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FUNCTIONAL FORM OF ENGEL CURVES FOR FOODSTUFFS

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september 1984

Abstract. Employing individual household expenditure data for seven foodstuffs we test five three-parameter and four two-parameter Engel curves against a more general form. All two-parameter functions must be rejected, including Working's function; it appears that a transformation of the budget share is in order to capture the observed curvature.

Keywords Engel curve, functional form.

JEL-codes: 220, 920.

FUNCTIONAL FORM OF ENGEL CURVES FOR FOODSTUFFS

1

This paper is concerned with the functional form of Engel curves for foodstuffs, and in particular with the empirical performance of the function

$$w_j = \alpha_j + \beta_j \ln y \quad (1)$$

with w_j denoting the budget share of the j 'th commodity and y total expenditure. This form, first introduced by Working (1943), has recently come into favour because of its easy compliance with the requirements of a complete consumer demand system, as demonstrated by Deaton and Muellbauer (1980). For the quality of the fit reference is usually made to Leser (1963), but since that study compares the fit of various functions to only four observations, each representing a constructed income class mean, the question bears re-examination.

We regard Working's function (1), along with other simple forms, as a simplification of the general formula

$$w_j^{(\lambda_j)} = \alpha_j + \beta_j y^{(k_j)} + \varepsilon \quad (2)$$

where we make use of the well-known transformation

$$z^{(\lambda)} = (z^\lambda - 1)/\lambda, \quad \lambda \neq 0, \quad (3a)$$

$$z^{(\lambda)} = \log z, \quad \lambda = 0 \quad (3b)$$

which is due to Box and Cox (1964). Single restrictions on the λ_j and k_j yield five intermediate forms, and double restrictions result in four simple two-parameter Engel functions, including (1). The full list of all ten functions under consideration, labeled from A to J, is given in Table 1.

Table 1. Functions and Commodities (with average budget shares)

A general $w^{(\lambda_j)} = \alpha_j + \beta_j y^{(k_j)}$	1. Bread and cereals (.031)
B symmetry $\lambda_j = k_j$	2. Fruit and vegetables (.031)
C $k_j = 1$	3. Drink and sweets (.046)
D semi-Working $k_j = 0$	4. Oils and fats ¹⁾ (.004)
E $\lambda_j = 0$	5. Meat and fish (.054)
F $\lambda_j = 1$	6. Dairy products (.032)
G double log $\lambda_j = 0, k_j = 0$	
H Working $\lambda_j = 1, k_j = 0$	
I $\lambda_j = 1, k_j = 1$	
J $\lambda_j = 1, k_j = -1$	

1) Since butter is classified as a dairy product, oils and fats constitute an ill-assorted commodity group with a very small budget share and with 11 zero expenditure records for a total of 12 households with any zero record.

see here Table 1

Upon assuming that the disturbance term ε in (2) is an independent Normal $(0, \sigma^2)$ variate, all functions can be estimated by Maximum Likelihood, and the various simplifying restrictions can be tested by the asymptotic Likelihood Ratio test.

2

The analysis has been carried out for the Engel curves of six food commodities, also listed in Table 1. They are all necessities, with income elasticities of between .3 and .6, and they all behave in much the same way (as we shall presently see). This choice avoids the difficulties of interpretation that beset Engel functions for expenditure on durable goods and for committed expenditure such as rent. It precludes the consideration of a complete system, and we need not trouble with adding-up restrictions.

The data have been taken from the 1980 Dutch household budget survey, conducted by the Central Bureau of Statistics. In the interest of homogeneity we use the observations on 624 individual households that consist of a married couple and two children under 16. There are altogether 636 such households in the sample, but 12 of these report zero expenditure on at least one food commodity, even though the records cover a full four weeks.

The Maximum Likelihood estimation of the functions of Table 1 was carried out with the help of the GRMAX program of Ridder (1982).

3

The likelihood ratio tests are documented in Table 2 and their outcome is illustrated in Figure 1. The results are clear-cut in the sense that

the tests register high significance or none at all, and the conclusions are much the same for all six food commodities.

See here Table 2, Figure 1

The four simple two-parameter Engel functions are all soundly rejected. If we take the loglikelihood as a rough measure of fit, it is not Working's function H but the staid double-log function G which does best.

The reason why the route to Working's function is blocked is that the transformation of the budget share is apparently essential. All three acceptable functions - the general form A and its simplifications B and D - have a Box-Cox transform of w_j as the dependent variable, with closely similar values of the parameter λ_j . All have the same curvature in common: if we use the parameter estimates to plot w_j against $\log y$, the three curves A, B and D are slightly concave as seen from below, in contrast to the straight line of Working's function. The quest is for a simpler form with the same characteristic. We have not yet found it.

The present results provide a minor complement to the study of Aasness and Rødseth (1983) for complete demand systems. These authors consider a much larger variety of functional forms than we do, but they stop short of transformations of the budget shares which constitute their dependent variables. Such transformations do not fit easily in the framework of a complete system, which is a major attraction of their work. Yet our evidence suggests that it is a restriction which must be rejected.

Table 2. LR test statistics with respect to function A.

function	commodity					
	1	2	3	4	5	6
B	1.48	.70	.05	.03	.16	.27
C	12.38	4.20	1.44	3.61	4.58	5.52
D	.22	.00	.46	.90	.08	.51
E	13.97	47.88	14.40	84.65	45.79	28.36
F	97.47	75.00	124.78	160.24	230.58	55.58
G	13.97	48.00	16.50	90.17	46.18	29.68
H	99.79	75.28	125.05	160.87	230.73	55.57
I	116.99	82.45	130.10	171.82	236.65	64.71
J	99.85	77.81	126.48	163.76	233.51	64.16

$\chi^2(1)$ at 0.05 3.84, at 0.01 6.63; $\chi^2(2)$ at 0.05 5.99, at 0.01 9.27

Figure 1. Results of LR tests of successive simplifications

The letters refer to the functions of Table 1. Each line corresponds to a single possible restriction; — acceptable, unacceptable, — · — · — · mixed, according to commodity.

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