Cross Country Demand and Savings Patterns

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CROSS COUNTRY DEMAND AND SAVINGS PATTERNS:
AN APPLICATION OF THE EXTENDED
LINEAR EXPENDITURE SYSTEM

C. Lluch and R. Williams*

I. Introduction

Prices and total consumption expenditure
are the usual explanatory variables in applied demand theory. In a previous paper
(Lluch and Williams (1975)), it has been
shown that at least for one country (U.S.A.)
and one model (the linear expenditure system,
LES), it is advisable to substitute personal dis-
posable income for total consumption expendi-
ture, and fit the extended linear expenditure
system, ELES (Lluch (1973)). The purpose of
this paper is to examine whether the same sub-
stitution is advisable when searching for sys-
tematic cross country variations in demand
patterns. To this effect, we report the empirical
results of fitting ELES to short time series on
income, expenditures and prices in 14 countries,
for an 8 commodity breakdown. The 14 coun-
tries are a subset of those used for the LES fit
in Lluch and Powell (1975), (henceforth re-
ferred to as L-P). The set of parameters in
ELES is the same as in LES, plus \( \mu \), the mar-
ginal propensity to consume. The obtained
ELES parameter estimates differ from esti-
mates reported in L-P, Which set of estimates
one should use in applications is an open ques-
tion, but the following remarks can be made
on ELES (versus LES) results. First, the cross
country variation of the estimated cost of sub-
sistence is considerably smaller. Second, cross
country patterns in key elasticities are more
discernible.

The paper is organized as follows. Section II
contains the statement of the fitted model. The
empirical results are given in section III. Cross
country patterns in ELES estimates of key
elasticities are sought for in section IV, using
GNP per capita as the explanatory variable.
A summary and suggestions for further work
is given in section V.

II. The Extended Linear Expenditure
System

Deterministic Model

The deterministic part of the fitted model is
the extended linear expenditure system, ELES,

\[
v_i = \beta_i y + \sum_{j=1}^{n} \beta_j p_j, \quad (i = 1, \ldots, n)
\]

(1)

which expresses consumption expenditures on
\( n \) goods \( (v_1, \ldots, v_n) \) as a linear function of
their prices \( (p_1, \ldots, p_n) \) and income, \( y \), with
fixed parameters that satisfy the constraints

\[
\beta_i = \mu_i, \quad 0 < \beta_i < 1, \quad \sum_{i=1}^{n} \beta_i = 1,
\]

(2)

\[
v_i - p_i y > 0.
\]

In Lluch (1973), ELES is derived from
an intertemporal formulation of the consumer
problem. It represents the optimal allocation

\[
\sum_{i=1}^{n} \beta_{i,t}\]

Key assumptions in the formulation of the problem are
(i) planning under certainty; (ii) intertemporal additivity;
(iii) stationary interest rate expectations; (iv) either sta-
tionary price expectations or a uniform expected inflation
rate for both prices and labor income. Thus, the applica-
tion of the model to countries with varying price inflation
rates does not affect the intercountry comparisons presented
here, as long as labor income is expected to grow at the
same rate as prices. Model (1) incorporates the additional
assumption that measured and permanent income are the
same: in the context of Lluch (1973), that the present
value of expected changes in labor income is zero. Removal
of this assumption has been tried (Williams and Chang
(1973)), using four measures of 'income' and a larger data

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who has provided stimulus and ideas to this work; to Rich-
ard Berner for making available to us disposable income data
for Italy; to Rita Piacelli and Sandra Hadler for assistance
in data compilation; and to John Chang, who provided
very able research assistance. Thanks are also due to a
referee for helpful suggestions. The World Bank is not
responsible for any views expressed here.

1 So the model comparison is possible, with due care for changes
in the sample period for some countries.

2 A key parameter in the aggregate consumption literature,
here estimated in the context of a complete system of
demand equations. The reasons for considering LES and
ELES fits as alternative estimation problems are given in
Lluch and Williams (1975).

3 Key assumptions in the formulation of the problem are
(i) planning under certainty; (ii) intertemporal additivity;
(iii) stationary interest rate expectations; (iv) either sta-
tionary price expectations or a uniform expected inflation
rate for both prices and labor income. Thus, the applica-
tion of the model to countries with varying price inflation
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same rate as prices. Model (1) incorporates the additional
assumption that measured and permanent income are the
same: in the context of Lluch (1973), that the present
value of expected changes in labor income is zero. Removal
of this assumption has been tried (Williams and Chang
(1973)), using four measures of 'income' and a larger data
of expenditures at the beginning of the consumer plan, when the instantaneous utility function is the Klein-Rubin (1947) indicator
\[ u(q) = \beta' \log (q - \gamma) \] (2)
where \( q = (q_1, \ldots, q_n)' \), \( q_i = v_i/p_i \), \( \beta = (\beta_1, \ldots, \beta_n)' \), \( \gamma = (\gamma_1, \ldots, \gamma_n)' \).

Adding up expenditures in (1) and using the restriction \( \Sigma \beta_i = 1 \), we obtain the aggregate consumption function associated with ELES
\[ v = (1 - \mu) \sum_{i=1}^{n} \beta_i q_i + \mu v \] (3)
where \( v = \Sigma_{i=1}^{n} v_i \). Thus, the parameter \( \mu \) in ELES is the marginal propensity to consume (MPM). In fact, equation (3) is a Keynesian consumption function, with the intercept defined as a linear function of prices.

In (3), we can express \( y \) as a function of \( v \). Substituting this function into (1) we obtain
\[ v_i = \beta_i q_i + \beta_i \left( v - \sum_{j=1}^{n} \beta_j q_j \right) \] (4)
which is the widely used linear expenditure system (LES) obtained by maximizing (2) under the constraint \( \Sigma \beta_i v_i = v \). Therefore, ELES can be decomposed into LES and the aggregate consumption function (3), so that the well known formulae of expenditure and price elasticities in LES are applicable in ELES. Thus, it is justified to center attention on these, as will be done in the rest of this paper. Also, it is of interest to point out that the Frisch parameter, \( \omega_i \) (the expenditure elasticity of the marginal utility of expenditure) enters into the definition of the savings ratio in the ELES model. After some manipulation, the aggregate consumption function (3) can be written as
\[ (1 - \mu) \frac{1}{y} = \frac{1}{1 + \psi} \] (5)
where \( \psi = -\omega \mu (1 - \mu) \). Expression (5) is useful: it relates the household saving ratio to the Frisch parameter and the marginal propensity to consume.

Stochastic Specification and Estimation Methods

The model to be estimated is
\[ v_i = \beta_i q_i + \beta_i \left( v - \sum_{j=1}^{n} \beta_j q_j \right) + e_i \] (6)
\[ (i = 1, \ldots, n; t = 1, \ldots, T), \]
where \( \beta_i = \mu \beta_i \) and the error term is assumed to be of the following structure
\[ E(e_i) = 0 \]
\[ E(e_i e_{i'}) = \begin{cases} \sigma^2, & i = j, \ t = t', \\ 0, & i \neq j, \ t \neq t'. \end{cases} \] (7)

This error specification allows for contemporaneous correlation across equations but does not allow for serial correlation either within or across equations. The explanatory variables \( (p_i, q_i) \) are taken to be nonstochastic or, if stochastic, independent of \( e_i \).

On the assumption that the error vector \( (e_{1t}, \ldots, e_{nt}) \) comes from a multivariate normal distribution, maximum likelihood estimates of the parameters \( (\beta_i, q_i) \) in (6) have been obtained using the (modified) Gauss-Newton procedure. An estimate of \( \mu \) is obtained from the restriction \( \Sigma \beta_i = 1 \), i.e., \( \mu = \Sigma \beta^* \). Asymptotic estimates of the variance-covariance matrix of estimated parameters in (6) were obtained from the Hessian of the log-likelihood function evaluated at estimated parameter values. The estimated variance-covariance matrix for \( (\mu, \beta, \gamma) \) follows easily.

In some cases the above maximum likelihood estimation procedure failed to converge. Convergence was achieved by replacing the error structure (7) by
\[ E(e_i) = 0 \]
\[ E(e_i e_{i'}) = \begin{cases} \sigma^2, & i = j, \ t = t', \\ 0, & i \neq j, \ t \neq t'. \end{cases} \] (8)

The linear expenditure system can be derived from ELES; but if ELES is the correct model, the resulting error term in LES is contemporaneously correlated with the explanatory variable, \( v \). It follows that conventional ML methods of estimation of LES are then inappropriate. For a fuller discussion of this, see Lluch and Williams (1975).

The program used was written for IBM by Y. Bard. For a full description see Bard (1967). Analytical rather than numerical derivatives were used.

For details, see Lluch and Williams (1975).
This error specification rules out contemporaneous correlation across equations and assumes a common error variance for each equation. Under this specification maximum likelihood estimation is equivalent to (systems) least squares, i.e., minimizing the estimated sum of squares over all equations and time periods, \( \sum_{t=1}^{T} e_{it}^2 \). This is the criterion adopted in Goldberger and Gamaletos (1970).

### III. Empirical Results

**Parameter Estimates**

The model was fitted to data on per capita expenditures, per capita personal disposable income, and (implicit) prices for 14 countries using an 8 commodity classification.\(^9\) Maximum likelihood estimation methods were employed, but in 6 cases it was necessary to use (systems) least squares to obtain convergence. Tables 1 and 2 contain estimates of \((\mu, \beta, \gamma)\), together with their asymptotic standard errors. Table 3 gives estimates of the subsistence parameters valued at 1969 United States dollars.

Estimates of the marginal propensity to consume, \(\mu\), range from 0.58 (Israel) to 0.93 (S. Korea) and have relatively small standard errors.\(^10\)

The estimates of the marginal budget shares, \(\beta\), are positive except in one case.\(^11\) The \(\beta\), values are broadly comparable with those obtained using LES, but some divergences occur.\(^12\)

The (absolute) ratio of the \(\beta\) estimates to their asymptotic standard errors is less than 2 in only five cases.\(^13\) The \(\gamma\) estimates are determined with considerably less precision.\(^14\) 33 out of the 110 estimates of \(\gamma\) are less than twice their standard error (in absolute terms). Eleven of the \(\gamma\) estimates are negative, with six of these occurring for the two commodity classes Transport and Other Services in the high income countries.\(^15\)

The two models, LES and ELES, yield considerably different values for the "subsistence regimen," \(\rho'\gamma\). Results are compared in the final column of table 3. The broad pattern is a small decline for low income countries using ELES, substantial increases for the middle income countries, and substantial decreases for the high income countries.\(^16\) The net effect is a considerable reduction in the range of \(\rho'\gamma\) using ELES, thereby reinforcing its interpretation as a "subsistence minimum."

Goodness of fit, as measured by the coefficient of determination,\(^17\) \(R^2\), is uniformly high using ELES. The values of \(R^2\) exceed 0.95 in 84 out of the 110 equations and are comparable to those obtained using LES.

A preponderance of low values for the Dur-
### Table 1. Estimated Marginal Propensity to Consume, $\mu$, and Marginal Budget Shares, $\beta$\(^a\)

<table>
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<tr>
<th>Country</th>
<th>Type of Estimate(^b)</th>
<th>$\mu$</th>
<th>Food</th>
<th>Clothing</th>
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<th>Household Equip.</th>
<th>Personal Care</th>
<th>Transport</th>
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<th>Other Services</th>
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</table>

* Asymptotic standard errors are given in parentheses.

* LS = Least Squares, ML = Maximum Likelihood.

bin-Watson $d$-statistic is observed in L-P. Similar results are obtained using ELES: 53 of the 110 values are less than 1.0, only 9 exceed 2.\(^{18}\) It follows that the reported standard errors should be interpreted with due care.

**Elasticities**

The estimated parameter values given in tables 1 and 2, the mean "supernumerary ratio,"\(^{19}\) $-\phi$, and the average budget shares given in Appendix table A1, can be used to compute all expenditure and price elasticities at mean sample values. The computed elasticities are not given here.\(^{20}\) The salient remarks to be made about them are (i) in only one case (Jamaica) is the utility specification (2) contradicted by the sign pattern of the price elasticity matrix; (ii) own price and Food cross price elasticities account for most of the total price response in each commodity demand function in all countries;\(^{21}\) (iii) differences in price elasticities obtained with LES and ELES estimates can on the whole be traced down to differences in estimated subsistence expenditure (table 3), and the corresponding $-\phi$. Using ELES estimates, countries in the high income range have price elastic demand functions for Transport and Other Services (due to negative ELES $\gamma$-estimates). In general, the ELES and LES price elasticity estimates differ as indicated in table 4.

\(^{18}\) Full results are available upon request.

\(^{19}\) The supernumerary ratio is defined as $-\phi = (\nu - \rho \gamma)/\nu$. See Goldberger and Gamaletos (1970).

\(^{20}\) They are available upon request.

\(^{21}\) As in the case of LES estimates. See L-P, p. 20 and table 8.
Table 2. — Estimated "Subsistence Minima", \( \gamma \)

<table>
<thead>
<tr>
<th>Country</th>
<th>Base Year</th>
<th>Food</th>
<th>Clothing</th>
<th>Housing</th>
<th>Household Equipment</th>
<th>Personal Care</th>
<th>Transport</th>
<th>Recreation</th>
<th>Other Services</th>
<th>Sum of ( \gamma )</th>
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<td>623.5</td>
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<td>15.6</td>
<td>57.8</td>
<td>37.9</td>
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<td>8.7</td>
<td>977.2</td>
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<td>557.6</td>
<td>161.7</td>
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<td>Greece</td>
<td>1958</td>
<td>3000.0</td>
<td>277.2</td>
<td>936.9</td>
<td>107.4</td>
<td>73.6</td>
<td>57.5</td>
<td>137.0</td>
<td>468.8</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>1963</td>
<td>84.5</td>
<td>12.6</td>
<td>21.1</td>
<td>5.1</td>
<td>1.7</td>
<td>8.3</td>
<td>8.8</td>
<td>8.6</td>
<td></td>
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<tr>
<td>Italy</td>
<td>1963</td>
<td>844.9</td>
<td>182.1</td>
<td>245.5</td>
<td>-46.6</td>
<td>98.6</td>
<td>50.1</td>
<td>129.3</td>
<td>1528.2</td>
<td></td>
</tr>
<tr>
<td>Israel</td>
<td>1964</td>
<td>652.3</td>
<td>165.0</td>
<td>397.1</td>
<td>117.4</td>
<td>122.5</td>
<td>116.5</td>
<td>136.4</td>
<td>1807.2</td>
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<tr>
<td>U.K.</td>
<td>1963</td>
<td>117.2</td>
<td>24.7</td>
<td>12.4</td>
<td>7.7</td>
<td>1.8</td>
<td>-12.8</td>
<td>13.5</td>
<td>-7.5</td>
<td></td>
</tr>
<tr>
<td>W. Germany</td>
<td>1954</td>
<td>579.1</td>
<td>164.5</td>
<td>96.0</td>
<td>13.4</td>
<td>-10.4</td>
<td>44.9</td>
<td>-32.7</td>
<td>854.7</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>1966–67</td>
<td>302.9</td>
<td>93.3</td>
<td>58.0</td>
<td>46.0</td>
<td>10.3</td>
<td>52.8</td>
<td>43.7</td>
<td>79.4</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>1959</td>
<td>973.3</td>
<td>379.5</td>
<td>360.8</td>
<td>101.4</td>
<td>12.2</td>
<td>-140.4</td>
<td>136.1</td>
<td>1866.3</td>
<td></td>
</tr>
<tr>
<td>U.S.A.</td>
<td>1963</td>
<td>416.1</td>
<td>67.2</td>
<td>224.3</td>
<td>28.0</td>
<td>12.4</td>
<td>110.2</td>
<td>38.5</td>
<td>-25.2</td>
<td></td>
</tr>
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</table>

* Measured in national currency units (NCU's) per capita in base year prices, except for S. Korea and Italy where the units are 10^6 NCU's. Asymptotic standard errors are given in parentheses.

Table 3. — Cost of Estimated “Subsistence Minima" (\( \rho \gamma \)) at Sample Mid-point (expressed in 1969 U.S. dollars)

<table>
<thead>
<tr>
<th>Country</th>
<th>Food</th>
<th>Clothing</th>
<th>Housing</th>
<th>Household Equipment</th>
<th>Personal Care</th>
<th>Transport</th>
<th>Recreation</th>
<th>Other Services</th>
<th>Total</th>
<th>% Change over L.E.S.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>31.5</td>
<td>3.3</td>
<td>6.1</td>
<td>0.7</td>
<td>2.9</td>
<td>1.9</td>
<td>0.3</td>
<td>0.4</td>
<td>47.2</td>
<td>-16e</td>
</tr>
<tr>
<td>S. Korea</td>
<td>73.2</td>
<td>12.5</td>
<td>14.9</td>
<td>2.2</td>
<td>4.2</td>
<td>4.1</td>
<td>4.7</td>
<td>2.9</td>
<td>118.7</td>
<td>0</td>
</tr>
<tr>
<td>Taiwan</td>
<td>75.0</td>
<td>5.5</td>
<td>17.5</td>
<td>5.3</td>
<td>0.5</td>
<td>1.9</td>
<td>7.6</td>
<td>114.3</td>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>Jamaica</td>
<td>111.9</td>
<td>0.7</td>
<td>34.7</td>
<td>-8.8</td>
<td>-4.2</td>
<td>7.9</td>
<td>-1.6</td>
<td>34.4</td>
<td>175.6</td>
<td>+86e</td>
</tr>
<tr>
<td>S. Africa</td>
<td>114.7</td>
<td>33.4</td>
<td>56.3</td>
<td>21.4</td>
<td>16.6</td>
<td>36.2</td>
<td>14.8</td>
<td>11.9</td>
<td>303.3</td>
<td>-12</td>
</tr>
<tr>
<td>Greece</td>
<td>116.0</td>
<td>9.7</td>
<td>35.3</td>
<td>3.8</td>
<td>2.8</td>
<td>2.2</td>
<td>4.8</td>
<td>2.5</td>
<td>177.1</td>
<td>+57e</td>
</tr>
<tr>
<td>Ireland</td>
<td>268.0</td>
<td>40.2</td>
<td>66.1</td>
<td>16.5</td>
<td>5.4</td>
<td>26.0</td>
<td>27.6</td>
<td>26.9</td>
<td>476.7</td>
<td>+31</td>
</tr>
<tr>
<td>Italy</td>
<td>159.9</td>
<td>35.8</td>
<td>47.8</td>
<td>-9.8</td>
<td>18.6</td>
<td>10.1</td>
<td>24.7</td>
<td>4.6</td>
<td>291.7</td>
<td>+252</td>
</tr>
<tr>
<td>Israel</td>
<td>231.6</td>
<td>58.7</td>
<td>136.0</td>
<td>41.7</td>
<td>42.6</td>
<td>40.7</td>
<td>47.4</td>
<td>64.5</td>
<td>663.2</td>
<td>+16</td>
</tr>
<tr>
<td>U.K.</td>
<td>351.2</td>
<td>74.7</td>
<td>35.7</td>
<td>23.8</td>
<td>5.6</td>
<td>-58.4</td>
<td>40.0</td>
<td>-22.2</td>
<td>450.4</td>
<td>-11</td>
</tr>
<tr>
<td>W. Germany</td>
<td>175.8</td>
<td>50.3</td>
<td>31.2</td>
<td>-4.6</td>
<td>-3.0</td>
<td>14.2</td>
<td>-13.8</td>
<td>251.2</td>
<td>67e</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>348.7</td>
<td>115.4</td>
<td>60.4</td>
<td>61.1</td>
<td>10.0</td>
<td>63.1</td>
<td>48.4</td>
<td>87.9</td>
<td>795.0</td>
<td>+18</td>
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<tr>
<td>Sweden</td>
<td>257.3</td>
<td>97.9</td>
<td>91.3</td>
<td>26.2</td>
<td>3.2</td>
<td>-36.1</td>
<td>36.2</td>
<td>11.4</td>
<td>487.4</td>
<td>-48</td>
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<tr>
<td>U.S.A.</td>
<td>469.2</td>
<td>76.9</td>
<td>253.8</td>
<td>32.4</td>
<td>13.9</td>
<td>127.0</td>
<td>43.0</td>
<td>-27.8</td>
<td>988.4</td>
<td>-60</td>
</tr>
</tbody>
</table>

* Conversions made by multiplying each \( \gamma \) in table 2 by the value of the corresponding \( \rho \) at the sample midpoint and then dividing by the implicit conversion factors in table A1 of the Appendix.

\( \rho \) (L.E.S. total — L.E.S. total) / L.E.S. total. L.E.S. total taken from L-P, table 4.

* Change in sample period between models.
Table 4.—Overall Changes in Price Elasticity Estimates (ELES versus LES)

<table>
<thead>
<tr>
<th>Absolute value of</th>
<th>Income Range (1969 $USA)</th>
<th>+</th>
<th>-</th>
<th>+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own Price</td>
<td></td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Cross Price</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

In the context of ELES, it is possible to estimate the elasticity of total consumption expenditure with respect to prices and income (see (3)). At mean sample values, the general observation is that income changes account for about 90%—95% of changes in total consumption expenditure in 11 countries. But in Taiwan, S. Africa and Israel, the influence of relative price changes is considerably higher, so that income changes account for only 65%—75% of changes in total consumption expenditure. Also, it is to be observed that among the price effects on total consumption expenditure, Food price is by far the most important in all countries.

Average Saving Ratios

Predicted average saving ratios at mean sample values have been computed from the transformations of (3) given in (5). The predicted and actual ratios are, in general, close;22 for 8 countries the difference is less than 5% of the actual ratio, and in only 3 cases23 does the difference exceed 10%. The predicted values tend, however, to be below the actual, and taking means over all countries the overall average savings ratio is underestimated by 6.5%.

IV. Cross Country Patterns

In this section we report on attempts to ascertain cross country patterns in demand behaviour. The relevant measurements chosen for analysis are the estimates at mean sample values of the expenditure, own-price, and cross-price elasticity with respect to Food. In all cases, we chose the (common) logarithm of GNP per head in 1969 USA dollars at the mid-point of the sample period as the explanatory variable,24 say X. Also, in all cases, Jamaica has been excluded from the regressions (on the ground that the sign pattern of the estimated price elasticity matrix does not satisfy the utility specification (2)).

Table 5 contains the results obtained by regressing expenditure and key price elasticities on X. The equations estimated were of the form25

\[ y = a_i + b_i X \quad (i = 1, \ldots, 8) \]

where \( y \) is, respectively: \( \eta''_i \), the estimated expenditure elasticity of good \( i \); \( \eta''_{ij} \), the estimated (uncompensated) own price elasticity of good \( i \); \( \eta''_{ij} \), the estimated (uncompensated) cross price elasticity with respect to the price of Food.

The dominant feature of table 5 is the observed tendency of cross elasticities with respect to the price of Food to decline in absolute value as GNP per capita increases: the coefficient of \( X \) is significant at the 5% level for 5 of the 7 commodities.26 The fitted regressions imply, for example, that the (negative) elasticity of demand for Clothing with respect to Food price falls in algebraic value from 0.52 at a GNP level of 100 dollars per head (1969 U.S. dollars) to 0.29 at a GNP level of 1000 dollars per head. The corresponding figures for Transport are 1.21 and 0.57.

For total expenditure elasticities, the coefficient of \( X \) is significant at the 5% level only for Recreation, where a negative relationship is found. However, when a binary variable which takes the value one for low income countries is added to the regressions, the Food elasticity declines significantly (at the 5% level) with increases in GNP per capita.27

22 Full estimates are available on request.
23 S. Korea, S. Africa and Israel.
24 So that in this section, as in L-P, we are guilty of international comparisons using exchange rates as conversion factors, both because of the use of \( X \) and the conversion of \( y \) to a common unit. See table A1 for the conversion factors used to obtain GNP per capita in 1969 USA dollars.
25 The data input order always followed the increasing per capita GNP scheme of table A1, and since the Durbin-Watson d-statistics show no significant positive autocorrelation in the residuals there is no indication of functional misspecification.
26 In comparable regressions, L-P (table 13) included a binary variable for "poor" countries, which was significant at the 5% level for 6 of the 7 Commodities; but otherwise no significant GNP effect was observed. A binary variable which took the value unity for Thailand, S. Korea and Taiwan was tried in the present analysis but was never significant.
27 The resulting equation is

\[ \eta''_{12} = 2.154^{**} - .494^{**} \log \text{GNP} -.363 D \]

(0.596) (0.191) (0.203)

\((R^2 = .432, d = 2.80)\)
<table>
<thead>
<tr>
<th>Commodity</th>
<th>Total Expenditure Elasticities</th>
<th>Own Price Elasticities</th>
<th>Cross Elasticities with Respect to Price of Food</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>R²</td>
</tr>
<tr>
<td>1. Food</td>
<td>1.207e</td>
<td>-.196b</td>
<td>.251</td>
</tr>
<tr>
<td></td>
<td>(.298)</td>
<td>(.102)</td>
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</tr>
<tr>
<td>2. Clothing</td>
<td>1.659c</td>
<td>-.234</td>
<td>.110</td>
</tr>
<tr>
<td></td>
<td>(.587)</td>
<td>(.201)</td>
<td></td>
</tr>
<tr>
<td>3. Housing</td>
<td>-.0270</td>
<td>.427b</td>
<td>.234</td>
</tr>
<tr>
<td></td>
<td>(.682)</td>
<td>(.233)</td>
<td></td>
</tr>
<tr>
<td>4. Household Equipm.</td>
<td>3.112e</td>
<td>-.527b</td>
<td>.356</td>
</tr>
<tr>
<td></td>
<td>(.809)</td>
<td>(.276)</td>
<td></td>
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<tr>
<td>5. Personal Care</td>
<td>.892</td>
<td>.162</td>
<td>.036</td>
</tr>
<tr>
<td></td>
<td>(.740)</td>
<td>(.255)</td>
<td></td>
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<tr>
<td>6. Transport</td>
<td>3.790c</td>
<td>-.669b</td>
<td>.285</td>
</tr>
<tr>
<td></td>
<td>(.939)</td>
<td>(.321)</td>
<td></td>
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<tr>
<td>7. Recreation</td>
<td>3.385e</td>
<td>-.746b</td>
<td>.558</td>
</tr>
<tr>
<td></td>
<td>(.585)</td>
<td>(.200)</td>
<td></td>
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<tr>
<td>8. Other Services</td>
<td>1.356</td>
<td>.057</td>
<td>.003</td>
</tr>
<tr>
<td></td>
<td>(.954)</td>
<td>(.328)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Jamaica is excluded from all regressions so that the sample size is always 13. The per capita GNP figures are in 1969 U.S. dollars at midpoint of sample period for each country. Standard errors are given in parentheses.

*Significant at 10% level.

**Significant at 5% level.
The own price elasticities for Housing and Personal Care increase significantly (in absolute terms) with increases in GNP per capita. The estimated equations imply, for example, that the Housing own price elasticity is \(-0.14\) for GNP per head of 100 dollars (1969 U.S. dollars) and \(-0.54\) for per capita GNP of 1000 dollars. The point estimates imply that Food is the only commodity for which the own price elasticity falls in absolute terms with increases in GNP per capita.

V. Summary and Suggestions for Further Work

In this paper, the ELES model has been fitted to short time series for 14 countries using an 8 commodity breakdown. An effort has been made to detect systematic changes in demand parameters across the spectrum of economic development, as measured by GNP per capita. The results have been compared to the similar exercise in L-P, using LES, a more conventional demand system. It was noted in L-P that own price and Food price accounted for most of the price effect in commodity demand functions. The most important new finding here is the systematic decline in the absolute value of the Food cross price elasticity as GNP per head rises. Also, there exists some additional evidence on patterns in own price elasticities. The evidence in L-P of cross country patterns in expenditure elasticities is repeated here.

Furthermore, there are questions that can be put to ELES and not to LES: those related to the aggregate consumption function (3). It is to be observed that average saving ratios are closely predicted at sample mean values, using ELES estimates of the Frisch parameter and the marginal propensity to consume. Also there is an observed pronounced effect of relative price changes upon total consumption expenditure in some countries.

It seems, therefore, that the use of personal disposable income instead of total consumption expenditure as the explanatory variable in complete (linear) systems of expenditure equations has some payoff in empirical work. This result is to some extent surprising, given the well known limitations of savings data.

It remains to be seen whether a eight commodity breakdown is too much of a burden on an additive model, like the one fitted in this paper. It may be of interest to explore the consequences of further commodity aggregation. Also, additional work should focus on the relevant income variable (to bring the aggregate consumption function in ELES more in line with contributions in consumption theory) and the effect of past consumption experience (as suggested by the results on serial correlation in this paper).

REFERENCES


### Table A1. — Characteristics of the Sample

<table>
<thead>
<tr>
<th>Country</th>
<th>Sample Period</th>
<th>Implicit Conversion Ratio Between NCU at Sample Midpoint and 1969 U.S. dollars (NCU per $ USA)</th>
<th>Average Budget Shares at Sample Mean Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Thailand</td>
<td>1960–69</td>
<td>20.19</td>
<td>.576</td>
</tr>
<tr>
<td>S. Korea</td>
<td>1955–68</td>
<td>.8267</td>
<td>.599</td>
</tr>
<tr>
<td>Taiwan</td>
<td>1955–58–68</td>
<td>.360</td>
<td>.055</td>
</tr>
<tr>
<td>Jamaica</td>
<td>1959–68</td>
<td>.7054</td>
<td>.433</td>
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<td>S. Africa</td>
<td>1955–68</td>
<td>.6574</td>
<td>.368</td>
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<td>Greece</td>
<td>1958–68</td>
<td>.2909</td>
<td>.468</td>
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<td>Ireland</td>
<td>1955–68</td>
<td>.3030</td>
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</tr>
<tr>
<td>Italy</td>
<td>1955–68</td>
<td>4.715</td>
<td>.463</td>
</tr>
<tr>
<td>Israel</td>
<td>1959–68</td>
<td>.2795</td>
<td>.319</td>
</tr>
<tr>
<td>W. Germany</td>
<td>1955–68</td>
<td>.7110</td>
<td>.365</td>
</tr>
<tr>
<td>Australia</td>
<td>1955–66</td>
<td>.7683</td>
<td>.333</td>
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<td>Sweden</td>
<td>1955–68</td>
<td>4.195</td>
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<tr>
<td>U.S.A.</td>
<td>1955–68</td>
<td>.8686</td>
<td>.267</td>
</tr>
</tbody>
</table>

* Countries are listed in ascending order of per capita GNP at sample midpoint expressed in 1969 U.S. dollars.

* Denominator of ratio is per capita GNP in National Currency Units (NCU's) at sample midpoint. Denominator is per capita GNP for 1969 in 1969 U.S. dollars as reported in *World Bank Atlas 1971* projected backwards to sample midpoints using growth rates from the same source.

* Data obtained from editions of *Yearbook of National Accounts Statistics*, United Nations, in some cases, supplemented by the National Accounts of the countries concerned. The commodity code, with the corresponding 1969 U.S. *Yearbook* definitions, is as follows: 1. Food (Food + Beverages + Tobacco); 2. (Clothing and Other Personal Effects); 3. Housing (Household Operation + Rent and Water + Fuel and Light); 4. Household Equipment (Furniture, Furnishings and Household Equipment); 5. Personal Care (Personal Care and Health Expenses); 6. Transport (Transport and Communication); 7. Recreation (Recreation and Entertainment); 8. Other Services (Financial Services + Education and Research + Other Services).
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