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PRICE AND INCOME EFFECTS ON URBAN UNDERNUTRITION

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Abstract. This paper estimates the extent of undernutrition in urban Pakistan in terms of calorie consumption after controlling heterogeneity in household characteristics. It also evaluates the sensitivity of price and income shocks on incidence, depth and severity of undernutrition. Approximately 27 percent incidence of urban undernourishment or food poverty is computed from the Household Integrated Economic Survey data of 1996-97. The results also reveal low magnitude of depth and severity of undernutrition.

I. INTRODUCTION

Many analysts believe that the locus of poverty and undernutrition is gradually shifting from rural to urban areas in the developing world. It is thought that the urban population exhibits more variation in poverty, mortality, and nutritional status compared to the rural population. During the last decade, development planners have taken a keen interest in issues related to malnutrition and undernutrition mainly in search of feasible policy interventions to alleviate poverty, hunger, and illness. This paper evaluates aggregate measures of undernutrition in urban Pakistan[1] using consumption data from the Household Integrated Economic Survey (HIES).

Although a complex web of physical, social, and economic factors influences human nutrition, the establishment of a link between nutritional

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[1]The analysis of undernutrition is undertaken for urban Pakistan only, using the calorie demand function with income and price of various food commodities. Inclusion of rural Pakistan is not feasible for the following reason. The majority of rural households consume staple food from their production and, as such, the sensitivity of market price change is not quantifiable for the purpose of estimating the rural household calorie demand function.

outcomes and change in food and non-food prices is an important area of research. Therefore, the paper also quantifies the short-term impact of changes in price and income on levels of undernutrition for urban Pakistan, in order to facilitate policy makers to form an appropriate intervention.

The paper is organized as follows. The relevant issues are discussed in the literature review in section II. Section III describes the adopted methodology for the analysis. The empirical findings related to calorie demand function are presented in section IV. Thereafter, section V presents the extent and intensity of undernutrition. The sensitivity analysis is discussed in section VI, while section VII is reserved for concluding remarks.

II. LITERATURE REVIEW

Economics and development as a sub-field have long been concerned with nutrition as it relates to poverty. Economists have analyzed issues ranging from how to measure nutritional intakes and outcomes, to appropriate norms, behavioural determinants, consequences, and underlying biology of poor nutrition, and more generally, poor health. Nonetheless, a discussion of appropriate or required nutritional norms has been widely focused in the literature.

The discussion of nutritional norms covers two related and heated debates: where to draw lines for measuring undernutrition, *i.e.* low calorie intakes and poor nutritional status. The controversy over recommended calorie standards has surfaced in the past ten years or so. The mainstream view is that the concept of "adequacy" is well-defined given a person's gender, age, weight, and level of "desirable" physical activity. Requirements will thus vary over individuals, but are reasonably constant for a given person. Further consideration can be in terms of not only minimally acceptable levels, but also optimal levels. These can, therefore, be used to construct cut off points for various measures of aggregate undernutrition.

In addition there are problems of aggregation. Once a norm is defined, and hence individual/household nutrition status determined, the question remains how to aggregate this information into a single index to proxy the status of a group of individuals. The issues in this regard primarily relate to assigning weights to differing intensities of undernutrition (Foster *et al.*, 1984; Sen, 1979). The most popular measure, namely the Head-Count Index assigns equal weights to all undernourished regardless of the extent of undernourishment. There are several other measures which have been suggested. These measures are sensitive to distribution of nutrition among the undernourished. A class of functional forms, which has been suggested by Foster, Greer and Thorbeke (FGT), uses various powers of the proportional gap between the observed and the required nutrition intake as the weights to indicate the level of intensity of undernourishment. The higher the power the greater the weight assigned to a given level of undernourishment. It therefore combines both the incidence and intensity.

The other set of issues relate to price and income responsiveness to nutrition intake. The empirical evidence indicates that income and prices have a much weaker link with nutrition intake than what intuition would suggest. Several reconciliatory arguments have been offered. They relate mostly to the potential biases due to the mis-specification of the demand functions, the presence of errors in those variables which are included, or also due to inappropriate estimation techniques. Behrman and Deolalikar (1987) have recently offered an explanation in terms of the difference between the demand for food quantity and the demand for food quality. Even if the nutrition intakes are less sensitive to income changes, the aggregate index may still be quite sensitive provided the interpersonal distributions are dense at the minimum required level (Ravallion, 1990). Nutrition sensitivity to income also relates to the data used to measure it. For instance, using data from Philippines and Kenya on calorie availability (based on food expenditure survey) and calorie intake (based on 24 hour recall), it has been shown that elasticity associated with calorie availability are biased upwards while those based on calorie intake are quite low and more reliable (Bouis and Haddad, 1992; Bouis, 1994).

Since most of the empirically estimated demand functions for food/ nutrients are based on cross-section data, which usually do not have enough price variations, the appropriate assessment of the price effects has been somewhat tenuous. Also there are many channels, which may influence the price effect. Therefore, a positive or negative impact is a statistical matter (Behrman, Deolalikar and Wolfe, 1988).

Finally, income and price elasticities are not the only options for policy intervention to produce adequate nutrition. Recent studies have established strong influences of factors other than food on the production of nutrition. For instance, Alderman and Garcia (1994) found that child nutrition responds strongly at the margin to health inputs more than to food availability.

III. METHODOLOGY AND DATA SOURCE

It is obvious that most of the difficult and somewhat unresolved problems in defining nutrition requirements relate to controlling inter- and intra-personal variations in responses to quantity of nutrition availability or intake. One way to get around problems of household heterogeneity in nutritional 'needs' and 'tastes' is to use the heterogeneity in the household characteristics, which are particularly pertinent in causing this heterogeneity. This is primarily the approach adopted by Ravallion (1990). More specifically, the approach consists of first estimating a nutrition demand equation, including budgetary variables like income and prices as well as non-budgetary variables like age and sex composition of the households, their educational background etc., which in essence should have been included to control the bias for missing variables. In the second step, this estimated demand equation is used to predict the demand for the same nutrition, again at the household level, but this time replacing the heterogeneous non-budgetary variables by their corresponding averages. This function yields demand for the nutrient as a function of budgetary variables for each household as if all of them have the same, non-budgetary characteristics. This way it holds the heterogeneity caused by variables other than the budgetary variables constant, and therefore isolates the effects of only budgetary variables on the demand for the nutrient.

To be more specific, in the first step standard calorie demand function is estimated. Household income, socio-economic and demographic characteristics, food and on-food prices etc. are included in the demand equation. The general form of the calorie demand function is as follows:

$$C_j = \delta + \hat{\lambda} y_j + \sum_{i=1} \hat{\alpha}_i P_{ji} + \sum_{k=1} \hat{\beta}_k D_{jk} + \sum_{q=1} \hat{\varphi}_q S_{jq} + e_j \quad (1)$$

Where:

C_j = Household Calorie Consumption

Y_j = Household Income

P_{ji} = Food and Non-Food Prices

D_{jk} = Household Demographic Characteristics

S_{iq} = Household Socio-Economic Characteristics

δ = Constant term

In the second step, the estimated demand function is used to predict consumption by the ith household as if it had reference characteristics fixed across all households. The implicit assumption in estimating this reference consumption is that all those non-budgetary variables, which influence intake or availability, also influence the requirements. Substitution of non-budgetary characteristics of a reference household in the estimated demand function will enable it to capture only the price and income effects. This is given by:

$$Q_i^r = \delta + \hat{\lambda}(Y_i - \bar{y}) + \sum_{j=1} \hat{\alpha}_i (P_{ij} - \bar{p}_j) \tag{2}$$

Where:

Q_i^r = 'Reference' calorie intake of the household

δ = Average calorie intake (constant in the Calorie Demand Function)

Y = Income of household

$\bar{y}$ = Average income

P_{ij} = Household reported prices of food items

$\bar{p}_j$ = Average prices

λ = Coefficient associated with income variable in the demand function

α_i = Coefficients associated with price variables in the demand function

In step three, the calorie availability of individual households as if they all had the same non-budgetary characteristics are compared with the minimum requirement. A household is undernourished only if available calories are less than the minimum calorie requirements (2230 per adult equivalent unit). This minimum requirement is recommended by Planning Commission (GOP, 1997). Since the main objective of this paper is to observe sensitivity of undernutrition due to economic shocks, the calorie cut off point is not very much important.

Once Q_i^r has been estimated for all households, the following form of aggregation (Foster *et al.*, 1984) is evaluated for various values of α.

$$P^\alpha = \left(\frac{1}{n}\right) \sum_i \left[\frac{\left(Q^m - Q_i^r\right)}{Q^m} \right]^\alpha \tag{3}$$

Where:

P^α = Aggregation measure

n = Total number of households

Q^m = Minimum required calories

Q_i^r = Observed 'reference' calories of household

Σ_i = Summation for all households those consume less than minimum requirement

Putting $\alpha = 0$, the formula shows Head Count Index (HCI), that is a proportion of households whose calorie consumption fall below the minimum requirement. This simple measure ignores the depth of undernourishment. Putting $\alpha = 1$, the Proportionate Gap Index (PGI) is calculated. It measures the average distance from the minimum requirement. PGI although shows the depth of undernutrition, but it is insensitive to the distribution among the undernourished. Putting $\alpha = 2$, FGT2 index is calculated. The index takes into account inequality amongst the undernourished and shows the severity of undernourishment by assigning greater weights to those households, who are far from the minimum required calories.

Finally, the impact of changes in income and prices on nutrition intake is simulated using specification (2) and (3).

The data for this study is drawn from HIES, 1997. The calorie intakes are derived from the quantities of food consumed by households. Food quantities have been translated into calories by applying the conversion factors taken from the Food Composition Table for Pakistan (GOP, 2001). An Adult Equivalent Scale for each household is also computed from this source, using calorie requirements for age and sex composition. Household demographic and economic variables and food prices are computed from the HIES unit record data.

IV. CALORIE DEMAND FUNCTION

The statistical results of log-linear estimated demand function are presented in Table 1. As the variables are used in a logarithmic form, the coefficients depict direct elasticities with respect to calorie consumption. It is evident from Table 1 that, except for the coefficient of oil and ghee price, all variables are significant at least at 90 percent level. The magnitude of R^2 is low, but it is acceptable in cross-section data.

Some interesting observations emerge from the findings. The income coefficient is positive and significant but elasticity is low. This supports earlier findings that the link between income and nutrition intake is weak. Wheat price elasticity is relatively high as compared with other food items

TABLE 1

Calorie Demand Function for Urban Pakistan
[Dependent Variable = Household Calorie
Consumption per Adult Equivalent Unit]

Explanatory Variables	*Coefficients*	*T Value*	*Significance*
Household Income	1.145	8.346	0.000
Household Income Square	–0.059	–6.162	0.000
Wheat Price	–0.211	–5.684	0.000
Rice Price	–0.070	–2.422	0.015
Meat Price	–0.140	–2.425	0.015
Oil and Ghee Price	–0.328	–1.477	0.140
Oil and Ghee Price Square	0.051	1.642	0.101
Share of Non-Food Expenditure in Total Expenditure	–0.308	–9.298	0.000
Family Size	0.433	10.729	0.000
Family Size Square	–0.140	–10.997	0.000
Proportion of Adult in the Household	0.038	2.290	0.022
Age of Head of Household	0.154	6.928	0.000
Education Level of Head of Household	–0.042	–1.704	0.088
Squared Education Level of Head of Household	0.019	1.928	0.054
Large City Dummy (1 if Household is in City)	–0.082	–6.195	0.000
Constant	2.994	4.502	0.000
Model Statistics			
R-Square	0.173		
Adjusted R-Square	0.171		
F-Ratio	75.60		
Number of Observations	5424		

(rice, meat, oil, ghee) included in the function.[2] This is quite understandable. Wheat is the main staple food and a change in its price significantly affects

[2]Initially all important food items for which prices are available in HIES were included in the demand function. However, due to insignificance with respect to calorie consumption and other econometric problems, some food items have been dropped and not reported in the final estimated equation.

the budget constraint. To capture the effect of changes in non-food prices, a proxy is used. The coefficient of the share of non-food expenditure is negative and significant, showing a decrease in calorie demand due to an increase in non-food prices. The variables relating to the household size, age of the head of the household and proportion of adults are primarily included to control inter-household heterogeneity and reduce possible bias in the coefficients of budgetary variables. They have taken expected signs and are significant.

Results corresponding to the variable related to the education of the head of the household do not confirm that it plays a significant role in the decision regarding nutrient intake. The coefficient is negative at initial levels of education, indicating a low calorie demand. However, beyond some threshold the coefficient shows a positive relationship between calorie consumption and education. To capture the location impact, a dummy variable is introduced. It assigns a value of 1 to households residing in large cities. Surprisingly, the coefficient is negative. The inverse relationship between calorie intake and large city dwellers may partly be explained in that relatively more weight is assigned to non-food items.

V. MEASURES OF UNDERNUTRITION

Table 2 presents various measures of undernourishment. There are few observations which emerge. If one takes the traditional head-count index as the measure of undernutrition then there is significant prevalence of undernutrition to the extent of 24 to 31 percent. Since the data are on a household basis, this in fact is the household-count index, representing the proportion of households rather than individuals.

TABLE 2

Level of Undernutrition (Food Poverty) in Urban Pakistan
[Percent of Households]

Urban Areas	Head Count Index [Incidence]	Proportionate Gap Index [Depth]	FGT2 Index [Severity]
Pakistan	26.73	2.24	0.30
Punjab	28.04	2.44	0.35
Sindh	24.30	1.83	0.22
NWFP	27.51	2.51	0.35
Balochistan	30.89	2.88	0.40

Source: Estimated from Caloric Demand Function and HIES (1996-97) data.

However, since a large proportion of the undernourished is only marginally undernourished, intensity-sensitive measures indicate a very low prevalence of undernourishment. For $\alpha = 1$ it drops to about 3 percent and for $\alpha = 2$ to only less than 1 percent, indicating a low level of the severely undernourished.

The situation across provinces reveals that urban Sindh has the lowest incidence as well as lowest severity of undernourishment. Urban Balochistan is on the other extreme. NWFP's position is better than Punjab with respect to incidence. However, the depth in undernutrition is more than urban Punjab.

VI. ECONOMIC SHOCKS AND UNDERNUTRITION

Tables 3 through 5 present the simulation results of income and price effects on calorie demand. These simulated impacts are short-term and should be viewed accordingly. Three scenarios have been chosen for this exercise: impact of wheat price; impact of non-food prices (share of non-food expenditure in total expenditure); and impact of overall inflation (decrease in household income).

TABLE 3

Short Term Impact of 10 Percent Increase in *Wheat Prices* on Undernutrition (Food Poverty)

Urban Areas	Increase in Undernutrition Measures (%)		
	HCI (Incidence)	PGI (Depth)	FGT2 (Severity)
Pakistan	18	24	30
Punjab	16	23	26
Sindh	21	27	32
NWFP	16	21	29
Balochistan	21	22	28

Table 3 displays the impact of an increase in wheat prices on various measures of undernutrition. It shows that the overall HCI would increase from its base by 18 percent, the PGI by 24 percent and the FGT index by 30 percent. Urban Sindh and Balochistan would face relatively more adverse positions. In terms of depth and severity, Sindh has the highest increase in the base of severity index. The lowest impact on incidence and depth of undernutrition in NWFP is mainly due to the fact that maize is also an important source of calorie in the province.

TABLE 4

Short Term Impact of 10 Percent Increase in *Non-Food Prices* on Undernutrition (Food Poverty)

Urban Areas	Increase in Undernutrition Measures (%)		
	HCI (Incidence)	PGI (Depth)	FGT2 (Severity)
Pakistan	26	36	43
Punjab	23	34	40
Sindh	32	41	50
NWFP	21	32	43
Balochistan	29	33	40

TABLE 5

Short Term Impact of 10 Percent Increase in *General Inflation* on Undernutrition (Food Poverty)

Urban Areas	Increase in Undernutrition Measures (%)		
	HCI (Incidence)	PGI (Depth)	FGT2 (Severity)
Pakistan	36	54	70
Punjab	33	52	66
Sindh	42	60	77
NWFP	35	49	69
Balochistan	35	49	65

According to Table 4, which shows the impact of non-food prices on undernutrition, urban Sindh would be in the worst position in terms of incidence, depth and severity of undernutrition. Overall magnitude of under-nourishment measures indicate that 10 percent increase in non-food prices would increase the HCI by 26 percent, the PGI by 36 percent and the FGT2 index by 43 percent. This clearly reflects the severity of non-food prices impact, especially in large urban areas.

Table 5 shows that for Pakistan, a 10 percent increase in the general price level is likely to increase the HCI from the base by 36 percent from 26.7 to 36.3, the PGI by 54 percent from 2.2 to 3.4 and the FGT2 index by 70 percent from 0.3 to 1.7 percent. Sindh is once again likely to be the worst affected, with incidence increasing by 42 percent, depth increasing by 60 percent and severity increasing by 77 percent. However, the increase in the magnitude is the highest in the case of Balochistan. The lowest increase in the incidence of undernutrition is computed for urban Punjab.

VII. CONCLUSION

Undernourishment is a form of food poverty and occurs on account of deficiency in food intake, which can occur because of fall in incomes, increase in food prices or increase in non-food prices. This study calculates the incidence, depth and severity of urban undernutrition after controlling heterogeneity in household characteristics. The approach adopted here is suggested by Ravallion (1990).

The analysis shows that over a quarter of households (26.7 percent) suffer from undernutrition and ranges across the provinces within a rather narrow band of 24-31 percent. The lowest undernutrition is in urban Sindh (24.3 percent) and the highest undernutrition is in urban Balochistan (30.9 percent). NWFP and Punjab lie in between at 27.5 and 28 percent respectively.

Fortunately, measures for depth and severity show that undernourish-ment is not a serious problem in Pakistan. The Proportionate Gap Index shows that affected households are located close to the food poverty line. Similarly, the severity of undernourishment ranges from 0.2 for urban Sindh to 0.4 to urban Balochistan.

The low level of depth and severity of undernutrition does not merit complacency, however, as the affected households are vulnerable to shocks. Simulation results of the short-run impact on undernutrition of food poverty of a 10 percent rise in wheat prices, non-food prices and general price level reveal interesting phenomenon across provinces. Urban Sindh and Balochistan seem to be more vulnerable than Punjab and NWFP provinces.

The study by documenting the extent and severity of undernutrition as well as simulation with respect to income and wheat prices provides basis for public intervention. The findings are useful for developing pro-poor food pricing policies and enhancing the effectiveness of various social safety nets.

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