Curvature in Slutsky Matrix: Estimates from Rural India[*]

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ABSTRACT

The motivation in this paper is to understand the nutritional impact of food price changes with large numbers suffering protein-calorie deficiency. In India, it has been reported that during the 1990s cereal consumption declined while non-cereal consumption increased. Whether this shift in consumption is a result of changes in relative prices is the focus of this analysis. In this paper we work with four food groups: wheat, rice, pulses and milk. The coefficients on income for all substitution elasticites except the one of rice with milk are significant. In all cases except milk with respect to other commodities these are positive as well. Thus with arise in income households are better able to substitute all commodities except milk with other commodities. On the other hand, the substitution elasticity of milk with respect to other commodities drops with income.

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I. Introduction and Motivation

It has been reported that in India cereal consumption declined during the 1990s whereas non-cereal consumption increased. Whether this shift in consumption is a result of changes in relative prices is the focus of this analysis. If the poor respond to such relative price changes differently from the non-poor then these relative price changes can have important implications for the nutritional status of the poor. This paper attempts to address this question.

The motivation for this paper comes from Timmer (1981) who outlined a procedure for estimating the curvature in the Slutsky matrix. The question is: do the terms in the Slutsky elasticity matrix curve move smoothly from low incomes to high incomes? A more specific question is whether the following equation has any empirical support.

$$\varepsilon_{ij}^{\ h} = f(a^h) \qquad (1)$$

where

$\varepsilon_{ij}^{\ h}$ = the Slutsky substitution elasticity for household *h* for commodity *i* when commodity j's price changes, *ceteris paribus*, and

a^h = the income of household h. We use the per capita income of the household.

Note that

$$e_{ij} = \varepsilon_{ij} - E_i \alpha_j \qquad (2)$$

where

e_{ij} = observed substitution elasticity (in contrast to ε_{ij} which is a pure substitution elasticity)

E_i = the income elasticity for good *i*, and

α_j = the budget share for good j, or $p_j q_j / a$, with

a = household per capita income.

The motivation here is to understand the nutritional impact of food price changes with large numbers suffering protein-calorie deficiency. In India, it has been reported that during the 1990s cereal consumption declined while non-cereal consumption increased. Whether this shift in consumption is a result of changes in relative prices is the focus of this analysis.

Following Timmer (1981) but with some modifications, we first estimate per capita demand for four commodity groups: rice, wheat, pulses, and milk and milk products (we had to restrict the number to limit estimation of cross-price elasticities or the size of the Slutsky matrix). Thus the estimated equation is:

Log of per capita expenditure on wheat= f (log of per capita income, log of square of per capita income, (log)prices of each cereal, pulses, and milk and milk products (at village level), (log)number of adult males and females, household caste and religion dummies, Bimaru and Coastal regional dummies). (3).

This is repeated for the other commodity groups. In addition we had a measure of (log) per capita calorie intake and protein intake as dependent variables and estimate their demand using the same set of right side variables.

Since the estimation strategy proposed here yields estimates of both observed cross- price elasticities and income elasticities, we compute the (compensated) Slustsky elasticities by inserting their values in equation (2).

An additional regression is run along the lines of equation (4) to validate the hypothesis of a curvature in the Slutsky matrix.

$$\left\lfloor \varepsilon_{ij}^{\ h} \right\rfloor = b_{ij} + c \log a^{h} \text{ …….(4)}$$

Further it may be confirmed that *c* estimated from (4) would be similar to *C* from the regression in (3) for any pair of commodities, since the Engel relationship is embedded in the demand function in (3).

$$\mathrm{E}_i = B_i + 2C_i \,(\text{total income/expenditure}) \quad \text{……..(5)}$$

where

B_i = the coefficient of log of total income from regression equation (3), and

C_i = the coefficient of log of square of income from the same regression.

The similarity between *c* and *C* suggests that that the rate of decline of commodity-specific income elasticities as income increases is approximately twice the rate of decline in the compensated price elasticities. Thus the following approximation is used:

$$\frac{\partial \varepsilon_{ij}{}^{h}}{\partial f(a^{h})} = 1/2 \frac{\partial E^{h}{}_{i}}{\partial f(a^{h})} \quad \text{..... (6)}$$

II. Data and Results

The data used in this paper comes from the National Council for Applied Economic Research (NCAER). The data collection methodology involved a multi-purpose household survey spread over six months, from January to June 1994. The data were collected using varied reference periods based on some conventional rules.

The results of the estimation of the response of the Slutsky substitution terms to income are presented in Table 1.

Table 1: Results on Estimation of Curvature of Slutsky Matrix

Equation 4				
	Income Coeffcient	P Value	Constant	P Value
	Wheat (i)			
Commodity j				
Rice	0.011	0	0.41	0
Pulses	0.002	0	0.18	0
Milk	0.004	0	-0.114	0
	Rice (i)			
Commodity j				
Wheat	0.000208	0	-0.58	0
Pulses	0.0000837	0	-0.29	0
Milk	0.00000523	0.621	0.33	0
	Pulses (i)			
Commodity j				
Rice	0.002	0	-0.27	0
Wheat	0.001	0	-0.005	0

Milk	0.001	0	0.052	0
		Milk(i)		
Commodity j				
Rice	-0.004	0	0.99	0
Wheat	-0.002	0	-0.15	0
Milk	-0.000741	0	0.47	0

The coefficients on income for all substitution elasticites except the one of rice with milk are significant. In all cases except milk with respect to other commodities these are positive as well. Thus with arise in income households are better able to substitute all commodities except milk with other commodities. On the other hand, the substitution elasticity of milk with respect to other commodities drops with income.

III. Conclusions

While consumers in rural India do substitute out of some food groups in response to price changes this is not true not of income. In fact with a rise in income the substitution elasticity of milk with respect to other goods falls.

References

Timmer, P. (1981) “Is there Curvature in the Slutsky matrix?” *Review of Economics and Statistics*¸ vol. 63, no.3, pp.395-402.