | -8.33e-05 | -0.000340 | 0.000527 | -0.00140 | 0.00357 | -0.0709*** | -0.00278 | -0.00124 | 0.0803*** | -0.0154 | -0.00678 |
| | (0.0107) | (0.00361) | (0.00195) | (0.000427) | (0.00445) | (0.00248) | (0.0195) | (0.0139) | (0.00877) | (0.0165) | (0.0160) | (0.00868) |
| lancode | 0.00685 | -0.00285 | 0.00306 | 0.000484 | 0.00229 | 0.00329 | 0.0235 | 0.00354 | 0.00730 | -0.0182 | -0.0265 | -0.00273 |
| | (0.0121) | (0.00405) | (0.00219) | (0.000481) | (0.00500) | (0.00278) | (0.0220) | (0.0156) | (0.00986) | (0.0185) | (0.0179) | (0.00976) |
| Constant | 0.779*** | 0.370** | 0.106*** | 0.0230*** | 0.198*** | 0.143*** | -1.320*** | 0.250* | 0.221** | 0.329** | 0.00769 | -0.106 |
| | (0.107) | (0.0360) | (0.0194) | (0.00426) | (0.0444) | (0.0247) | (0.195) | (0.138) | (0.0875) | (0.164) | (0.159) | (0.0866) |
| R-squared | 0.457 | 0.412 | 0.162 | 0.172 | 0.117 | 0.308 | 0.400 | 0.121 | 0.127 | 0.197 | 0.087 | 0.160 |

# Regression Results, Rich and Poor

## Table 6.68A: Pooled Sample (n= 400)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | cereal | pulse | sugar | salt | oil | spice | efm | milk | fruit | veg | pti | Bev |
| L_food | -0.0902*** | -0.0318*** | -0.00995*** | -0.00188*** | -0.0162*** | -0.0157*** | 0.154*** | -0.0204* | -0.0160** | -0.0103 | 0.0345*** | 0.0234*** |
| | (0.00902) | (0.00262) | (0.00158) | (0.000234) | (0.00418) | (0.00190) | (0.0154) | (0.0105) | (0.00751) | (0.0133) | (0.0125) | (0.00621) |
| famsize | 0.0392*** | 0.000838 | 0.00170*** | 0.000221*** | 0.00430*** | 0.00339*** | -0.00720 | -0.00124 | -0.00377 | -0.0145*** | -0.0172*** | -0.00579*** |
| | (0.00306) | (0.000887) | (0.000535) | (7.93e-05) | (0.00142) | (0.000644) | (0.00521) | (0.00356) | (0.00255) | (0.00450) | (0.00424) | (0.00210) |
| onech_dum | -0.0234*** | -0.00365 | -0.00236 | -0.000253 | 0.00516 | 0.000495 | 0.00313 | 0.0209** | 0.0143** | -0.00692 | -0.00752 | 7.17e-05 |
| | (0.00863) | (0.00251) | (0.00151) | (0.000224) | (0.00400) | (0.00182) | (0.0147) | (0.0101) | (0.00719) | (0.0127) | (0.0120) | (0.00594) |
| morech_dum | -0.0836*** | 0.00360 | -0.00745*** | -0.000517* | -0.00446 | -0.00984*** | 0.0135 | 0.0387*** | 0.0181** | 0.00223 | 0.0362** | -0.00650 |
| | (0.0107) | (0.00311) | (0.00188) | (0.000278) | (0.00496) | (0.00226) | (0.0183) | (0.0125) | (0.00892) | (0.0158) | (0.0149) | (0.00738) |
| educode | -0.0114 | 0.00247 | 0.00223 | -0.000243 | -0.0120** | -0.00120 | -0.0786*** | -0.0217 | 0.0276** | 0.0355* | 0.0546*** | 0.00291 |
| | (0.0128) | (0.00372) | (0.00225) | (0.000333) | (0.00594) | (0.00270) | (0.0219) | (0.0150) | (0.0107) | (0.0189) | (0.0178) | (0.00883) |
| relgcode | 0.0116 | 0.000495 | 0.00177 | 0.000154 | 0.00578 | -0.00684*** | -0.0760*** | -0.00361 | 0.0115* | 0.0231** | 0.0181 | 0.0140** |
| | (0.00795) | (0.00231) | (0.00139) | (0.000206) | (0.00368) | (0.00167) | (0.0136) | (0.00927) | (0.00662) | (0.0117) | (0.0110) | (0.00547) |
| socgcode | 0.00918 | -0.000236 | 0.00160 | 7.00e-05 | 0.000749 | 0.000682 | -0.0366*** | 0.0136 | 0.00258 | 0.0311*** | -0.0177* | -0.00507 |
| | (0.00729) | (0.00211) | (0.00128) | (0.000189) | (0.00337) | (0.00154) | (0.0124) | (0.00850) | (0.00607) | (0.0107) | (0.0101) | (0.00502) |
| lancode | -0.00181 | -0.00441** | 0.000312 | 0.000144 | 0.000500 | 0.00304** | 0.0232* | 0.00722 | 0.00311 | -0.0191* | -0.00969 | -0.00243 |
| | (0.00730) | (0.00212) | (0.00128) | (0.000189) | (0.00338) | (0.00154) | (0.0125) | (0.00852) | (0.00608) | (0.0108) | (0.0101) | (0.00503) |
| rescode | 0.00283 | -0.00137 | -0.000242 | -0.000789*** | 0.00854** | 0.00338** | 5.16e-05 | -0.00250 | -0.00478 | 0.0162 | -0.0138 | -0.00751 |
| | (0.00784) | (0.00227) | (0.00137) | (0.000203) | (0.00363) | (0.00165) | (0.0134) | (0.00914) | (0.00653) | (0.0115) | (0.0109) | (0.00539) |
| Constant | 0.847*** | 0.323*** | 0.102*** | 0.0196*** | 0.176*** | 0.158*** | -1.070*** | 0.288*** | 0.200*** | 0.266** | -0.174 | -0.136** |
| | (0.0773) | (0.0224) | (0.0135) | (0.00200) | (0.0358) | (0.0163) | (0.132) | (0.0901) | (0.0643) | (0.114) | (0.107) | (0.0532) |
| R-squared | 0.340 | 0.333 | 0.135 | 0.217 | 0.078 | 0.245 | 0.298 | 0.058 | 0.053 | 0.111 | 0.099 | 0.079 |

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

**Table 6.69A: Poorest 30% Household (n=120)**

| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruits | Veg | PTI | Bev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L_food | -0.152*** | -0.0226*** | -0.00634 | -0.00206*** | -0.0453*** | -0.0119** | 0.258*** | 0.0227 | -0.0319* | 0.00615 | -0.00199 | -0.0129 |
| | (0.0298) | (0.00753) | (0.00455) | (0.000663) | (0.00998) | (0.00589) | (0.0341) | (0.0299) | (0.0178) | (0.0311) | (0.0266) | (0.0121) |
| famsize | 0.0592*** | -0.00646*** | -8.89e-05 | 0.000230 | 0.00913*** | 0.00259 | -0.0275** | -0.0134 | 0.00657 | -0.0208** | -0.00717 | -0.00236 |
| | (0.00922) | (0.00233) | (0.00141) | (0.000205) | (0.00309) | (0.00182) | (0.0106) | (0.00925) | (0.00550) | (0.00963) | (0.00823) | (0.00375) |
| onech_dum | -0.0710*** | 3.19e-06 | -0.00335 | 0.000198 | -0.00977 | -0.00420 | 0.0331 | 0.0321* | 0.00736 | 0.0129 | 0.0164 | -0.0137* |
| | (0.0189) | (0.00480) | (0.00290) | (0.000422) | (0.00635) | (0.00375) | (0.0217) | (0.0190) | (0.0113) | (0.0198) | (0.0169) | (0.00770) |
| morech_dum | -0.167*** | 0.0133* | -0.00748 | -0.000829 | -0.0200** | -0.0184*** | 0.0765** | 0.0714** | -0.0247 | 0.0534* | 0.0298 | -0.00578 |
| | (0.0299) | (0.00756) | (0.00457) | (0.000666) | (0.0100) | (0.00591) | (0.0342) | (0.0300) | (0.0178) | (0.0312) | (0.0267) | (0.0121) |
| educode | -0.0228 | 0.0226*** | 0.0126** | -0.000332 | 0.00909 | -0.00687 | -0.120*** | 0.0573* | 0.0337* | 0.0227 | 0.00323 | -0.0108 |
| | (0.0339) | (0.00857) | (0.00518) | (0.000755) | (0.0114) | (0.00670) | (0.0388) | (0.0340) | (0.0202) | (0.0354) | (0.0302) | (0.0138) |
| relgcode | 0.0277 | -0.000579 | 0.00109 | -2.14e-06 | 0.0105* | -0.0120*** | -0.116*** | -0.000153 | 0.0276** | 0.0223 | 0.0248 | 0.0146* |
| | (0.0185) | (0.00468) | (0.00283) | (0.000412) | (0.00619) | (0.00366) | (0.0212) | (0.0185) | (0.0110) | (0.0193) | (0.0165) | (0.00750) |
| socgcode | 0.0304* | -0.00763* | 0.00272 | -0.000386 | -0.00182 | 0.00180 | -0.0524*** | -0.00612 | 0.0138 | 0.0242 | -0.00585 | 0.00137 |
| | (0.0169) | (0.00428) | (0.00258) | (0.000377) | (0.00567) | (0.00334) | (0.0194) | (0.0170) | (0.0101) | (0.0177) | (0.0151) | (0.00687) |
| lancode | -0.0124 | -0.00568 | -0.00242 | 0.000192 | -0.00466 | -0.000405 | 0.0200 | 0.00937 | 0.00724 | 0.00282 | -0.0135 | -0.000485 |
| | (0.0167) | (0.00423) | (0.00255) | (0.000372) | (0.00560) | (0.00330) | (0.0191) | (0.0168) | (0.00997) | (0.0174) | (0.0149) | (0.00678) |
| rescode | -0.000170 | -0.00653 | -0.00347 | -0.000877** | 0.00340 | 0.00269 | 0.0431** | -0.00447 | -0.0110 | 0.0120 | -0.0334** | -0.00125 |
| | (0.0166) | (0.00421) | (0.00254) | (0.000370) | (0.00557) | (0.00329) | (0.0190) | (0.0167) | (0.00993) | (0.0174) | (0.0148) | (0.00675) |
| Constant | 1.350*** | 0.276*** | 0.0793** | 0.0216*** | 0.422*** | 0.139*** | -1.921*** | -0.0549 | 0.283* | 0.127 | 0.109 | 0.169* |
| | (0.240) | (0.0607) | (0.0366) | (0.00534) | (0.0803) | (0.0474) | (0.274) | (0.241) | (0.143) | (0.250) | (0.214) | (0.0973) |
| Observations | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |
| R-squared | 0.313 | 0.414 | 0.138 | 0.211 | 0.190 | 0.223 | 0.517 | 0.083 | 0.147 | 0.104 | 0.091 | 0.139 |

SE_in_parenthesis

*** p<0.01, ** p<0.05, * p<0.1

## Table 6.70A Richest 30% Household (n=120)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | Cereal | Pulse | Sugar | Salt | Oil | Spice | EFM | Milk | Fruits | Veg | PTI | Bev |
| L_food | -0.0644*** | -0.0295*** | -0.00948*** | -0.00121*** | -0.0162*** | -0.0134*** | 0.125*** | 0.00334 | -0.0370** | -0.0373 | 0.0567* | 0.0233** |
| | (0.0108) | (0.00371) | (0.00229) | (0.000285) | (0.00550) | (0.00259) | (0.0308) | (0.0192) | (0.0143) | (0.0248) | (0.0292) | (0.0113) |
| famsize | 0.0251*** | 0.00438** | 0.00181* | -4.98e-07 | 0.00753*** | 0.00255** | -0.0227 | -0.0133 | 0.00526 | -0.000478 | -0.0133 | 0.00322 |
| | (0.00493) | (0.00170) | (0.00105) | (0.000130) | (0.00252) | (0.00119) | (0.0141) | (0.00877) | (0.00654) | (0.0113) | (0.0134) | (0.00518) |
| onech_dum | 0.00159 | -0.00709 | -0.00295 | -5.46e-05 | 0.0107 | 0.00562* | 0.0280 | 0.0293 | -0.00325 | -0.0517* | -0.0126 | 0.00238 |
| | (0.0133) | (0.00458) | (0.00284) | (0.000352) | (0.00680) | (0.00321) | (0.0381) | (0.0237) | (0.0177) | (0.0306) | (0.0361) | (0.0140) |
| morech_dum | -0.0233 | -0.00501 | -0.00804** | -2.01e-05 | -0.00965 | -0.00302 | 0.0699 | 0.0357 | -0.00340 | -0.0531 | 0.0271 | -0.0272 |
| | (0.0175) | (0.00602) | (0.00373) | (0.000463) | (0.00894) | (0.00422) | (0.0500) | (0.0311) | (0.0232) | (0.0403) | (0.0475) | (0.0184) |
| educode | 0.0222 | -0.00570 | 0.00246 | 0.000192 | -0.00396 | 0.0105*** | -0.0710 | -0.0358 | 0.0136 | -0.0105 | 0.0797* | -0.00160 |
| | (0.0163) | (0.00560) | (0.00347) | (0.000431) | (0.00832) | (0.00392) | (0.0465) | (0.0290) | (0.0216) | (0.0375) | (0.0442) | (0.0171) |
| relgcode | 0.00327 | 0.00177 | 0.00258 | 0.000173 | 0.00804 | 0.00176 | -0.0806*** | 0.00368 | -0.0253* | 0.0260 | 0.0401 | 0.0184* |
| | (0.00970) | (0.00334) | (0.00207) | (0.000257) | (0.00496) | (0.00234) | (0.0277) | (0.0173) | (0.0129) | (0.0223) | (0.0264) | (0.0102) |
| socgcode | -0.00186 | -0.00106 | 0.00186 | -0.000106 | 0.000262 | -0.00128 | -0.0556** | 0.0190 | -0.0196 | 0.0761*** | -0.0283 | 0.0106 |
| | (0.00924) | (0.00318) | (0.00197) | (0.000245) | (0.00472) | (0.00223) | (0.0264) | (0.0164) | (0.0123) | (0.0213) | (0.0251) | (0.00971) |
| lancode | -0.00837 | -0.00578* | -0.000327 | 5.47e-05 | -0.00284 | 0.00256 | 0.0161 | 0.00345 | 0.00893 | -0.00973 | -0.00185 | -0.00223 |
| | (0.00981) | (0.00338) | (0.00209) | (0.000260) | (0.00502) | (0.00237) | (0.0281) | (0.0175) | (0.0130) | (0.0226) | (0.0267) | (0.0103) |
| rescode | -0.00901 | 0.00131 | -4.25e-05 | -0.000278 | 0.0103* | -8.47e-05 | -0.0298 | 0.00412 | -0.0108 | 0.0190 | 0.00712 | 0.00817 |
| | (0.0111) | (0.00384) | (0.00237) | (0.000295) | (0.00570) | (0.00269) | (0.0319) | (0.0198) | (0.0148) | (0.0257) | (0.0303) | (0.0117) |
| Constant | 0.631*** | 0.295*** | 0.0965*** | 0.0134*** | 0.160*** | 0.126*** | -0.735*** | 0.0892 | 0.435*** | 0.486** | -0.415 | -0.183* |
| | (0.0961) | (0.0331) | (0.0205) | (0.00254) | (0.0492) | (0.0232) | (0.275) | (0.171) | (0.128) | (0.221) | (0.261) | (0.101) |
| Observations | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |
| R-squared | 0.364 | 0.404 | 0.208 | 0.204 | 0.260 | 0.325 | 0.283 | 0.064 | 0.116 | 0.217 | 0.112 | 0.140 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**Issue of Zero Consumption: Urban/Rural**

In many cases, we have zero consumption.

**Table 6.71A: Zero Consumption Cases (Urban/Rural)**

| Food Items | Urban (n=240) | Rural (n=160) |
|---|---|---|
| Cereal | 1 | 0 |
| Pulse | 0 | 0 |
| Sugar | 0 | 0 |
| Salt | 0 | 0 |
| Oil | 1 | 0 |
| Spice | 0 | 0 |
| EFM | 7 | 6 |
| Milk | 23 | 21 |
| Fruit | 18 | 3 |
| Veg | 3 | 1 |
| PTI | 41 | 27 |
| Bev | 2 | 5 |

**Table 6.72A: Zero Consumption Cases: Poor/Rich**

| Food Item | Poor (n=120) | Rich(n=120) |
|---|---|---|
| Cereal | 0 | 0 |
| Pulse | 0 | 0 |
| Sugar | 0 | 0 |
| Salt | 0 | 0 |
| Oil | 0 | 0 |
| Spice | 0 | 0 |
| EFM | 7 | 2 |
| Milk | 19 (15.84%) | 10 (8.34%) |
| Fruits | 9 | 3 |
| Veg | 3 | 3 |
| PTI | 27 (22.5%) | 15 (12.5%) |
| Beverages | 4 | 0 |

These zero reporting may arise due to many factors. First, these can be a true 'zero', for example, economic, caste and religious restrictions imply many families do not purchase the item. On the other hand, such zero consumptions also may arise due to the fact that either the households did not purchase those items or those items were not available (although normally the households do purchase such items from time to time) within the time period concerned (see Deaton, 1997).

To mitigate the potential bias arising out of sample selection bias, we employ Heckman two-step estimation methodology (see, for example, Raper *et. al*. (*op cit*) or Ulubasoglu *et al* (2016). We briefly explain the methodology here.

Suppose the consumption equation to be estimated is given by

$$\mathbf{w} = \mathbf{x}\boldsymbol{\beta} + \boldsymbol{\varepsilon} ...(A6.1)$$

Here, w is the vector of shares, β is the vector of coefficients to be estimated and x is the vector of explanatory variables. However, the vector w contains many 0 (non-purchase) observations. We assume that the purchase decision (in effect, a zero-one decision) is related to a latent process

$$\mathbf{z}^* = \boldsymbol{\xi}\boldsymbol{\Pi} + \mathbf{u} ...(A6.2)$$

Here ξ is the vector of the explanatory variables and Π is the coefficient vector. Probit specification assumes that the vector of errors follows a standard normal distribution, i.e. $\mathbf{u} \sim N(0, \mathbf{I})$. Moreover, the set of variables x must be a subset of ξ.[116] We observe $z_i$=1 (positive purchase) if $z^*_i$> 0 and $z_i$=0 otherwise.

To be more specific to our context, we assume that

$$\begin{aligned} I_i &= \pi_0 + \pi_1 * L\_Food + \pi_2 * \ln(non\_food) + \pi_3 * famsize \\ &+ \pi_4 * onech\_dum + \pi_5 * morech\_dum + \pi_6 * educode + \sum_{k>6} \pi_k * d_k + u_i ...(A6.3) \end{aligned}$$

Here $I_i$= 1 0r 0, $d_k$ is the social indicators we had encountered in equation (*ref to the main body). The only change here is we posit that the purchase decision depends *on expenditure on non-food expenditure* as well as food budget.[117] Households typically do purchase foods and non-foods together, and if the non-food expenditure is high, it may have an impact on food expenditure as well.

The inverse-Mill's ratio (IMR) for a typical household is obtained by estimating the above equation

$$IMR_h = \frac{\phi(\boldsymbol{\xi}\boldsymbol{\Pi})}{\Phi(\boldsymbol{\xi}\boldsymbol{\Pi})} ...(A6.4)$$

For households purchasing the item and

$$IMR_h = \frac{\phi(\boldsymbol{\xi}\boldsymbol{\pi})}{1 - \Phi(\boldsymbol{\xi}\boldsymbol{\pi})} ...(A6.5)$$

[116] Wooldridge (1999).

[117] See Ulugubaslu et al (op.cit).

for households not purchasing the item. Here, φ and Φ are, respectively, the standard normal density function and cumulative density function evaluated at the predicted values.[118]

In the second stage of the procedure, the $IMR_h$ is added as an explanatory variable in the original equation, i.e.

$$w_i = \alpha_0 + \alpha_i \ln(X) + \beta_{1i} * family\_size + \beta_{2i} * one\_child\_dum + \beta_{3i} * (more\_child\_dum)$$
$$+ \beta_{4i} * educ + \beta_{5i} * relg + \beta_{6i} * caste + \beta_{7i} * language + \beta_{8i} * IMR + \varepsilon_i ....(A6.6)$$

The coefficient $\beta_{8i}$ measures $\rho\sigma_\varepsilon$, where ρ is the correlation between ε and v. If $\beta_{8i}$ is not significantly different from zero (running the regressions only with $w_i > 0$), then there is no difference between the two-step and the one-step procedures. Then the marginal effect of ln(X) on w is $\alpha_i$ as reported in the earlier equation. [119]

Given the data, we posit that zero consumption is likely to be an issue with milk and PTI, where close to 10% of total observations do are zero. Hence we investigate these two items in detail.

First, we report the probit regression separately for urban and rural consumption of milk.

[118] Inverse Mill's ratio is the hazard function.

[119] Suppose the null cannot be rejected. Then, running the regressions only for families with $w_i > 0$, we get the conditional expenditure elasticity $e_i(w_i > 0) = 1 + \frac{\alpha_i}{w_i}|_{w_i>0} + \beta_{8i}\left(\frac{\partial IMR}{\partial \ln X}\right)_{w_i>0}$. Given that $IMR = \frac{\phi(\xi\Pi)}{\Phi(\xi\Pi)}$, we must have

$$\frac{\partial}{\partial \ln X}\left(\frac{\phi(\xi\Pi)}{\Phi(\xi\Pi)}\right)$$
$$= \frac{\pi_1 * \Phi * \phi' - \phi * \Phi * \pi_1}{\Phi^2}$$
$$= \pi_1 * \frac{-(\xi\Pi) * \phi * \Phi - \phi^2}{\Phi^2}$$
$$= \pi_1\left[-(\xi\Pi) * \left(\frac{\phi}{\Phi}\right) - \left(\frac{\phi}{\Phi}\right)^2\right]$$

Thus

$$e_i(w_i > 0) = 1 + \frac{1}{w_i}\left\{\alpha_i - \beta_{8i}\pi_1\left[(\xi\Pi) * \left(\frac{\phi}{\Phi}\right) + \left(\frac{\phi}{\Phi}\right)^2\right]\right\}$$

**Table 6.73A: Probit Regressions: Milk (urban/Rural)**

| | Rural | Urban |
|---|---|---|
| VARIABLES | milkdum | milkdum |
| L_food | 1.019*** | 0.391 |
| | (0.354) | (0.350) |
| famsize | -0.393*** | -0.122 |
| | (0.128) | (0.0838) |
| onech_dum | 0.445 | 0.360 |
| | (0.272) | (0.223) |
| morech_dum | 1.654*** | 0.460 |
| | (0.466) | (0.322) |
| educode | -0.585 | 0.573 |
| | (0.642) | (0.406) |
| relgcode | -1.139*** | -0.00914 |
| | (0.427) | (0.276) |
| socgcode | -0.209 | 0.502** |
| | (0.288) | (0.243) |
| lancode | -0.0436 | 0.212 |
| | (0.333) | (0.239) |
| Lnfe | 0.0508 | -0.120 |
| | (0.157) | (0.169) |
| Constant | -6.303** | -1.517 |
| | (2.880) | (2.955) |
| Observations | 160 | 240 |

Interestingly, for urban consumption, almost all variables are not significant (does not change the probability of zero consumption). On the other hand, in rural samples, probabilities of consumption are higher for families with a higher food budget and more than one child. However, the probability falls with higher family size and households belonging to the majority religion.

Incorporating the inverse mill's ratios estimated from Probit equation, first, we estimate the equation for consumption in (see equation A1.6) for rural and urban families with I=1(that is w>0) to check if there is any selection bias.

**Table 6.74A: Selection Equation for Milk (urban/Rural)**

| | Rural Purchasers | Urban Purchasers |
|---|---|---|
| VARIABLES | share_milk_food | share_milk_food |
| L_food | -0.0136 | -0.0532*** |
| | (0.0268) | (0.0199) |
| famsize | -0.0102 | 0.0117* |
| | (0.00989) | (0.00674) |
| onech_dum | 0.0312 | -0.0153 |
| | (0.0193) | (0.0203) |
| morech_dum | 0.0895** | -0.0227 |
| | (0.0369) | (0.0257) |
| educode | -0.0419 | -0.0498** |
| | (0.0317) | (0.0236) |
| relgcode | -0.0268 | 0.00957 |
| | (0.0245) | (0.0110) |
| socgcode | -0.00306 | -0.0134 |
| | (0.0138) | (0.0254) |
| lancode | 0.00279 | -0.00641 |
| | (0.0149) | (0.0135) |
| imr_rur_milk | 0.114 | |
| | (0.0818) | |
| imr_urb_milk | | -0.195 |
| | | (0.164) |
| Constant | 0.266 | 0.638*** |
| | (0.223) | (0.215) |
| Observations | 139 | 217 |
| R-squared | 0.127 | 0.077 |

Note that the coefficients of IMR (for both rural and urban sub-samples) are not significant. Hence, there is no substantial selection bias in either rural or urban samples for milk consumption.[120] We can proceed with the coefficients reported in one-step procedure.

Second, we turn towards PTI.

[120] Wooldridge (1999, pp 566-567)

**Table 6.75A: Probit Regression, PTI (Urban/Rural)**

| | Rural | Urban |
|---|---|---|
| VARIABLES | pti_dum | pti_dum |
| L_food | 0.00848 | 0.344 |
| | (0.320) | (0.278) |
| famsize | 0.0467 | -0.0226 |
| | (0.117) | (0.0911) |
| onech_dum | 0.623** | 0.104 |
| | (0.301) | (0.240) |
| morech_dum | 0.134 | 0.0502 |
| | (0.396) | (0.334) |
| educode | 0.228 | 0.214 |
| | (0.601) | (0.389) |
| relgcode | 1.295*** | 0.461** |
| | (0.290) | (0.219) |
| socgcode | 0.219 | -0.243 |
| | (0.280) | (0.222) |
| lancode | -0.930*** | 0.105 |
| | (0.353) | (0.201) |
| Lnfe | 0.0615 | 0.314** |
| | (0.162) | (0.141) |
| Constant | -0.258 | -5.223** |
| | (2.491) | (2.387) |
| Observations | 160 | 240 |

Incorporating the inverse mill's ratios estimated from Probit equation, first, we estimate the equation for consumption in rural and urban families with I=1 (that is w>0).

**Table 6.76A: Selection Regression, PTI (Urban/Rural)**

| | Rural Purchasers | Urban Purchasers |
|---|---|---|
| VARIABLES | share_PTI_food | share_PTI_food |
| L_food | 0.0191 | 0.0228 |
| | (0.0204) | (0.0226) |
| famsize | -0.0217*** | -0.0208*** |
| | (0.00762) | (0.00611) |
| onech_dum | 0.000875 | -0.0324* |
| | (0.0283) | (0.0178) |
| morech_dum | 0.0594** | 0.0307 |
| | (0.0257) | (0.0220) |
| educode | 0.00168 | 0.0376 |
| | (0.0425) | (0.0291) |
| relgcode | 0.0234 | -0.0213 |
| | (0.0502) | (0.0228) |
| socgcode | -0.0200 | -0.00155 |
| | (0.0182) | (0.0158) |
| lancode | -0.0201 | -0.0113 |
| | (0.0331) | (0.0143) |
| imr_rur_pti | 0.0463 | |
| | (0.102) | |
| imr_urb_pti | | -0.150* |
| | | (0.0894) |
| Constant | -0.0102 | 0.0293 |
| | (0.190) | (0.227) |
| Observations | 133 | 199 |
| R-squared | 0.119 | 0.163 |

Note that the IMR coefficient is not significant in the rural sample of purchasers and is only *weakly* significant in the urban sample (t value of 1.68). Therefore, we can conclude that, like milk, urban and rural samples of PTI consumption do not show any evidence of selection bias. We can now proceed with the values generated in the main section of the paper.

Now we repeat the procedure for poor/rich households. As we have already noticed above, the maximum zero reporting occurs in Milk and PTI as well.

**Table 6.77A: Probit Regressions: Milk (Rich/Poor)**

| VARIABLES | Poor | Rich |
|---|---|---|
| L_food | 1.447** | 0.701* |
| | (0.631) | (0.383) |
| famsize | -0.248 | -0.291 |
| | (0.207) | (0.195) |
| onech_dum | 0.695* | 0.847** |
| | (0.375) | (0.382) |
| morech_dum | 1.000* | 0.962 |
| | (0.572) | (0.690) |
| educode | 0.601 | 0.213 |
| | (0.673) | (0.530) |
| relgcode | -1.063** | 0.181 |
| | (0.425) | (0.381) |
| socgcode | -0.100 | 0.0122 |
| | (0.302) | (0.368) |
| lancode | 0.199 | 0.0829 |
| | (0.321) | (0.375) |
| rescode | 0.548* | -0.310 |
| | (0.308) | (0.426) |
| Lnf | -0.722* | 0.169 |
| | (0.410) | (0.296) |
| Constant | -4.758 | -6.339 |
| | (4.941) | (4.265) |
| Observations | 120 | 120 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Thus, the probability of purchase increases with income for poor and rich (although the coefficient is weakly significant for rich). Compared to the reference households of no children, families with one child have a higher probability of purchase (coefficient is weakly significant in case of poor), and Hindu poor households have a lower probability of purchase. Higher spending on non-food weakly reduces the purchase of probability for poor.

Now we present the selection regressions, running them only for the purchasers

**Table 6.78A: Selection Regressions: Milk (Rich/Poor)**

| VARIABLES | Poor | Rich |
|---|---|---|
| L_food | -0.0323 | -0.0279 |
| | (0.0364) | (0.0404) |
| famsize | 0.00240 | -0.00391 |
| | (0.0113) | (0.0165) |
| onech_dum | 0.0107 | -0.0115 |
| | (0.0206) | (0.0530) |
| morech_dum | 0.0366 | -0.00649 |
| | (0.0349) | (0.0610) |
| educode | 0.0307 | -0.0542 |
| | (0.0311) | (0.0346) |
| relgcode | 0.0308 | -0.000115 |
| | (0.0223) | (0.0194) |
| socgcode | 0.00283 | 0.0265 |
| | (0.0158) | (0.0169) |
| lancode | 0.00823 | 0.00325 |
| | (0.0147) | (0.0180) |
| rescode | -0.0166 | 0.0143 |
| | (0.0165) | (0.0246) |
| imr_poor_milk | 0.00914 | |
| | (0.0619) | |
| imr_rich_milk | | -0.101 |
| | | (0.206) |
| Constant | 0.391 | 0.401 |
| | (0.298) | (0.395) |
| Observations | 101 | 110 |

We can see that none of the selected variables are significant. Hence we can conclude that selection is not a problem in the case of milk and we can proceed with the estimates and elasticities as in the main text

Next, we analyse the case of PTI.

**Table 6.79A: Probit Regressions: PTI (Rich/Poor)**

| VARIABLES | Poor | Rich |
|---|---|---|
| L_food | -0.969* | 0.187 |
| | (0.522) | (0.387) |
| famsize | 0.170 | 0.394* |
| | (0.181) | (0.208) |
| onech_dum | 0.390 | -0.164 |
| | (0.303) | (0.534) |
| morech_dum | 0.277 | -1.327* |
| | (0.495) | (0.699) |
| educode | 0.698 | 0.303 |
| | (0.547) | (0.774) |
| relgcode | 0.775** | 1.050*** |
| | (0.305) | (0.381) |
| socgcode | -0.379 | -0.341 |
| | (0.300) | (0.311) |
| lancode | -0.164 | 0.792** |
| | (0.287) | (0.370) |
| rescode | -0.321 | 0.341 |
| | (0.298) | (0.393) |
| Lnf | -0.0374 | 0.116 |
| | (0.288) | (0.312) |
| Constant | 8.661* | -3.585 |
| | (4.711) | (4.374) |
| Observations | 120 | 120 |

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

For the poor, a higher food budget reduces the probability of purchase (coefficient is weakly significant). For both rich and poor, the probability of purchase increases for Hindu households. For the rich class, the probability of purchase is higher for Assamese-speaking households.

Next, we report selection equations.

**Table 6.80A: Selection Regression: PTI (Rich/Poor)**

| VARIABLES | Poor | Rich |
|---|---|---|
| L_food | -0.0611 | 0.0534* |
| | (0.0673) | (0.0310) |
| famsize | -0.00339 | -0.0305 |
| | (0.0140) | (0.0187) |
| onech_dum | 0.0490 | -0.0149 |
| | (0.0323) | (0.0384) |
| morech_dum | 0.0690* | 0.0796 |
| | (0.0387) | (0.0641) |
| educode | 0.0742 | 0.0708 |
| | (0.0609) | (0.0504) |
| relgcode | 0.101 | -0.0115 |
| | (0.0618) | (0.0535) |
| socgcode | -0.0298 | -0.0192 |
| | (0.0278) | (0.0286) |
| lancode | -0.0320 | -0.0405 |
| | (0.0207) | (0.0388) |
| rescode | -0.0689** | -0.00330 |
| | (0.0282) | (0.0330) |
| imr_poor_pti | 0.258 | |
| | (0.167) | |
| imr_rich_pti | | -0.110 |
| | | (0.154) |
| Constant | 0.493 | -0.238 |
| | (0.463) | (0.314) |
| Observations | 93 | 105 |
| R-squared | 0.122 | 0.121 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As we can see, the coefficients of the $imr_j$ (j= rich, poor) terms are not significant. Hence we conclude that, in both cases, we can go forward with our elasticity estimates as reported in the main text.

## Testing the Constraints

The Engle curve we are estimating is the following

$$w_i = \alpha_0 + \alpha_i \ln(X) + \beta_{1i} * family\_size + \beta_{2i} * one\_child\_dum + \beta_{3i} * (more\_than\_one\_child\_dum)$$
$$+ \beta_{4i} * educ + \beta_{5i} * relg + \beta_{6i} * caste + \beta_{7i} * language + \varepsilon_i ....(A6.7)$$

Since $\sum w_i = 1$, the following parameter restrictions must hold:

$\sum \alpha_i = 0, \sum_i \beta_{ki} = 0, \sum \alpha_{0i} = 1$.[121]

There are three different strategies to impose the constraints. First, *ex-ante*, we can impose the constraints before estimation. Second, we can compute the coefficients of 11 of the 12 food groups and calculate the coefficients of the remaining subgroup by imposing the constraints *ex-post*. We take the third path: after obtaining the coefficients from 12 equations, we explicitly test for the restrictions.

The result is summarized in the table below:

**Table 6.81A: Theoretical Constraint for Rural/Urban Analysis**

| Null Hypothesis | Rural | Urban | Full Sample |
|---|---|---|---|
| $\sum \alpha_0 = 1$ | 0.04 | 0.05 | Satisfied |
| p value (chi square) | 0.8497 | 0.8227 | -do- |
| $\sum \alpha_i = 0$ | 0.04 | 0.03 | Satisfied |
| p value (chi square) | 0.8460 | 0.8548 | - |
| $\sum \beta_{1i} = 0$ | 0.00 | 0.05 | Satisfied |
| p value (chi square) | 0.9600 | 0.8205 | - |
| $\sum \beta_{2i} = 0$ | 0.39 | 0.02 | 0.27 |
| p value (chi square) | 0.5330 | 0.8912 | 0.6058 |
| $\sum \beta_{3i} = 0$ | 0.05 | 0.00 | 0.04 |
| p value (chi square) | 0.8206 | 0.9459 | 0.8481 |
| $\sum \beta_{4i} = 0$ | 0.17 | 1.31 | Satisfied |
| p value (chi square) | 0.6795 | | - |
| $\sum \beta_{5i} = 0$ | 0.02 | 0.00 | 0.02 |
| p value (chi square) | 0.8927 | 0.9767 | 0.8849 |
| $\sum \beta_{6i} = 0$ | 1.62 | 1.47 | 0.10 |
| p value (chi square) | 0.2034 | 0.2260 | 0.7579 |
| $\sum \beta_{7i} = 0$ | 0.12 | 0.12 | 0.11 |
| p value (chi square) | 0.7343 | 0.7282 | 0.7397 |

[121] See Ulugubaslu (op.cit)

Thus, in both urban and rural subsamples, the restrictions cannot be rejected. In the pooled sample, due to the nature of the data, none of the restrictions are rejected.

For the income class analysis, we proceed exactly as above. The only difference is we incorporate residence dummy explicitly.

The Engle curve we are estimating is the following

$$w_i = \alpha_{0i} + \alpha_i \ln(X) + \beta_{1i} * family\_size + \beta_{2i} * one\_child\_dum + \beta_{3i} * (more\_than\_one\_child\_dum)$$
$$+ \beta_{4i} * educ + \beta_{5i} * relg + \beta_{6i} * caste + \beta_{7i} * language + \beta_{8i} * residence + \varepsilon_i ....(A6.8)$$

The result is summarized in the table below:

**Table 6.82A: Theoretical Constraints for Rich/Poor Analysis**

| Variables | Poor | Rich | Pooled |
|---|---|---|---|
| Constant | Satisfied | Satisfied | 0.05 |
| p value (chi square) | – | – | 0.8178 |
| Food Budget | Satisfied | Satisfied | 0.06 |
| p value | _ | _ | 0.8017 |
| Family Size | Satisfied | Satisfied | 0.02 |
| p value | _ | _ | 0.8957 |
| One child | 1.05 | 4.02** | 0.15 |
| p value | 0.3051 | 0.0450 | 0.6997 |
| More than one Child | Satisfied | 3.56* | 0.05 |
| p value | - | 0.0592 | 0.8272 |
| Education | 1.14 | 0.00 | 1.41 |
| p value | 0.2858 | .99 | 0.2351 |
| Religion | 3.98** | 1.51 | 0.04 |
| p value | 0.0459 | 0.2194 | 0.8323 |
| Caste | 1.15 | Satisfied | 0.05 |
| p value | 0.2841 | _ | 0.8239 |
| Language | 0.40 | 1.66 | 0.00 |
| p value | 0.5265 | 0.1978 | 0.9635 |
| Residence | 1.15 | 1.81 | 0.56 |
| p value | 0.2840 | 0.1787 | 0.4558 |

Thus, in the case of the pooled sample, all restrictions are satisfied. In case of the poor subset, the constraints are automatically satisfied for a food budget, family size, the dummy for households with more than one child, and the constant. However, the constraint is violated for religion dummy.[122] For other variables, the null hypothesis cannot be rejected. For the rich 30% subset, the constraints are automatically satisfied for the food budget, family size, caste dummy and constant term. However, the constraints on children dummies are not satisfied.[123] For the other variables, the null hypothesis cannot be rejected.

We can conclude that the data set does not violate the theoretical restrictions in both analyses (urban/rural and rich/poor) of Engle curve.

[122] The linear combination (sum of the coefficients, using Stata's *lincom* command) yields that the sum is 4.69*exp(-09). However, a very low standard error is making this coefficient appear significantly different from zero.

[123] The linear combination (sum of these coefficients, using the *lincom* command of Stata), yields that the of the sums are -7.94*exp(-09) and -1.03exp(-08), respectively. However, very low standard errors make these coefficients to be "significantly" different from zero.

# Chapter 7

## Summary and Conclusion

This is the concluding section of this thesis. It records the significant findings of the work. It also presents a few policy implications of the findings. The current research focuses on the study of the effect of the household budget and other demographic variables (such as family size and composition, household-level educational attainment, socio-demographic variables such as caste, religion, and linguistic identity) on household consumption. The focus of the present study is Assam in general and Kamrup (Metro) and Kamrup Districts in specific. The main thrust of the research project is to understand consumption patterns. It is our contention that consumption patterns are reflected in elasticities. Consequently, changing elasticities, either over-time or in a cross-section, imply shifts in economic and behavioural factors that determine consumption. In turn, such shifts have important consequences for policies.

For both primary and secondary sources, I have analyzed the collected data using multiple estimation strategies. The relevant econometric models mainly come in two subgroups. The majority of the work is done through multiple equation demand system estimation. The commodities (or groups of commodities) under consideration are such that price-quantity data is available for all. Where such information is limited, a single equation model is adopted to include all categories. The focus is mainly on estimating various elasticities and doing a comparative analysis across sub-samples and demand models. As an application of elasticity measurements, I show how the data (in a limited way) can hint towards the direction of commodity tax reform.

In sum, the following are the main research questions

- How can we compute relevant elasticities and other parameters?
- How do these elasticities change over sub-samples? Such sub-samples are defined over a cross-section as well as over-time.

- How can we use the elasticities for practical purposes? More importantly, how can we compare policies over-time as well as over cross-section?
- Apart from economic factors such as prices and income, what are the roles played by various demographic characteristics in shaping up consumption?
- Are the estimates consistent across the models?

The following section presents the objectives and major findings of the study.

## 7.1 Summary of Chapters and Major Findings

### Chapter 2

The particular chapter is devoted to the literature review. Literature suggests that there exists considerable regional variation in demand patterns across India. As food policy (and possibly other social security policies) is tied up with elasticity measures, any such central initiative should show flexibility for differential implementation across states. For that, regional analysis is imperative. Besides, India has embarked on comprehensive tax reform as nationwide GST has been introduced during 2018-19. It is our contention that the pan Indian studies (Meenakshi 1996; Ray and Meenakshi 1999) which have been done may not be a suitable guide for the positive or normative understanding of consumption patterns. The gaps in the literature have been identified and discussed. Hence, it provides a motivation for the current research.

### Chapter 3

The chapter provides a brief and technical survey of the methodology. First, we identify the key parameters which are to be estimated. Second, the methodologies for estimation of multiple equation complete demand systems as well as single equation models are provided. The assumptions of each model have been discussed which is followed by the (system of) equations generated. Moreover, elasticities formulae are derived and I show how the elasticities relate to issues of commodity tax reform.

### Chapter 4

This chapter presents a comparative demand analysis of selected food items in Assam using 66$^{th}$ and 68$^{th}$ round secondary data of NSSO. Data has been analysed using LES and LA-AIDS

Demand system. Own and Cross price elasticities along with expenditure elasticities have been calculated. The marginal welfare cost of taxation has been calculated for two sub-samples, viz. rural and urban to predict the direction of optimal commodity tax reform.

Comparisons of estimates, elasticities and marginal welfare costs of taxation within a single round and over-time between different rounds have been estimated and compared. It was found that depending on the value judgement of the social planner, for urban and rural sectors, the tax policies are expected to be different. Urban and rural elasticities also exhibit differences, both over cross-section and over-time. But to fill up the gaps of this analysis (the main problem is obsolescence of data), a primary survey needs to be undertaken at a much-disaggregated level.

**Chapter 5**

In this chapter, we have summarized the methodology and exploratory findings from the survey. The details of the selection of field study, collection of data, including the broad profile of sample area have been described. The survey was carried in two districts of Assam- Kamrup (Metropolitan) and Kamrup. The field survey gathered information on certain necessary food items of consumption such as cereals, pulses, sugar, salt and oil, fruits, vegetables, milk, egg, fish, meat, beverages, intoxicants, etc. including their monthly consumption expenditure.

A stratified multi-stage design has been adopted for the primary survey Also, purposive sampling and proportional sampling had been used in the collection of data. We interviewed a total of 400 households. The questionnaire used in the field has questions that have been replicated from NSSO 66$^{th}$ round data. A one-month reference period had been taken and the survey was done from September 2018 to May 2019.

This chapter helps in obtaining an overall picture of well-being in the sampled households which is representative of the population under study. But there is no single and universally adopted indicator as a yardstick. We mainly focussed on total household consumption expenditure, household food consumption expenditure and commodity-wise consumption expenditure with respect to the demographic variables. The indicators such as per capita expenditure, total household consumption expenditure, household food consumption expenditure and adult per capita expenditure provide only a quantitative aspect of welfare. Using methods such as pair wise t-test or ANOVA, we show that expenditure patterns are significantly different for different demographic groups.

**Chapter 6**

In this chapter, we have used our survey data to analyse demand patterns for two contiguous districts of Assam: Kamrup Metropolitan (Guwahati City) and Kamrup District. Due to the limitation of data, price is available for only a subset of the commodities. We ran two different estimation strategies.

First, we have estimated complete demand systems based on the limited subset of commodities. The estimation procedures include both LES and LA-AIDS. The focuses are on the effects of demographic variables, the elasticities as well as marginal welfare cost of taxation. We carry out the analysis for two sub-samples, viz. rural and urban.[124] As in chapter 4, we have compared the estimates/policy implications across rural/urban consumption categories.

In the second part of the chapter, we run an Engle curve analysis on all commodities, the independent variables being family food budget and various demographic factors. The focus is on the impacts of socioeconomic variables as well as expenditure elasticity. The estimation strategy allows for effect-comparisons of the demographic factors (and relevant elasticities) across the pooled data and various sub-samples. We consider two sub-samples here. One is the urban/rural (as in the case of complete demand) and another is poor/rich (top /bottom 30% of MPCE classes). In general, one expects that the subsamples (urban/rural/rich/poor) to be different from their pooled counterparts. Yet, surprisingly, the impact of many variables on the pooled Engel curve is identical to that with the subsamples, thus making the pooled curve a good approximation for overall behaviour. The consistency of the subsamples with the pooled sample is higher in the case of urban/rural division than in the case of poor/rich division. This is however expected as the poor/rich (120 each) division contains fewer data points than the urban/rural (240/160) division. Consequently, if a food policy targets urban/rural separately, our survey more or less conforms to the adaptation of universal application (based on, say, the pooled data).

[124] Note that the issue of tax reform has limited application in the context of a district analysis, and more so in the context of urban/rural subsamples within the same district. Nevertheless, the analysis is presented for

However, if the food policy targets rich and poor separately, then a more nuanced approach is required.

### 7.2 Policy Implications

Based on those results, one of the major implications of our thesis is that policymakers should consider context-specific factors for understanding consumption and formulate welfare improving strategies. This will help in taking an effective preventive measure, say, against malnutrition, and a better target for improvement of food security among the population at a disaggregated level rather than universal, one-size-fits-all‖ type intervention, for example, fixing a common tax-subsidy rule for the whole country. The analysis also suggests that one should not ignore the effects of socio-demographic variables (such as family size, education, religious and caste alignments) on consumption. These may serve as a crucial guide to policymakers for formulating differential food policy for different groups of the society. However, as far as tax reforms are concerned, the results do not vary greatly across demand models.

Tax reform indicates that cereals and pulses should have their taxes increased, sugar, salt and oil may have their taxes decreased for commodity taxes to be optimal. Note that the ranking of lambdas are fairly consistent under different assumptions of ε. Here, we may reduce the tax on the top 3 commodities, i.e., sugar, salt and oil and increase tax on the bottom two ranking items which are cereals and sugar. But as we move from $\varepsilon=0$ to $\varepsilon=0.5$, we need to reduce taxes on pulses, sugar and oil and increase taxes on cereals and salt. This result is consistent throughout all the εs.

I adopt the convention that "top three" commodities should have a reduction of taxes or increase in subsidy (and the rest qualifies for an increase in taxes or reduction in subsidy), and that on "bottom two" should be decreased, Thus, comparing the rural and urban sectors, the prescription is that taxes on oil and salt should always be decreased and that on pulse should be increased.

The optimality table (for primary survey) for urban and rural areas indicates that as per their lambda values, the ranking of the commodities is reasonably robust to the changing values of epsilon. Again, for the urban sector, sugar and oil are the top two commodities for ε=0. For other all, it is pulses and sugar except for ε=2, where it is pulses and salt. Thus, the taxes mainly on pulses and sugar should be decreased and that on cereals and oil may be increased. For the rural sector, there are rank reversals for sugar and pulses for ε=.5 and all other values of ε. Thus, the taxes on pulses and sugar should be decreased and that on cereals and oil may be increased. In the rural sector also, we have remarkable consistency: taxes on pulse and sugar to be reduced.

We can see that for the pooled sample, the ranks of marginal welfare costs are stable for various values of ε except for $\varepsilon = 0$. The "top two" commodities are pulses and sugar for $\varepsilon = 0$, and pulses and salt for the rest and hence taxes on these commodities may be decreased.

### 7.3 Future Scope

Given the time constraint, our sample constituted only two districts of Assam and five food commodities in the primary survey. Also, secondary data was last collected during 2012. Based on the findings of this survey, further research can examine all food and non-food items in the total budget consumption. Discussions of this study can be utilized by policymakers and also by researchers in exploring differential policies focusing on the demographics of a particular region. Demand systems other than LES and LA-AIDS may be used to estimate demand models too, and the performance can be compared. It is also possible to extend the estimations to other directions, e.g. construction of cost of living indices, welfare changes (e.g. given a hypothetical price shock), demand for calories and other nutrients, etc.

In sum, there exists a valid future research agenda.

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