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Food Demand Elasticities by Income Group by Urban and Rural Populations for Pakistan

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INTRODUCTION

This paper presents food demand elasticity estimates for the Pakistan by urban and rural populations by income quartile for thirteen food groups. Income and price elasticities are estimated using a new food demand estimation technique based on demand for characteristics. This new technique requires far less data than the usual econometric approaches and so may be implemented relatively quickly and cost-effectively. However, the resulting demand elasticity estimates depend directly on strong *a priori* assumptions made concerning food demand behaviour, but assumptions which do not depend on assumptions of weak or strong separability. Rather quite the opposite assumption is made – that the marginal rate of substitution between two foods depends directly on the levels of consumption of all other foods.

The paper is organised as follows. The first section provides a brief overview of the methodology used for undertaking the demand estimations. The second section discusses the data used for these estimations and food consumption patterns. The third section presents the demand elasticity estimates.

I. THE FOOD CHARACTERISTIC DEMAND SYSTEM (FCDS)

Several studies in the literature have shown that parameter estimates can vary widely across income groups (see Alderman 1986 for a review). Demand parameter estimates may also vary significantly by region as production environments and tastes change. Such regional and income variation in consumption behaviour coupled with (1) differential supply-side impacts of agricultural commodity price

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Author's Note:. Tables 1A through 1H and Appendix A mentioned in the text are available with the author. These were included in the original paper read at the conference, but excluded in this printed version due to space constraints.

changes and government investment strategies on various rural groups specialising in the production of particular crops, and (2) the necessity do disaggregate the food demand parameter matrix by a relatively large number of foods, makes the task of estimating a complete food demand matrix for several regional and socioeconomic groups a nearly intractable task.[1]

The two broad methodologies available for estimation of the required food demand matrices [again, see Alderman (1986) for a review] are (1) direct econometric estimation requiring data with price variability (with or without parameter restrictions derived from demand theory) and (2) use of some type of expenditure system which makes assumptions about the form of the utility function. Direct estimation from cross-section or panel household food expenditure surveys is very data intensive and time consuming, and may introduce and array of econometric problems.[2]

Use of some type of linear or quadratic expenditure system is a much more practical alternative to direct estimation in the sense that only *a priori* knowledge of income elasticities for individual foods (plus a minor number of additional parameters, the specific parameters depending on the particular technique used) is required for generation of a complete set of own-price and cross-price elasticities; estimates of income elasticities and these other parameters can be estimated relatively quickly if they are not available from previous studies. However, this second group of techniques depends on an assumption of either strong or weak separability between *food* groups in the utility function.[3]

An impasse is reached between the need for developing a large number of food demand matrices for policy analysis and the lack of a practical means for doing so – direct estimation because it is too data-intensive, time consuming, and the appropriate methodologies are still being debated, and an expenditure system approach because the underlying assumptions are unacceptable. A food demand system

[1]For example, food demand analysis for a country with 2 regions with diverse taste preferences times 4 income groups times 4 major crops times 2 occupation groups (owners and laborers), requires estimation of 64 food demand matrices.

[2]For example, Bouis and Haddad (forthcoming) show that *after* control for simultaneity of an endogenous income variable and possible bais due to household fixed effects (two of the above-mentioned econometric problems), use of panel data may still lead to upwardly biased income elasticities for individual staple foods due (1) to correlation in errors in measuring quantities of foods purchased and total expenditures, and (2) to leakage between foods purchased and fed to non-household members, leakage which will be an increasing function of income. Alderman (1986) reviews other problems which include non-consumption by some households (error-term distributions are truncated), heteroscedasticity (when group cell averages have differing numbers of observations), and derviation of price information from expenditure and quantity data (errors in quantity and price data are negatively correlated).

[3]Assuming that the research focus is food and nutrition policy, a relatively disaggregate *food* demand matrix is required.

based on demand for characteristics provides a possible means out of this dilemma.

In this system, three characteristics – energy, variety, and tastes of individual foods – are assumed to be additive in the utility function, as contrasted, for example, with additive utilities for individual food items using the Frisch technique. Energy and variety enter the utility function in such a way that utility from consumption of one food depends on the level of consumption of all other foods. By specifying an explicit functional form for these characteristics in the utility function, it turns out that the entire matrix of price and income elasticities can be derived for a system of n foods and one nonfood good from prior knowledge of just $K+4$ elasticities in the $(n+1)$ by $(n+2)$ matrix of price and income elasticities, where K is the number of broad food groups (e.g. "meats") into which individual foods (e.g. beef, mutton, fish) are categorised.[4] A brief mathematical exposition of the model is provided in Appendix A. See Bouis (1991) for a full mathematical treatment and discussion of the properties of the model

II. DATA REQUIREMENTS AND FOOD CONSUMPTION PATTERNS

1. The Data

Apart from prior knowledge of any five elasticities in the $(n+1)$ by $(n+2)$ demand matrix for a system of thirteen foods (one "meat" food group is specified), data requirements are (1) per capita quantities consumed for each of the thirteen foods, (2) prices paid per kilogram for each food, (3) calorie conversion rates per kilogram for each food, (4) total nonfood expenditures, and (5) the ratio of adult equivalents over total household members. Data for calorie conversion rates and the age and gender structure of an average household typically are not available from published summaries of expenditure survey data.

Estimates of per kilogram (as purchased) calorie conversion rate for disaggregate food groups may be obtained from country-specific food composition tables and dietary surveys. For specific foods (e.g. wheat and rice) these conversion rates will not vary greatly across countries, so that, as is the case here, estimates available from other countries may be used. The assumed food-group-specific calorie conversion rates are presented in Tables 1A through 1H (along with quantities consumed and prices paid which are discussed below). Using these assumed calorie conversion rates, per adult equivalent consumption of calories per day ranged from a low of 2,004 for the lowest income quartile in urban areas to a high

[4] K may equal zero. Staple foods such as wheat and rice which are consumed primarily for their calorie content are treated in a unique way in the FCDS. Only non-staple foods may need to be categorised into food groups.

Table 2 A

Food Demand Elasticity Estimates, Urban, Income Quartile 1

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.32	.06	.00	.00	.06	.00	.00	.01	.00	.00	.00	.19	.05	.00	–.06
Rice	.29	–1.09	–.03	.00	–.02	.00	.00	–.01	.00	.00	.00	.06	.00	.03	.77
Vegetables	–.08	–.01	–1.10	.04	.42	.00	.00	.01	.00	.00	.00	.06	.13	.02	.49
Fruits	–.13	–.01	.14	–1.20	.19	.00	.00	–.01	.00	.00	.00	.02	.06	.04	.90
Fresh Milk	–.03	.00	.21	.03	–1.04	.00	.00	.00	.00	.00	.00	.03	.09	.03	.68
Other Milk	–.08	–.01	–.03	–.01	–.06	–1.07	.00	–.03	.00	.00	.00	–.03	–.02	.05	1.29
Eggs	–.12	–.01	.00	.00	–.01	.00	–1.08	–.02	.00	.00	.00	–.02	–.01	.05	1.23
Beef	–.03	.00	.02	.00	.02	.00	.00	–.71	.04	.12	.01	–.01	.00	.02	.51
Other Meat	–.10	–.01	–.02	.00	–.03	.00	.00	.43	–1.25	.06	.00	–.02	–.01	.04	.90
Mutton	–.13	–.01	–.03	.00	–.04	.00	.00	.29	.02	–1.15	.00	–.02	–.02	.04	1.05
Chicken	–.14	–.01	–.03	–.01	–.05	.00	.00	.22	.01	.03	–1.15	–.02	–.02	.05	1.12
Edible Oil	.28	.02	.03	.00	.02	.00	.00	–.02	.00	.00	.00	–1.34	.00	.04	.97
Other Food	–.14	–.01	.00	.00	.00	.00	.00	–.02	.00	.00	.00	–.02	–1.09	.05	1.23
Non–foods	–.22	–.01	–.06	–.01	–.09	.00	.00	–.03	.00	–.01	.00	–.03	–.03	–1.05	1.56

Table 2 B

Food Demand Elasticity Estimates, Urban, Income Quartile 2

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.32	.08	–.01	.00	.06	.01	.00	.01	.00	.00	.00	.19	.05	–.01	–.08
Rice	.33	–1.06	–.02	.00	–.01	.00	.00	–.01	.00	.00	.00	.07	.01	.08	.51
Vegetables	–.07	–.01	–1.08	.05	.40	.00	.00	.01	.00	.00	.00	.06	.13	.06	.44
Fruits	–.10	–.01	.14	–1.18	.20	.00	.00	.00	.00	.00	.00	.03	.06	.10	.75
Fresh Milk	–.01	.00	.20	.03	–1.01	.00	.00	.00	.00	.00	.00	.03	.09	.07	.58
Other Milk	–.03	.00	–.02	.00	–.04	–1.06	.00	–.02	.00	.00	.00	–.03	–.02	.14	1.10
Eggs	–.07	–.01	.01	.00	.01	.00	–1.08	–.02	.00	.00	.00	–.02	.00	.13	1.04
Beef	–.01	.00	.02	.00	.03	.00	.00	–.74	.08	.13	.01	–.01	.01	.05	.42
Other Meat	–.04	.00	.01	.00	.00	.00	.00	.56	–1.31	.10	.01	–.01	.00	.08	.61
Mutton	–.09	–.01	–.02	.00	–.03	.00	.00	.27	.03	–1.14	.00	–.02	–.01	.11	.90
Chicken	–.09	–.01	–.02	.00	–.03	.00	.00	.25	.03	.04	–1.17	–.02	–.01	.12	.92
Edible Oil	.30	.03	.04	.01	.04	.00	.00	–.01	.00	.00	.00	–1.31	.00	.10	.80
Other Food	–.09	–.01	.01	.00	.01	.00	.00	–.02	.00	.00	.00	–.01	–1.07	.13	1.05
Non–foods	–.19	–.02	–.05	–.01	–.08	.00	.00	–.03	.00	.01	.00	–.03	–.03	–1.10	1.55

Table 2 C

Food Demand Elasticity Estimates, Urban, Income Quartile 3

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.33	.10	–.01	.00	.06	.01	.00	.02	.00	.00	.00	.20	.05	–.02	–.08
Rice	.33	–1.03	–.02	.00	.00	.01	.00	.00	.00	.00	.00	.08	.01	.14	.49
Vegetables	–.05	–.01	–1.05	.06	.38	.00	.01	.02	.00	.00	.00	.07	.12	.10	.35
Fruits	–.07	–.01	.13	–1.14	.19	.00	.00	.00	.00	.00	.00	.03	.06	.17	.63
Fresh Milk	.00	.00	.18	.04	–.99	.00	.00	.01	.00	.00	.00	.04	.08	.14	.50
Other Milk	.01	.00	–.01	.00	–.02	–1.06	.00	–.02	.00	.00	.00	–.02	–.01	.24	.88
Eggs	–.02	.00	.02	.01	.03	.00	–1.08	–.01	.00	.00	.00	–.01	.01	.23	.83
Beef	.01	.00	.02	.01	.03	.00	.00	–.74	.07	.16	.02	.00	.01	.09	.32
Other Meat	–.02	.00	.01	.00	.01	.00	.00	.48	–1.26	.10	.01	–.01	.00	.15	.54
Mutton	–.05	–.01	–.01	.00	–.01	.00	.00	.27	.03	–1.12	.01	–.01	–.01	.20	.71
Chicken	–.05	–.01	–.01	.00	–.01	.00	.00	.27	.03	.06	–1.18	–.01	–.01	.20	.71
Edible Oil	.32	.04	.06	.01	.07	.00	.00	–.01	.00	.00	.00	–1.28	.01	.17	.61
Other Food	–.04	–.01	.02	.00	.03	.00	.00	–.01	.00	.00	.00	–.01	–1.06	.23	.85
Non–foods	–.13	–.02	–.04	–.01	–.07	.00	.00	–.03	.00	–.01	.00	–.02	–.02	–1.14	1.50

Table 2 D

Food Demand Elasticity Estimates, Urban, Income Quartile 4

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.32	.11	–.01	.00	.06	.03	.01	.02	.00	.01	.00	.20	.05	–.06	–.09
Rice	.30	–.97	–.01	.00	.02	.01	.00	.00	.00	.00	.00	.08	.02	.21	.35
Vegetables	–.04	.00	–1.01	.06	.32	.01	.01	.02	.00	.01	.00	.06	.09	.17	.29
Fruits	–.03	.00	.08	–1.07	.14	.00	.00	.00	.00	.00	.00	.03	.04	.30	.51
Fresh Milk	.02	.00	.13	.04	–.94	.01	.01	.01	.00	.00	.00	.04	.06	.23	.38
Other Milk	.05	.01	.01	.00	.01	–1.04	.00	–.01	.00	.00	.00	–.01	.00	.37	.62
Eggs	.02	.00	.03	.01	.05	.00	–1.06	.00	.00	.00	.00	.00	.01	.35	.58
Beef	.03	.00	.03	.01	.04	.00	.00	–.87	.08	.30	.08	.01	.01	.10	.17
Other Meat	.01	.00	.01	.00	.02	.00	.00	.37	–1.23	.20	.05	.00	.01	.21	.35
Mutton	–.01	.00	.00	.00	.00	.00	.00	.21	.03	–1.05	.03	.00	.00	.30	.49
Chicken	–.01	.00	.01	.00	.01	.00	.00	.25	.04	.13	–1.16	.00	.00	.28	.46
Edible Oil	.30	.04	.07	.02	.10	.00	.00	.00	.00	.00	.00	–1.17	.02	.23	.38
Other Food	–.01	.00	.02	.01	.03	.00	.00	–.01	.00	.00	.00	.00	–1.03	.37	.62
Non–foods	–.06	–.01	–.02	–.01	–.04	.00	.00	–.02	.00	–.01	.00	–.02	–.01	–1.14	1.35

Table 2 E

Food Demand Elasticity Estimates, Urban, Income Quartile 1

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.25	.08	.00	.00	.07	.02	.00	.01	.00	.00	.00	.12	.05	.00	–.10
Rice	.25	–1.05	–.03	.00	–.04	.01	.00	–.01	.00	.00	.00	.04	.00	–.01	.86
Vegetables	–.15	–.01	–1.15	.02	.39	.00	.00	.00	.00	.00	.00	.03	.11	–.01	.76
Fruits	–.22	–.02	.09	–1.19	.16	.00	.00	–.01	.00	.00	.00	.00	.04	–.02	1.17
Fresh Milk	–.04	.00	.21	.02	–1.00	.00	.00	.00	.00	.00	.00	.02	.11	–.01	.67
Other Milk	–.18	–.02	–.04	.00	–.09	–1.07	.00	–.02	.00	.00	.00	–.03	–.03	–.02	1.52
Eggs	–.23	–.02	–.02	.00	–.05	.00	–1.07	–.02	.00	.00	.00	–.02	–.02	–.02	1.50
Beef	–.06	–.01	.01	.00	.01	.00	.00	–.78	.13	.10	.04	–.01	.00	–.01	.57
Other Meat	–.20	–.02	–.03	.00	–.06	.00	.00	.30	–1.16	.04	.02	–.02	–.02	–.02	1.18
Mutton	–.22	–.02	–.03	.00	–.07	.00	.00	.25	.05	–1.15	.01	–.02	–.02	–.02	1.25
Chicken	–.20	–.02	–.03	.00	–.06	.00	.00	.29	.06	.04	–1.20	–.02	–.02	–.02	1.18
Edible Oil	.14	.01	.00	.00	–.01	–.01	.00	–.02	.00	.00	.00	–1.25	–.01	–.02	1.18
Other Food	–.21	–.02	.01	.00	.01	.00	.00	–.02	.00	.00	.00	–.02	–1.11	–.02	1.39
Non-foods	–.30	–.03	–.06	–.01	–.11	.00	.00	–.02	.00	.00	.00	–.03	–.04	–.97	1.58

Table 2 F

Food Demand Elasticity Estimates, Urban, Income Quartile 2

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.25	.11	.00	.00	.07	.03	.00	.01	.00	.00	.00	.09	.04	.00	–.11
Rice	.40	–.98	–.02	.00	.00	.02	.00	.00	.00	.00	.00	.05	.01	.02	.51
Vegetables	–.10	–.01	–1.11	.03	.44	.01	.00	.00	.00	.00	.00	.03	.12	.02	.57
Fruits	–.17	–.02	.08	–1.15	.15	.00	.00	–.01	.00	.00	.00	.00	.04	.04	1.04
Fresh Milk	–.02	.00	.18	.02	–.96	.01	.00	.00	.00	.00	.00	.02	.09	.03	.64
Other Milk	–.10	–.01	–.03	.00	–.06	–1.06	.00	–.02	.00	.00	.00	–.02	–.02	.05	1.28
Eggs	–.16	–.02	–.01	.00	–.03	–.01	–1.06	–.02	.00	.00	.00	–.02	–.01	.05	1.28
Beef	–.04	–.01	.01	.00	.02	.00	.00	–.75	.10	.11	.05	–.00	.00	.02	.50
Other Meat	–.11	–.01	–.01	.00	–.02	.00	.00	.44	–1.23	.07	.03	–.01	–.01	.03	.84
Mutton	–.15	–.02	–.02	.00	–.05	.00	.00	.28	.04	–1.15	.02	–.01	–.02	.04	1.04
Chicken	–.15	–.02	–.02	.00	–.05	.00	.00	.27	.04	.04	–1.16	–.01	–.02	.04	1.06
Edible Oil	.17	.02	.01	.00	.01	–.01	.00	–.01	.00	.00	.00	–1.19	.00	.04	.96
Other Food	–.14	–.02	.01	.00	.02	.00	.00	–.02	.00	.00	.00	–.01	–1.09	.05	1.20
Non–foods	–.25	–.03	–.05	–.01	–.11	–.01	.00	–.02	.00	.00	.00	–.02	–.03	–1.05	1.59

Table 2 G

Food Demand Elasticity Estimates, Urban, Income Quartile 3

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.20	.08	.00	.00	.07	.04	.00	.01	.00	.00	.00	0.08	.04	–.02	–.11
Rice	.35	–.92	–.01	.00	.01	.02	.00	.00	.00	.00	.00	.04	.01	.07	.45
Vegetables	–.08	–.01	–1.10	.02	.36	.01	.00	.00	.00	.00	.00	.02	.09	.09	.57
Fruits	–.12	–.01	.06	–1.12	.16	.00	.00	–.01	.00	.00	.00	.00	.04	.13	.86
Fresh Milk	.00	.00	.14	.02	–.89	.01	.00	.00	.00	.00	.00	.02	.09	.08	.52
Other Milk	–.05	–.01	–.01	.00	–.04	–1.04	.00	–.01	.00	.00	.00	–.01	–.01	.15	1.04
Eggs	–.10	–.01	.00	.00	–.01	.00	–1.04	–.01	.00	.00	.00	–.01	.00	.16	1.04
Beef	–.01	.00	.01	.00	.03	.00	.00	–.77	.08	.14	.10	.00	.01	.05	.38
Other Meat	–.08	–.01	.00	.00	–.02	.00	.00	.34	–1.19	.07	.05	–.01	–.01	.11	.74
Mutton	–.10	–.01	–.01	.00	–.03	.00	.00	.24	.03	–1.12	.04	–.01	–.01	.13	.86
Chicken	–.09	–.01	–.01	.00	–.03	.00	.00	.29	.04	.06	–.1.15	–.01	–.01	.12	.81
Edible Oil	.19	.02	.02	.00	.04	.00	.00	–.01	.00	.00	.00	–.1.12	.01	.11	.74
Otr Food	–.09	–.01	.02	.00	.04	.00	.00	–.01	.00	.00	.00	–.01	–1.06	.14	.98
Non–Foods	–.21	–.02	–.03	–.01	–.10	–.01	.00	–.02	.00	.00	.00	–.02	–.03	–.1.10	1.55

Table 2 H

Food Demand Elasticity Estimates, Urban, Income Quartile 4

Food Group	Wheat	Rice	Vegetables	Fruits	Fresh Milk	Other Milk	Eggs	Beef	Other Meat	Mutton	Chicken	Edible Oils	Other Food	Non-foods	Income
Wheat	–.18	.09	.00	.00	.07	.04	.00	.01	.00	.00	.00	.07	.04	–.04	–.12
Rice	.30	–.85	.00	.00	.02	.02	.00	.00	.00	.00	.00	.03	.02	.11	.34
Vegetables	–.04	–.01	–1.05	.03	.32	.01	.00	.00	.00	.00	.00	.02	.09	.15	.48
Fruits	–.05	–.01	.05	–1.07	.14	.00	.00	.00	.00	.00	.00	.01	.04	.23	.67
Fresh Milk	.03	.00	.11	.03	–.85	.01	.00	.01	.00	.00	.00	.02	.08	.14	.41
Other Milk	.01	.00	.00	.00	–.01	–1.01	.00	–.01	.00	.00	.00	.00	.00	.26	.77
Eggs	–.02	.00	.01	.00	.02	.00	–1.03	–.01	.00	.00	.00	.00	.00	.26	.77
Beef	.02	.00	.02	.00	.04	.00	.00	–.82	.06	.21	.15	.00	.01	.07	.22
Other Meat	–.03	.00	.00	.00	.00	.00	.00	.30	–1.17	.11	.08	.00	.00	.18	.53
Mutton	–.04	–.01	.00	.00	–.01	.00	.00	.22	.02	–1.07	.06	.00	.00	.21	.63
Chicken	–.04	–.01	.00	.00	.00	.00	.00	.23	.03	.09	–1.10	.00	.00	.20	.60
Edible Oil	.22	.03	.02	.01	0.6	.00	.00	.00	.00	.00	.00	–1.03	.02	.17	.51
Other Food	–.03	.00	.02	.00	.05	.00	.00	–.01	.00	.00	.00	.00	–1.03	.25	.75
Non–Foods	–.12	–.02	–.02	.00	–.06	–.01	.00	–.02	.00	–.01	.00	–.01	–.02	–1.11	1.40

of 2,894 for the highest income quartile in rural areas.[5] Data on household size were available for the Pakistan expenditure survey used here; however, it was necessary to make assumption as to the ratio of adult equivalents to total household members.[6]

The food consumption and price data for Pakistan shown in Tables 1A through 1H are taken from the *Household Income and Expenditure Survey 1984-85* conducted by the Federal Bureau of Statistics. Prices given in these tables are initialised on the cost of wheat for low income consumers in urban area. Wheat is a much cheaper source of calories than rice and is overwhelmingly the predominant staple; consumption shows some tendency to decline with income in urban areas. Milk, which has a high food budget share, is a very expensive source of calories relative to wheat and rice, but (in the food characteristic demand framework) is a relatively inexpensive source of variety. Vegetables are the cheapest source of variety, but a more expensive source of calories than milk. The four meats shown are both expensive sources of calories and expensive sources of variety. Beef is the least expensive source of the characteristic "meat".Total food budget shares range from 70 percent for the lowest expenditure quartile in rural areas to 37 percent for the heighest expenditure quartile in urban areas.

[5]Food expediture surveys will tend to exaggerate the increase in calorie consumption as incomes increase, so that data for food quantities consumed collected using a food recall technique are to be preferred over information from a food expenditure survey (see Bouis and Haddad forthcoming). Unfortunately, use of food recall techniques is rare for a national sample, and only food expenditure information is available for Pakistan.

Bliss and Stern (1978) argue quite persuasively, using *a priori* reasoning based on results found in the nutrition literature, that for moderately active populations and assuming wide bounds to account for various sources of measurement error, one would not expect to observe populations consuming below 2,000 calories per day per adult equivalent (which were not losing weight on average) or above 3,000 calories per day per adult equivalent (which were not gaining weight on average). Using the assumed calorie conversion rates for the thirteen food aggregate food groups, then, the estimates of total calorie consumption are in the plausible range.

For each expenditure quartile, calorie availability is higher for rural populations than for urban population and increases more rapidly for rural populations moving from low to high expenditure quartiles. These patterns are typical of other countries in Asia Bouis (1991) and may be due both to a real phenomenon, greater energy expenditures in rural areas, and the fact that significant amounts of food purchased by high income rural households is eaten (in the form of in-kind wages or as guest meals) by low income rural households see Bouis and Haddad (forthcoming). However, the divergence between calorie availability and calorie intakes for rural areas would appear to be far less of a problem for the Pakistan data than for food expenditure data for five other countries in Asia Bouis (1989).

[6]Age and gender structure for countries with similar average household sizes and incomes do not vary a great deal, so that, where this information is otherwise unavailable, rough assumptions may be made for these data inputs as well. The assumptions made for Pakistan are given in the final column of the chart presented later in this section. The age structure was assumed to increase marginally with increased incomes. Typically, per capita incomes of households increase during later stages of the life cycle.

2. Prior Assumptions

One further requirement for implementing the methodology is prior knowledge of any combination of five food demand elasticities and/or five parameters in the utility function from which shadow prices can be derived for the characteristics of energy, variety, and taste. Below are the assumptions made to fulfill this requirement:

Urban/ Rural	Expenditure Quartile	Food Income Elasticity	$-e_2 / 2e_3$	$\hat{p}_e 2e_3$	$\hat{p}$	W_k for Meats
Urban						
	1	0.70	3100	−0.055	0.70	0.25
	2	0.60	3000	−0.060	0.70	0.25
	3	0.50	2900	−0.065	0.70	0.25
	4	0.40	2800	−0.070	0.70	0.25
Rural						
	1	0.75	3200	−0.055	0.70	0.25
	2	0.65	3100	−0.060	0.70	0.25
	3	0.45	3000	−0.065	0.70	0.25
	4	0.35	2900	−0.070	0.70	0.25

Food income elasticities assumed for the various expenditure quartiles were selected arbitrarily, although the pattern of selected values adheres to Engel's Law. The column labelled $-e_2 / 2e_3$ indicates those levels of calorie consumption (per adult equivalent) at which the marginal utilities to further calorie consumption are zero. These levels are reduced marginally for successive expenditure quartiles under the assumption that activity levels are lower at higher income levels. For the same reason, they are increased marginally for rural populations as compared with urban populations in the same expenditure quartile. The remaining three assumptions corresponding to (i) the amount of curvature in the quadratic function for utility from energy, (ii) the shadow price for variety, and (iii) the shadow price for meat were selected so as to generate urban income elasticities for middle income groups for wheat of about − 0.05, for vegetables of about 0.40, and for beef of about 0.35.

III. ELASTICITY ESTIMATES

The income elasticities presented in Tables 2A through 2H for staple and non-staple foods are generally in accordance with *a priori* expectations. Wheat, the

cheapest source of calories, has the lowest income elasticities. Rice income elasticities are high, consumption starting from a low absolute base and replacing wheat as a more preferred staple as income increases. Demand for wheat is quite inelastic. Own price elasticities for rice are much higher. Price response for these food staples declines somewhat, though not dramatically, with income.

Vegetables, the cheapest food among the non-staples on a per kilogram basis and so the cheapest source of variety in the diet, have among the lowest income elasticties among the non-staple foods. Fruits, which are roughly 50 percent more expensive than vegetables, have much higher income elasticities, than vegetables. Vegetable income elasticities decline marginally with income. Fruit income elasticities decline more precipitously.

Meats and dairy products generally have among the highest income elasticities, which is consistent with the arc income elasticities shown in Tables 3A and 3B. It is remarkable that the *relative* magnitudes of the income elasticities across foods, that is a ranking of foods from lowest to highest income elasticities, is very similar comparing the arc elasticities and the estimated elasticities. For example, beef, the cheapest meat, has the lowest income elasticities, while, chicken and mutton, the most expensive meats, have the highest income elasticities. Nevertheless, the very high arc income elasticities for these two meats shown in Tables 3A and 3B could not be replicated using the FCDS.

The elasticity estimates found in Tables 2A through 2H need to be treated with some caution in that (i) several exogenous assumptions are made in deriving these estimates (for example, the food income elasticities shown in the chart above) which require more careful analysis than is given here and (ii) the FCDS methodology is new and evolving. However, one advantageous feature of the model is that calorie income elasticities are constrained to be low by the quadratic nature of utility for energy. This is consistent with recent empirical evidence which shows that calorie income elasticities have often been overestimated using food expenditure data (Bouis and Haddad, forthcoming).[7] Ultimately, it is hoped that demand estimates generated using this cost-effective methodology can be used by policy analysts for various applications, and in particular those that are concerned with the differential impacts of government policies across income groups and urban and rural populations.

[7]See Alderman (1988) for estimates of complete food matrices for Pakistan which sow much higher calorie income elasticities. Analysis provided in Bliss and Stern (1978) of nutritional relationships suggests that high calorie-income elasticities cannot be reconciled with observed differences in bodyweights across income groups.

Table 3 A

Comparison of Arc Income Elasticities between Income Groups and Income Elasticity Estimates, by Income Group by Food, Urban

Food	Income Group	Arc Income Elasticity between Income Group			Estimated Income Elasticity
		2	3	4	
Wheat					
	1	–.03	–.15	–.05	–.06
	2		–.06	–.26	–.08
	3			–.02	–.08
	4				–.09
Rice					
	1	1.966	1.52	.60	.77
	2		.40	1.10	.51
	3			.24	.49
	4				.35
Vegetables					
	1	.28	.36	.28	.49
	2		.31	.46	.44
	3			.30	.35
	4				.29
Fruits					
	1	1.28	1.63	1.22	.90
	2		1.17	1.78	.76
	3			.92	.63
	4				.51
Fresh Milk					
	1	.83	.50	.42	.68
	2		.41	.43	.58
	3			.45	.50
	4				.38
Other Milk					
	1	7.56	5.31	4.17	1.29
	2		2.04	2.10	1.10
	3			1.71	.88
	4				.82

Continued –

Table 3A – (*Continued*)

Food	Income Group	Arc Income Elasticity between Income Group 2	3	4	Estimated Income Elasticity
Eggs					
	1	2.09	3.07	3.06	1.23
	2		2.77	3.23	1.04
	3			1.93	.83
	4				.58
Beaf					
	1	.80	1.17	.50	.51
	2		.47	1.45	.42
	3			.25	.32
	4				.17
Other Meat					
	1	5.17	3.19	2.12	.90
	2		1.15	1.28	.81
	3			1.08	.54
	4				.35
Mutton					
	1	1.88	2.77	3.31	1.05
	2		3.11	2.98	.90
	3			2.34	.71
	4				.49
Chicken	1	9.44	9.06	18.90	1.12
	2		9.50	4.20	.92
	3			6.87	.71
	4				.46
Edible Oils					
	1	.59	.39	.23	.97
	2		.20	.29	.80
	3			.20	.61
	4				.38
Other Food					
	1	.35	.22	.17	1.23
	2		.17	.14	1.05
	3			.20	.85
	4				.62

Table 3B

Comparison of Arc Income Elasticities between Income Groups and Income Elasticity Estimates, by Income Group by Food, Urban.

Food	Income Group	Arc Income Elasticity between Income Group			Estimated Income Elasticity
		2	3	4	
Wheat					
	1	.12	.39	.17	–.10
	2		.20	.68	–.11
	3			.10	–.11
	4				–.12
Rice					
	1	2.97	.96	.49	.86
	2		.12	–.47	.51
	3			.31	.45
	4				.34
Vegetables					
	1	1.01	.11	.17	.76
	2		.05	–.59	.57
	3			.25	.57
	4				.46
Fruits					
	1	1.58	1.36	1.15	1.17
	2		1.01	1.11	1.04
	3			.97	.86
	4				.67
Fresh Milk					
	1	1.60	1.26	.61	.67
	2		.44	.92	.64
	3			.34	.52
	4				.41
Other Milk					
	1	5.04	3.79	1.83	1.52
	2		.90	1.79	1.26
	3			.83	1.04
	4				.77

Continued –

Table 3B – (*Continued*)

Food	Income Group	Arc Income Elasticity between Income Group			Estimated Income Elasticity
		2	3	4	
Eggs					
	1	3.29	2.93	1.60	1.50
	2		1.03	2.01	1.28
	3			.71	1.04
	4				.77
Beaf	1	1.48	.92	.67	.57
	2		.53	.47	.50
	3			.59	.36
	4				.22
Other Meat					
	1	−.91	−.40	.08	1.18
	2		.29	.00	.84
	3			.42	.74
	4				.53
Mutton					
	1	1.83	2.69	2.96	1.25
	2		2.77	2.97	1.04
	3			2.09	.85
	4				.63
Chicken					
	1	4.52	7.01	6.23	1.18
	2		4.30	5.94	1.06
	3			2.23	.81
	4				.60
Edible Oils					
	1	.60	−.27	.10	1.18
	2		.12	−.01	.96
	3			.17	.74
	4				.51
Other Food					
	1	.47	.46	.34	1.39
	2		.35	.49	1.20
	3			.34	.98
	4				.75

REFERENCES

Alderman, Harold (1986) The Effect of Food Price and Income Changes on the Acquisition of Food by Low Income Households. Washington, D.C.: International Food Policy Research Institute.

Alderman, Harold (1988) Estimates of Consumer Price Response in Pakistan Using Market Prices as Data. *The Pakistan Development Review* 27:2 89–107.

Bliss, Christopher and Nicholas Stern (1978) Productivity, Wages, and Nutrition: Parts I and II. *Journal of Development Economics* 5:4 331–398.

Bouis, Howarth (1989) Prospects for Rice Supply/Demand Balances in Asia. Washington, D.C.: International Food Policy Research Institute.

Bouis, Howarth (1991) Rice in Asia: Is It Becoming a Commercial Good: Comment. *American Journal of Agricultural Economics* 37: 2 522–527.

Bouis, Howarth (1991a) A Food Demand System Based on Demand for Characteristics: If there is Curvature in the Slutsky Matrix, What Do the Curves Look Like and Why? Washington, D.C.: International Food Policy Research Institute.

Bouis, Howarth, and Lawrence Haddad (Forthcoming) Are Estimates of Calorie-Income Elasticities Too High: A Recalibration of the Plausible Range. Journal of Development Economics.

Comments on "Food Demand Elasticities by Income Group by Urban and Rural Populations for Pakistan"

When I was asked to be a discussant on the paper, I was a little reluctant to accept the offer because, in my opinion, all that could be said on the topic of demand elasticities has already been said, and it was inconceivable that anything new and interesting could be developed on the concept which is atleast a century old. After going through the paper I must confess that I was wrong, not only because the author has come up with a novel idea of estimating demand elasticity, but also that the efficacy of the new technique can not be refuted.

The new technique proposed by the author is less demanding on data, and is, thus, cost effective and very useful. The efficacy of this technique lies in its cost effectiveness. This aspect can only be appreciated by realising that with the use of proposed technique, the key parameters of demand could be estimated, and made available to the policy makers, at only a fraction of time and cost needed by the conventional econometric techniques. Similarly, in LDCs, where information and data are expensive inputs, a lot of good research ideas are stifled for the want of appropriate data. If similar techniques could be devised for other areas of research, a number of new areas could be researched.

It is true that the proposed new technique could be criticised on the basis of the strong *a priori* assumptions it entails about the demand behaviour, but then the same criticism, to lesser or greater extent, could be levied against any standard estimation technique. However, there are certain features which have to highlighted, if for nothing else but to caution the researchers about the possible hazards which may result from the improper and hasty use of the new technique.

1. There is no doubt that the methodology adopted by the author is cost effective compared to the standard econometric estimation techniques because of its data economy. However, compared to the econometric exercise, the new estimation methodology entails much more subjectivity and value judgments. The amount of *a priori* information (about the value of atleast some parameters) required for estimation, not counting for data requirements, is many times more than classical econometric estimation and, perhaps, only marginally less than the bayesian econometrics.

2. The cost effectiveness of the new technique is achieved at a cost of foregoing a lot of relevant information which becomes available in a standard econometric estimation. This information includes the descriptive statistics of the estimated coefficients (the demand elasticities). For example, the new estimation technique provides the point estimates only and does not provide any

information on the standard errors of the estimates and, thus, it is impossible to asses the statistical significance of the estimated coefficients. This becomes very important when the analysis, as in the present paper, requires inter-group comparison of estimates.

3. The above two points are of cursory nature and merely highlight the trade-offs that a researcher may have to weigh while choosing the new technique vis a vis the standard techniques, and in my opinion the scales tip in favour of the new technique, especially for the LDCs where data constraint is severely binding. However, my strongest disagreement with the author is on application of this new technique where data were available for standard econometric estimation. The accepted qualities of the estimators include, among other qualities, unbiasedness, efficiency and sufficiency. It is the obvious absence of the last which brother me the most. The sufficiency property, as is known to all, attributes a higher quality to the estimator which uses the maximum amount of existing information. Much more information was available in the published source from where the data for present exercise was taken, and indeed from other sources, but adoption of new technique compelled the author to disregard most of it. The information on all the relevant variables was available for a direct estimation of the complete set of demand elasticities for food for rural and urban areas of Pakistan using the standard econometric techniques. Separate estimation of various income groups in the urban and rural regions could have been made possible by inter-temporal and inter-provincial pooling of data (i.e. HIESs).

Finally, I have to say that the proof of pie is in eating. It is the overall reliability and empirical robustness of the estimated coefficients (elasticities) that would determine the overall quality of the new technique. The comparison of income elasticities estimated from the new technique with the arc elasticity, though itself not a perfect technique, suggests that much more rigorous statistical exercise has to be undertaken to prove the robustness of the estimates avaiable from this new technique, which is essential before a suggestion is made to the policy makers to adopt the estimated coefficients as relevant policy parameters.

With these words of caution, I once again commend the author for adding to the tool kit of the applied econometricians a new estimation technique, which if used with appropriate care and caution can go a long way in overcoming the data bottlenecks.

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