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DEMAND PATTERNS ACROSS THE DEVELOPMENT SPECTRUM: ESTIMATES FOR THE AIDADS SYSTEM

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ABSTRACT

This is a companion paper to *Impact Preliminary Working Paper* No OP-73 in which Rimmer and Powell report on a new *implicitly directly additive demand system* (AIDADS) which (in Cooper and McLaren's 1992b terminology) is effectively globally regular. In OP-73 AIDADS is fitted to a six-commodity disaggregation of a 35-year Australian time series of consumption. Unlike the linear expenditure system and the Rotterdam model, the new system allows marginal budget shares to vary as a function of income.

In the current paper we also work at a six-commodity level, fitting AIDADS to an international cross section of 30 countries in 1975. The data are from the International Comparisons Project of Kravis, Heston and Summers (1982) and previously were analyzed by Theil and Clements (1987) using a combination of additive preferences and Working's (1943) model in differential form. The present results overcome two potential shortcomings of the earlier work by replacing Working's model with a more regular specification of Engel effects and by providing and estimating an explicit functional form in the *levels* of the variables.

A rough comparison can be made between the time-series estimates of OP-73 and the cross-sectional ones reported here. We found the two sets of results broadly consistent (although the rate of decline in Food's marginal budget share was less in the Australian time series than in the international cross section). Overall, the new system performed well empirically. It seems suitable for modelling demand for broad consumption aggregates (say up to about a dozen commodities) in situations in which there may be very large variations in income per head.

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1. Introduction

Theil and Clements (1987) employed a novel approach to estimate an additive preferences demand system from the international comparisons data constructed by Kravis, Heston and Summers (1982). The motivation for this work sprang partly from the observation that the marginal budget share of food seemed to decline with increasing per capita real consumption. Since marginal budget shares are constant both in the Rotterdam model (see e.g., Theil 1965) and in Stone's (1954) Linear Expenditure System (LES), neither was suitable for Theil and Clements' estimation.

A better Engel specification, and the one used by Theil and Clements, was Working's (1943) formulation in which the budget share of food was written as a linear function in real per capita total expenditure. This is the Engel specification employed in Deaton and Muellbauer's Almost Ideal Demand System (AIDS) (1980).

Theil and Clements did not attempt to make their demand system explicit in the levels of the variables, preferring to work in terms of differentials. Thus the differences in per capita demands for broad commodity aggregates between the thirty or so countries of the international comparisons data were explained by the differences in per capita real total consumption and in relative prices across the cross section. The relatively high level of aggregation (10 commodities) and the need to preserve degrees of freedom led them to impose directly additive preferences. Under the latter specification, it is known (Houthakker 1960) that in any given price/total expenditure locality, the Allen-Uzawa cross partial substitution elasticities are proportional to the product of the Engel elasticities; that is,

$$\sigma_{ij} = -\phi E_i E_j , \qquad (\phi < 0;\ i\neq j;\ i, j=1, \ldots, n) \tag{1.1}$$

where the constant of proportionality ϕ is independent of the particular pair {i, j} of commodities. Whilst ϕ (closely related to the so-called Frisch (1959) 'parameter') in principle is a function of all prices and total expenditure, Theil and Clements concluded that the dependency was weak in their sample, and treated ϕ as an absolute constant (which turned out empirically to be about – 0.5).

Working's formulation and AIDS share the problem that, under large changes in real incomes, budget shares can stray outside the [0,1] interval. It was such irregular behaviour that led Cooper and McLaren (1987, 1988, 1991, 1992a) to modify the AIDS system to become MAIDS, a system with regular properties over a much wider subset of the price-expenditure space and to propose (1992b) a new class of *effectively globally regular (EFG)* demand systems. In our current contribution we fit an EFG demand system — one which has proved promising with relatively long (35 years) Australian time

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* The authors would like to thank Russel Cooper and Keith McLaren for helpful suggestions.

series data (Rimmer and Powell, 1992) — to the international comparisons data. Our system goes by the acronym AIDADS (an implicitly directly additive demand system)

By effectively global regularity in the current context we mean that AIDADS is regular throughout that part of the price-expenditure space in which the consumer is at least affluent enough to meet subsistence requirements.

The remainder of this paper is structured as follows. In Section 2 the essentials of AIDADS are set out. Results are given in Section 3, which includes a brief description of the data and a comparison with recent time-series work using AIDADS (Rimmer and Powell, 1992).

2. Brief Description of AIDADS[1]

2.1 The new expenditure system

Hanoch (1975) defines implicit direct additivity by the utility function:

$$\sum_{i=1}^{n} U_i(x_i\,,\,u) \quad = \quad 1, \tag{2.1.1}$$

where $\{x_1, x_2, \ldots, x_n\}$ is the consumption bundle, u is the level of utility, and the U_i are twice-differentiable monotonic functions satisfying appropriate concavity conditions. Using some intuition stemming from Cooper and McLaren's (1992a) and from the LES, we choose the U_i as follows:

$$U_i \quad = \quad \frac{[\alpha_i + \beta_i\, G(u)]}{[1 + G(u)]} \ln\left(\frac{x_i - \gamma_i}{A\, e^u}\right) \quad = \quad \phi_i \ln\left(\frac{x_i - \gamma_i}{A\, e^u}\right) \ , \qquad (i = 1, 2, \ldots, n) \tag{2.1.2}$$

where G(u) is a positive, monotonic, twice-differentiable function, and the lower-case Greek letters and A are parameters, with

$$0 \leq \alpha_i\,,\, \beta_i \leq 1; \qquad \sum_{i=1}^{n} \alpha_i \quad = \quad 1 \quad = \quad \sum_{i=1}^{n} \beta_i\ . \tag{2.1.3}$$

The first-order conditions for minimizing the cost M of obtaining a given level of utility u subject to given prices $\{p_1\,,\, p_2,\ \ldots,\ p_n\}$ are (2.1.1) and:

$$\frac{\lambda\, [\alpha_i + \beta_i\, G(u)]}{(x_i - \gamma_i)\ [1 + G(u)]} \quad = \quad p_i\ . \qquad (i = 1, 2, \ldots, n) \tag{2.1.4}$$

Hence

$$\lambda^{-1}\, p_i\, (x_i - \gamma_i) \quad = \quad [\alpha_i + \beta_i\, G(u)]\ /\ [1 + G(u)]\ . \qquad (i = 1, 2, \ldots, n) \tag{2.1.5}$$

Using the budget identity

1 For a fuller account, see Rimmer and Powell (1992).

(2.1.6) $$\sum_{i=1}^{n} p_i x_i = M,$$

by adding (2.1.5) across i, and using (2.1.3) to solve for λ we obtain:

(2.1.7) $$\lambda = (M - p'\gamma) ,$$

where p'γ is shorthand for $\sum_{i=1}^{n} p_i \gamma_i$. Back-substituting from (2.1.7) into (2.1.5), after rearrangement we obtain

(2.1.8) $$p_i (x_i - \gamma_i) = \phi_i (M - p'\gamma) , \qquad (i = 1, 2, ..., n)$$

where from (2.1.2):

(2.1.9) $$\phi_i = \phi_i (u) = \frac{[\alpha_i + \beta_i G(u)]}{[1 + G(u)]} . \qquad (i = 1, 2, ..., n)$$

2.2 Substitution properties

The substitution elasticities associated with implicit direct additivity are:

(2.2.1) $$\sigma_{ij} = \frac{(x_i - \gamma_i)(x_j - \gamma_j)}{x_i x_j} \Big/ \frac{(M - p'\gamma)}{M} \qquad (i \neq j, i, j = 1, 2, ..., n)$$

$$= -\phi^* E_i^* E_j^*$$

where

(2.2.2) $$\phi^* = -\frac{(M - p'\gamma)}{M}$$

and

(2.2.3) $$E_i^* = \phi_i / W_i \qquad (i = 1, 2, ..., n)$$

in which W_i is the budget *share* of i.[2]

2.3 Engel properties

Not much further progress can be made without specifying a functional form for G. Here we keep the LES interpretation of γ as the subsistence bundle, and require as well that

(2.3.1a) $$\lim_{x \to \infty} u(x) = \infty ;$$

(2.3.1b) $$\lim_{x \to \gamma+} u(x) = -\infty ;$$

2 Note that ϕ^* in (2.2.3) has the same form and interpretation as the φ of (2.1.1) in the LES; the E_i^* , however, are the ratios of two *average* budget shares: namely, of ϕ_i = [supernumerary expenditure $p_i(x_i - \gamma_i)$ on i]/ [total supernumerary expenditure $(M - p'\gamma)$] to the ordinary average budget share $W_i = p_i x_i / M$.

$$(2.3.1c) \qquad \lim_{u \to \infty} G(u) = \infty ;$$

and

$$(2.3.1d) \qquad \lim_{u \to -\infty} G(u) = 0 .$$

x is the bundle $\{x_1, x_2, ..., x_n\}$, and the notation $x \to \infty$ implies that every x_i grows without limit, while $x \to \gamma+$ implies that each x_i converges to its corresponding γ_i from above.) G's monotonicity together with the bounds imposed on it above ensure that ϕ_i behaves logistically, remaining always in the $[\alpha_i, \beta_i]$ interval. It can be shown that if $\alpha_i < \beta_i$, the logistic behaviour of ϕ_i implies that the lowest value of i's marginal budget share is α_i, occurring when total expenditure is just enough to cover purchase of the subsistence bundle γ; the upper asymptote of MBS_i as expenditure grows without limit is β_i. If, on the other hand, $\alpha_i > \beta_i$, the largest value of i's marginal budget share is α_i, occurring at the subsistence expenditure level; its asymptote as expenditure grows indefinitely large and lowest value is β_i.

The Engel elasticities in AIDADS are:

$$(2.3.2) \qquad \varepsilon_i = \frac{\phi_i \; M}{p_i \gamma_i + \phi_i \; (M - p'\gamma)} + \frac{[\partial\phi_i/\partial M] \; M \; (M - p'\gamma)}{p_i \gamma_i + \phi_i \; (M - p'\gamma)}$$

$$= \frac{\phi_i \; M}{p_i \gamma_i + \phi_i \; (M - p'\gamma)} + \frac{[\partial\phi_i/\partial u] \; [\partial u/\partial M] \; M \; (M - p'\gamma)}{p_i \gamma_i + \phi_i \; (M - p'\gamma)} . \qquad (i = 1, 2, ..., n)$$

Further progress cannot be made without specifying a functional form for G. The simplest G(•) satisfying (2.3.1c&d) is:

$$(2.3.3) \qquad G(u) = e^u .$$

In this case

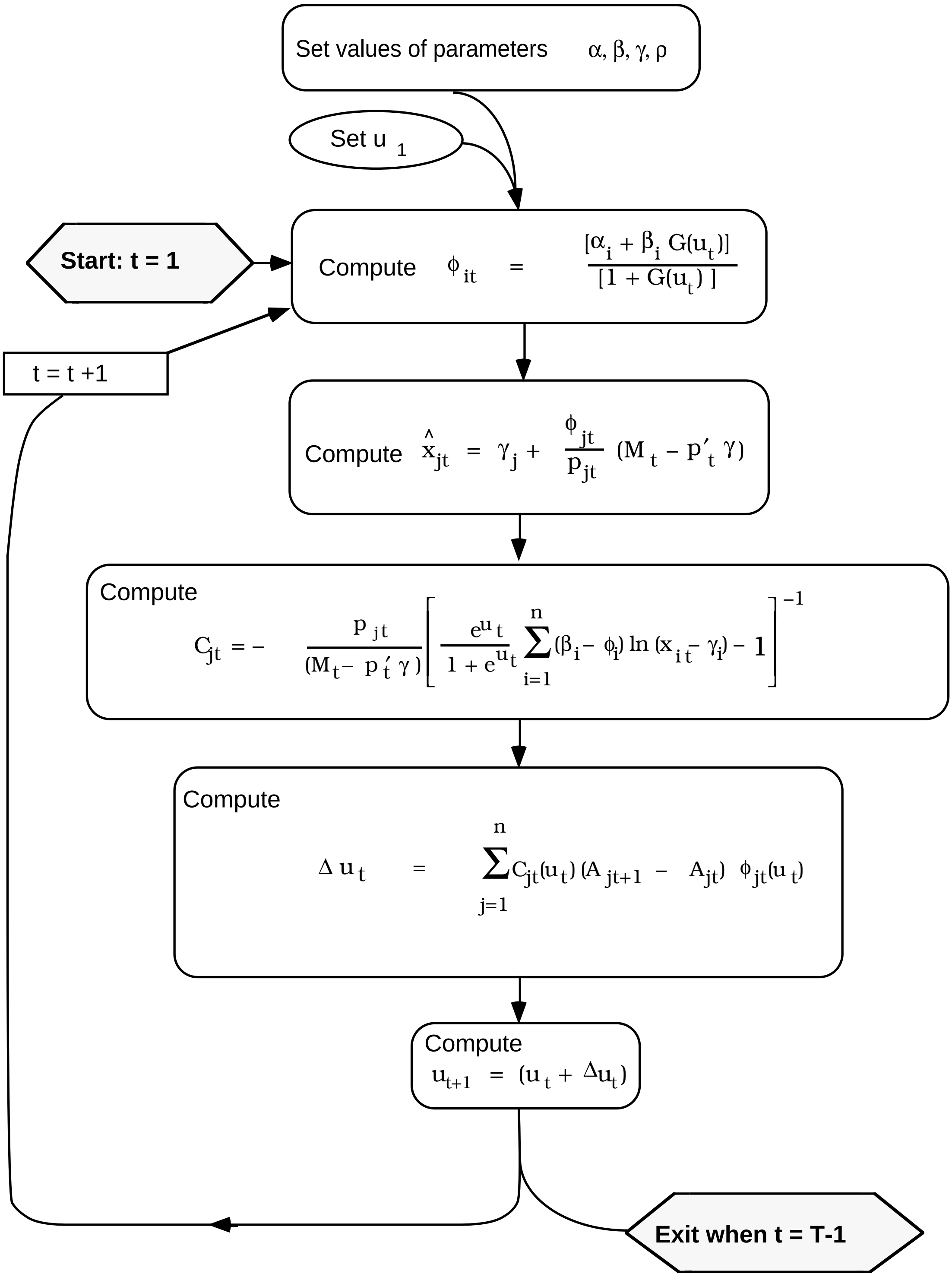
$$(2.3.4) \qquad \partial\phi_i/\partial u = (\beta_i - \phi_i) \; e^u \; / (1 + e^u) . \qquad (i = 1, 2, ..., n)$$

An expression for $\partial u/\partial M$ is given in Rimmer and Powell (1992) .

2.4 Estimation of AIDADS

Because the expenditure system (2.1.9) depends via ϕ_i on the implicitly defined and unobservable variable u, estimation of AIDADS requires an initial level u_1 of u to be treated as a parameter. When moving from an initial data point (here, read 'country') with exogenous variable coordinates $\{M; p_1, p_2, ..., p_n\}_1$ to the next data point with exogenous variable coordinates $\{M; p_1, p_2, ..., p_n\}_2$, we need to be able to show how the change in utility level Δu_1 depends on the parameters (which are common across countries) of the utility function and on the differences between total per capita expenditure and prices in the two. In Rimmer and Powell (1992) it is shown that this can be achieved using the scheme shown in Figure 2.4.1. Note that in this figure $\hat{x}_{it}$ is short-hand for the solution of (2.1.8) in terms of x_{it}, while the A_{jt} are:

$$(3.3.7) \qquad A_{jt} = (M_t - p'_t \gamma) \; / \; p_{jt} . \qquad \begin{matrix}(t=1, 2)\\(j=1,2, ..., n)\end{matrix}$$



[after Rimmer and Powell (1992)]

Figure 2.4.1: Flow chart for data/parameter transformations in computation of the ML estimates

To keep the differences between sample points small (and therefore amenable to the use of differential analysis as in Figure 2.4.1), we followed Theil and Clements (1987) and arranged the cross-section of countries in a series according to increasing order of real per capita total expenditure. The plot of rank against real (international dollar) expenditure per head is shown in Figure 2.4.2 (the actual data are shown below in Table 3.1.1).

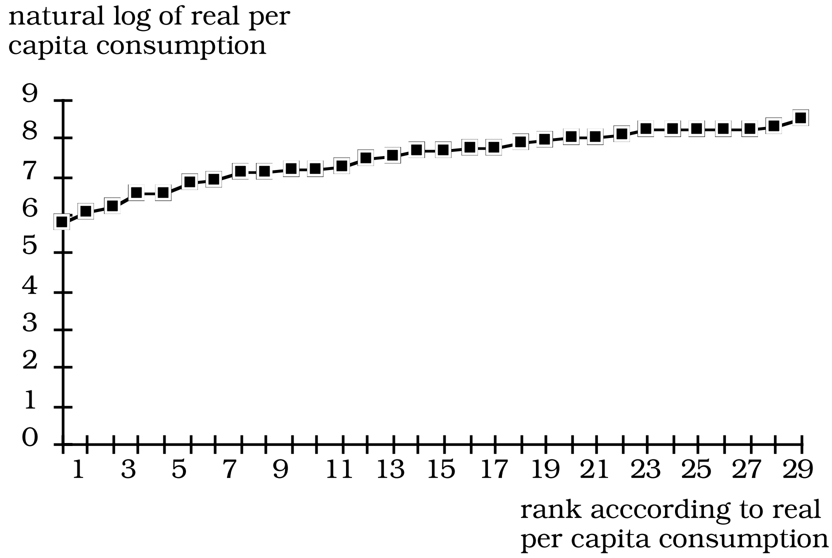


Figure 2.4.2 Sample variation in real per capita consumption in the international comparisons data

3. *Empirical Estimates*

3.1 The Data

The estimation of AIDADS requires data on nominal total expenditure as well as commodity prices. For each of thirty countries[3] from the International Comparison Project listed in Table 3.1.1, Theil and Clements extracted data on real total consumption expenditure and real expenditure by commodity in 1975 expressed in "international dollars"[4], Q_t being real total consumption expenditure in country t and x_{it} being real consumption expenditure on commodity i in country t. In addition they used data on the budget shares w_{it} of commodity i in country t. The commodity data were at the ten commodity level of disaggregation as listed in Table 3.1.2.

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3 There were thirty-four countries in the Kravis, Heston and Summers study. Of these four countries were rejected by Theil and Clements. Kenya, Zambia and Malawi were omitted as outliers and because Kravis *et al.* regarded the data for these countries as beset with numerous problems. The fourth country, Jamaica, was omitted because it had an exceptionally large budget share devoted to "other " expenditure.

4 International prices are used to value the category quantities in each country under study in *international dollars*. The international price for a category is the quantity weighted average of detailed category Purchasing Power Parities (PPP's) after standardization.

Table 3.1.1

Consumption Per Capita For Thirty Countries in 1975
(from the International Comparisons Project)

	Country	Gross consumption per capita (in 1975 International dollars)
1.	India	338.0
2.	Pakistan	441.8
3.	Sri Lanka	510.1
4.	Philippines	693.6
5.	Thailand	699.3
6.	Malaysia	939.5
7.	Korea	1019.4
8.	Brazil	1219.0
9.	Colombia	1265.3
10.	Syria	1295.4
11.	Iran	1345.3
12.	Romania	1435.6
13.	Yugoslavia	1712.6
14.	Mexico	1839.4
15.	Poland	2154.8
16.	Uruguay	2234.4
17.	Ireland	2299.3
18.	Hungary	2313.2
19.	Italy	2636.4
20.	Japan	2912.7
21.	Spain	3001.0
22.	United Kingdom	3173.9
23.	Netherlands	3398.1
24.	Belgium	3715.1
25.	Austria	3721.4
26.	Germany	3743.4
27.	France	3745.6
28.	Denmark	3887.2
29.	Luxembourg	3934.6
30.	United States	4954.5

For comparison purposes with the AIDADS estimates obtained by Rimmer and Powell (1992) from Australian time series, this international data set of Theil and Clements was aggregated to six commodity groups as shown in Table 3.1.3. They are *very roughly* comparable to the commodity categories in the Australian study.

Relative price data π_{it} (with the price of food the numeraire) were obtained for each of the six commodity groups in Table 3.1.3 in each country as the ratios $\frac{w_{it}\, x_{1t}}{w_{1t}\, x_{it}}$ of each budget share other than for Food to that of Food multiplied by the ratio of the per capita real consumption of food to that of each other commodity.

Table 3.1.2

The Theil and Clements Ten Commodity Level of Disaggregation of Final Consumption Expenditure

(1)	Food
(2)	Beverages and tobacco
(3)	Clothing and footwear
(4)	House furnishings and operation
(5)	Medical care
(6)	Transport and communication
(7)	Recreation
(8)	Education
(9)	Gross rent and fuel
(10)	All other expenditure

Table 3.1.3

The Six-Commodity Disaggregations used for the International Comparisons Data and the Australian Time-series Data

International cross section	Australian time series
(1) Food	Food
(2) Beverages and tobacco	Alcohol & tobacco
(3) Clothing and footwear	Clothing and footwear
(4) House furnishings & operation	Durables
(5) Gross rent and fuel	Rent
(6) All other expenditure	All other expenditure

3.2 Estimating Equation

The expenditure system (2.1.8) was estimated in the form:

$$(3.2.1) \qquad W_{it} = \phi_{it} + \left(\frac{p_{it}\gamma_i - \phi_i\, p'_t\, \gamma}{M_t}\right) + v_{it}\ , \qquad (i = 1, 2, ..., n)$$

where W_{it} is the budget share of the i^{th} commodity in the t^{th} country , and v_{it} is a zero-mean random error, assumed normally distributed and independent of $v_{it\pm\tau}$ (for all integral $\tau \neq 0$). Full information maximum likelihood estimates were computed with the variance-covariance matrix of the v_{it}s constrained à la Selvanathan (1991).[5] Because the variables $\{\phi_{1t}, \phi_{2t}, ..., \phi_{nt}\}$ are functions of u_t, and because at any given parameter setting the values of u_1, u_2, ..., u_{t-1} must be computed before u_t can be evaluated (see Figure 2.4.1), flexible software is needed. We found *GAUSS 386* on a 486 personal computer up to the task.

3.3 The ML Estimates

We fitted AIDADS in the levels using the Theil and Clements cross section data described above. The results of that estimation appear in Table 3.3.1. The fitted and actual budget shares are plotted in Figure 3.3.1.

Table 3.3.1

Maximum Likelihood Estimates of AIDADS fitted in the Levels, 30 Country Cross Section Data for 1975

Item[(a) (b)]	Commodity i 1 Food	2 Beverage & Tobacco	3 Clothing & Footwear	4 Household Furnishings & Operations	5 Gross Rent & Fuel	6 Other
α_i	.693	.125	.182	.000	.000	.000
t ratio	18.15	4.47	6.01	0.01	0.00	0.01
β_i	.000	.023	.049	.125	.183	.620
t ratio	0.00	0.29	1.57	11×10^3	64×10^3	24×10^3
γ_i	112.33	0.91	0.07	0.02	13.13	0.08
t ratio	7.59	1.82	0.71	0.31	2.05	0.64
Marginal budget shares ψ_{it}:						
poorest country	.33	.07	.11	.07	.10	.33
richest country	.02	.03	.05	.12	.18	.60
Durbin-Watson statistic	1.96	1.97	01.69	1.79	1.55	1.95

utility level for the poorest country, u_1 = –0.869: utility level in for the richest country, u_T = +1.290.
t value for u_T = 16.44.

While naturally there is much more variability in the cross section budget share data (see Figure 3.3.1) than in the Australian time series studied by Rimmer and Powell (1992), the same trends of decreasing shares for Food, Beverages and Tobacco, and Clothing and Footwear, and increasing shares for House furnishings an operation, Gross rent and fuel, and All other expenditure, are observed. Little overall change in budget share can be seen in Beverages and tobacco, and Clothing and footwear although, in keeping with the Australian study, for the most affluent

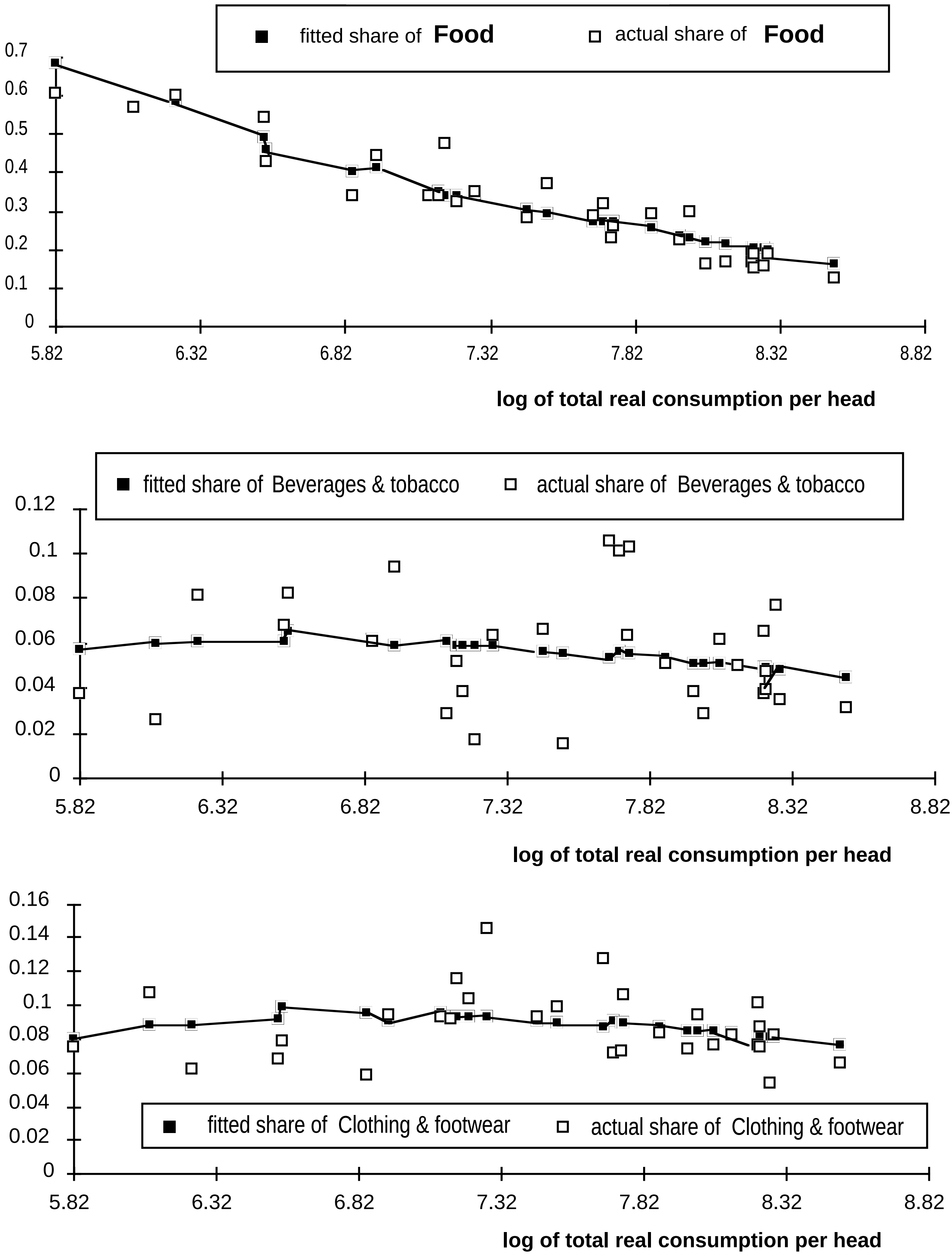
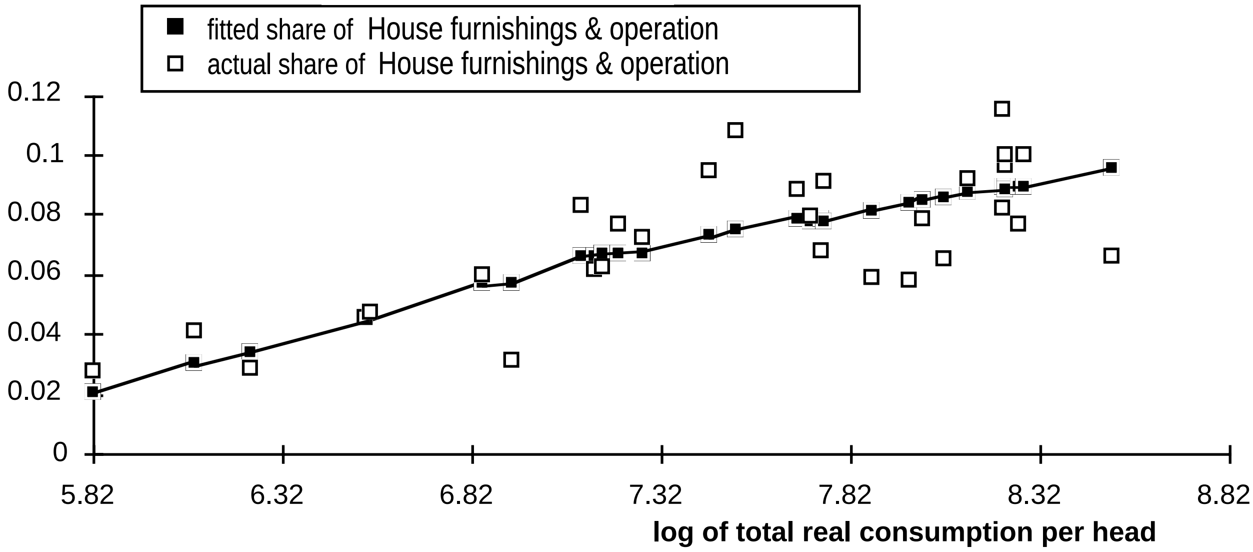
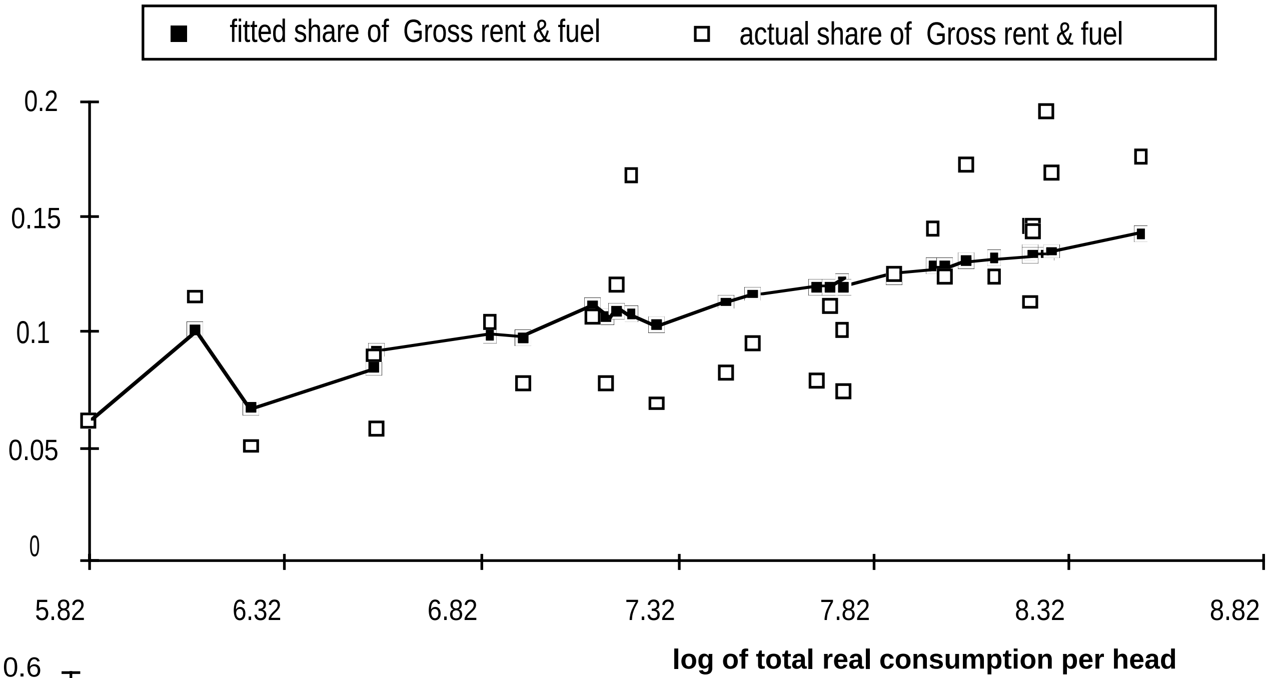


Figure 3.3.1: Actual and fitted budget shares for international comparisons data





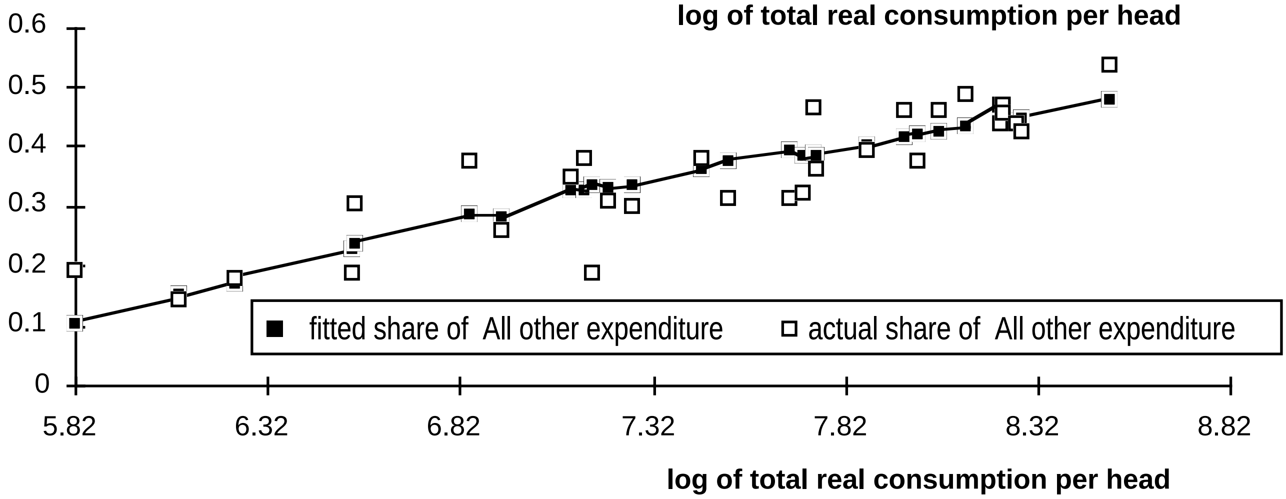


Figure 3.3.1 *(continued)*

half of the countries, a downward trend in budget share with increasing affluence can be detected.

Corner solutions were obtained for the α_i value for House furnishings and Operation, Gross rent and Fuel, and All other expenditure, while effectively zero subsistence quantities were found for all commodities except Food and All other expenditure. In keeping with the findings of Theil and Clements (1987) and the Adams, Chung and Powell (1988), the estimates show a strongly decreasing marginal budget share (MBS) for Food, from 0.33 to 0.02, whereas the AIDADS estimates for time series Australian data show an almost constant marginal budget shares for Food of around 0.07. The difference between the two AIDADS results can be explained substantially in terms of the span of real income across the samples. Figure 3.3.2 shows the MBS's for the countries in the cross section study. From Figure 3.3.2 it can be seen that for the majority of the countries very little change in the MBS for Food was observed and for countries within the time-series income range of Australia[6], values ranged between 0.08 and 0.03 .

Own and cross price elasticities of demand and Engel elasticities are given in Tables 3.3.2 and 3.3.3 respectively for the least affluent and most affluent countries in the sample. At constant prices it can be shown that the Engel elasticities for AIDADS tend to unity as expenditure grows without limit. However this movement towards unity need not be monotonic. With substantial price variation across countries, as is occurring in this cross section study, this pattern of movement to unity in Engel elasticities can be further obscured. The Engel elasticities are graphed in Figure 3.3.3. Movement of the Engel elasticity away from unity with increasing affluence is particularly evident for the necessity Food. As for the AIDADS estimation on Australian time series data, several of the cross price elasticities are positive indicating gross substitutability rather than gross complementarity. The estimated elasticities of substitution are shown for the richest and poorest countries in Table 3.3.4.

Table 3.3.2

Estimated Engel and Own and Cross-Price Elasticities
*for the Low Lowest Income Country**

Commodity	Price which changes, j						Engel Elasticity ε_i
	1 Food	2 Alcohol & Tobacco	3 Clothing & Footwear	4 Durables	5 Rent	6 Other	
1	–0.530	0.010	0.1853	0.005	–0.008	0.024	.485
2	– 0.400	–0.902	0.032	0.008	–0.026	0.041	1.246
3	–0.473	0.013	–0.966	0.008	–0.032	0.039	1.411
4	–1.678	–0.088	–0.111	–1.0265	–0.139	–0.142	3.184
5	–0.833	–0.044	–0.055	–0.014	–0.564	–0.010	1.581
6	–1.681	–0.089	–0.111	–0.029	–0.139	–1.141	3.190

* Based on parameter estimates shown in Table 3.3.1.

6 Australia's per capita income range across the sample period 1954-55 through 1988-89 is roughly spanned by the 1975 levels for Mexico and Luxembourg.

Table 3.3.3

Estimated Engel and Own and Cross-Price Elasticities for the Highest Income Country

Commodity	Price which changes, j: 1 Food	2 Alcohol & Tobacco	3 Clothing & Footwear	4 Durables	5 Rent	6 Other	Engel Elasticity ε_i
1	–0.773	0.034	0.059	0.075	0.1096	0.371	.124
2	0.051	–0.078	0.032	0.041	0.058	0.202	.596
3	0.034	0.014	–0.975	0.031	0.043	0.154	.698
4	–0.054	–0.011	–0.018	–1.023	–0.037	–0.115	1.264
5	–0.058	–0.011	–0.018	–0.023	–1.017	–0.113	1.240
6	–0.059	–0.011	–0.018	–0.023	–0.037	–1.115	1.264

* Based on parameter estimates shown in Table 3.3.1.

Table 3.3.4

*Estimated Substitution Elasticities from AIDADS for Richest and Poorest Countries**

i= / j	1 Food	2 Beverage & Tobacco	3 Clothing & Footwear	4 Household Furnishings & Operations	5 Gross Rent & Fuel	6 Other	σ_{ii} *poorest*	σ_{ii} *richest*
1	*see last 2 cols*	0.901	0.904	0.904	0.886	0.904	–.300	–4.58
2	0.659	*see last 2 cols*	1.019	1.019	0.999	1.019	–14.43	–21.45
3	0.716	1.644	*see last 2 cols*	1.022	1.002	1.022	–10.75	–12.16
4	0.716	1.646	1.787	*see last 2 cols*	1.002	1.023	–46.68	–9.41
5	0.356	0.817	0.889	0.888	*see last 2 cols*	1.002	–7.73	–5.87
6	0.718	1.648	1.990	1.792	0.890	*see last 2 cols*	–8.00	–1.08

*The lower triangle shows values estimated for the poorest country; the upper triangle values estimated for the richest country.

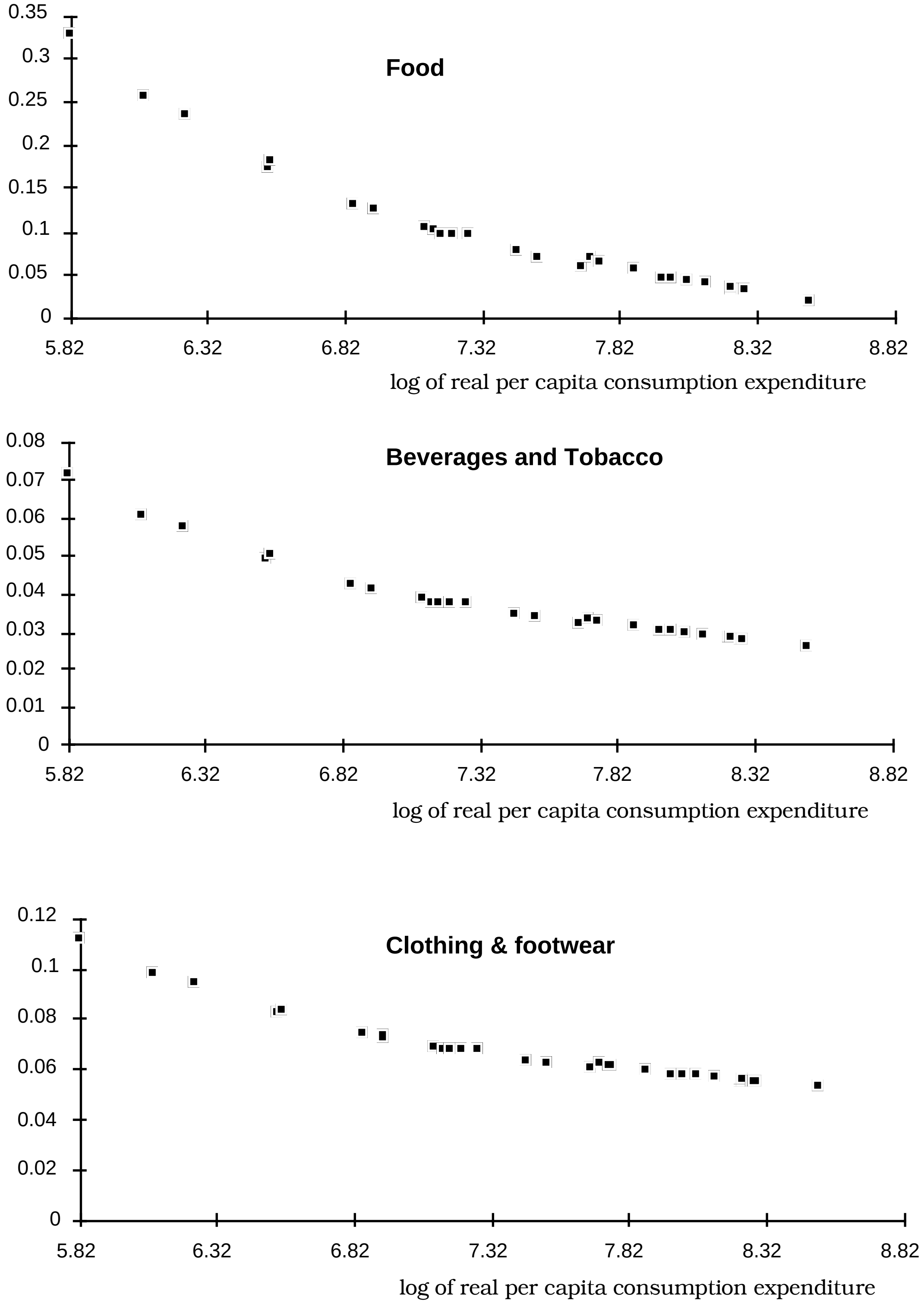
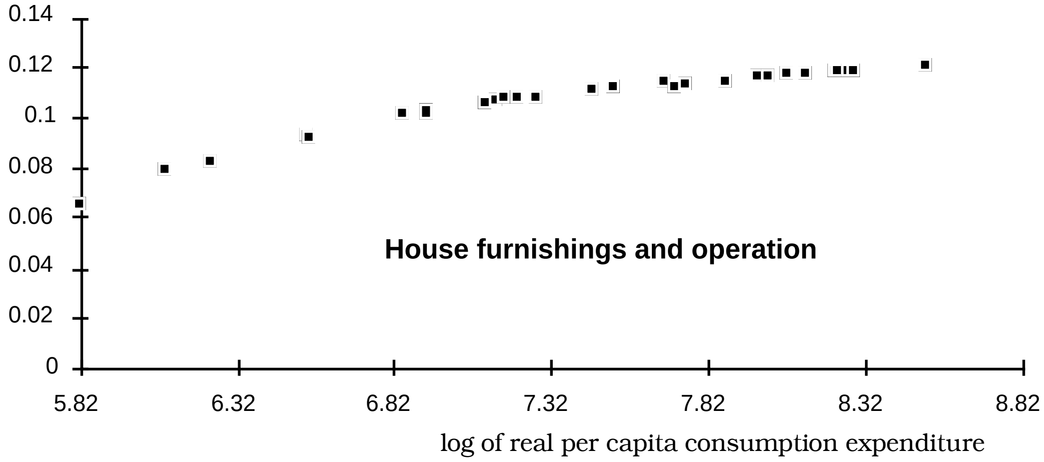
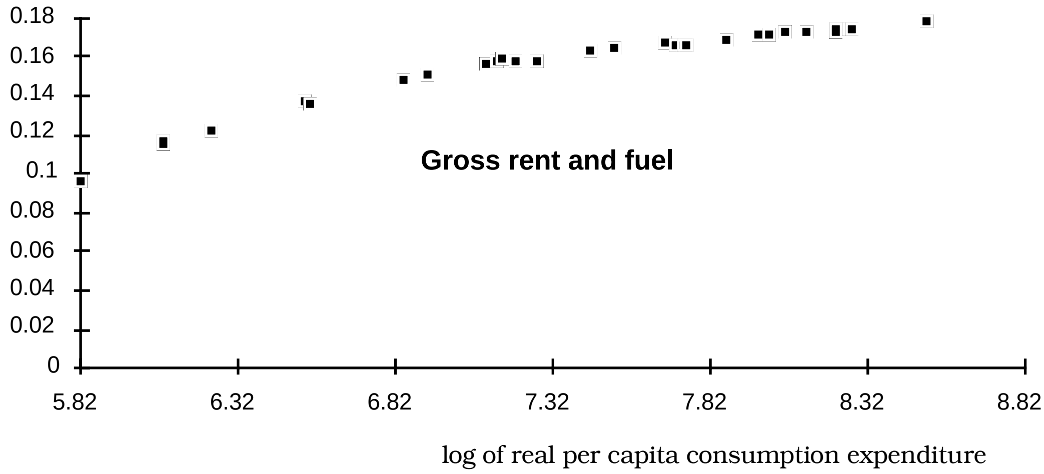


Figure 3.3.2: Estimated marginal budget shares as a function of affluence





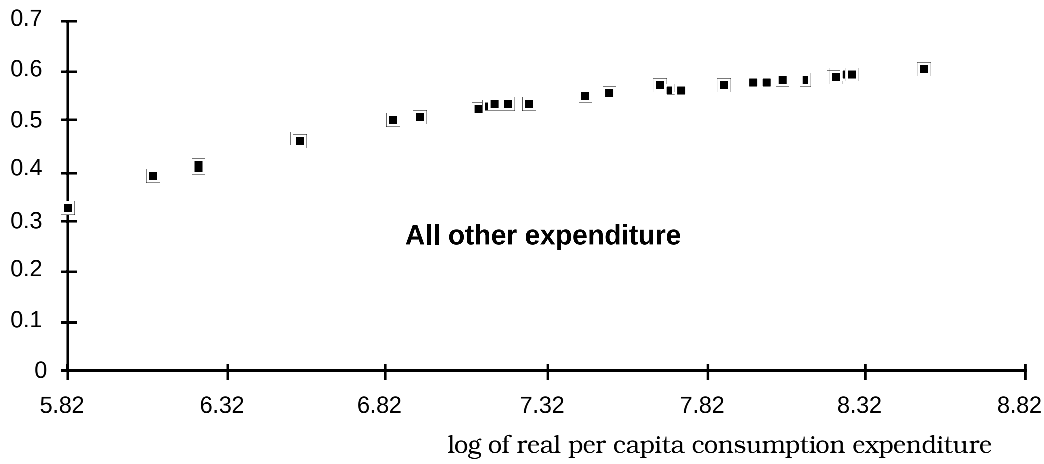


Figure 3.3.2 *(continued)*

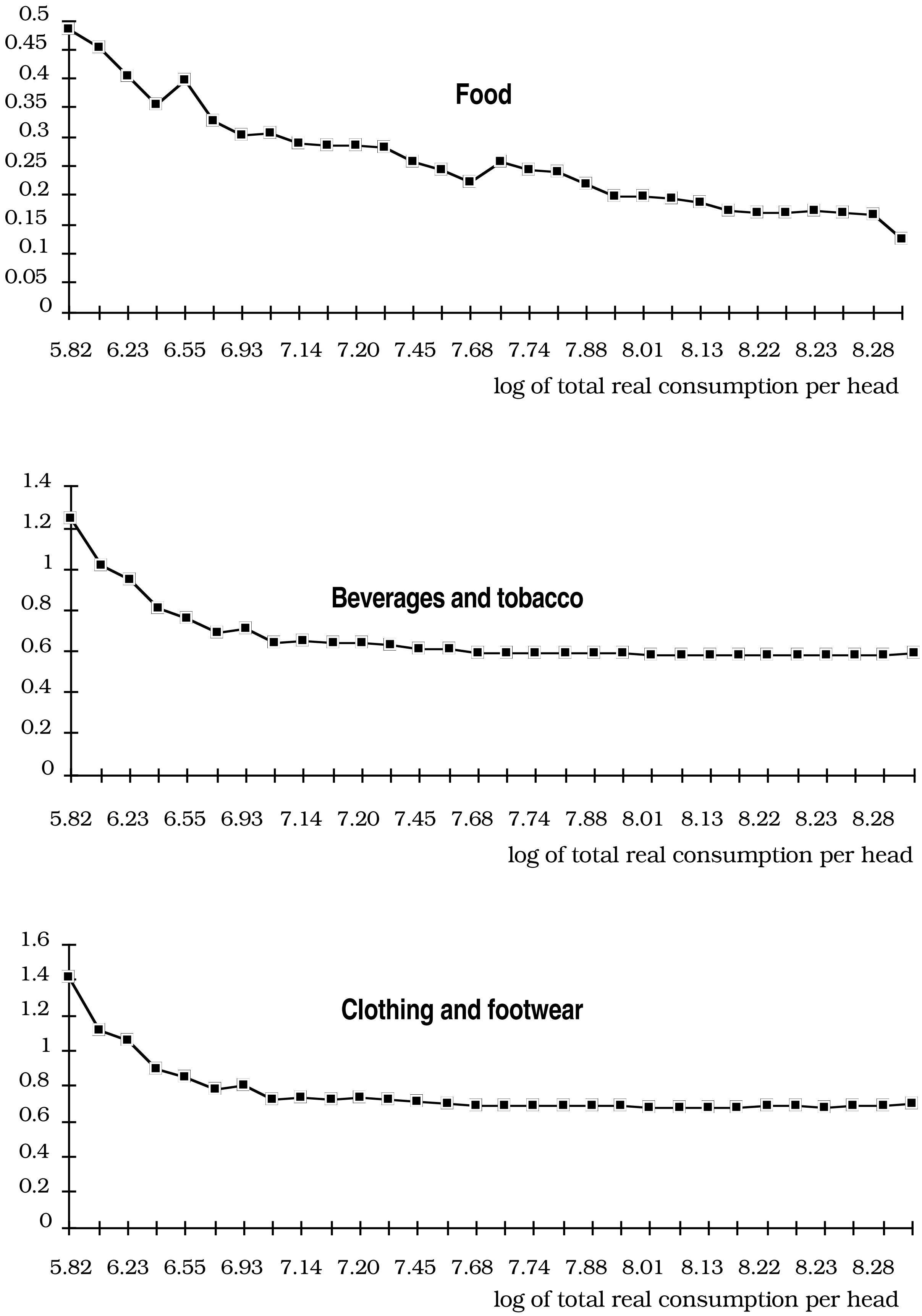
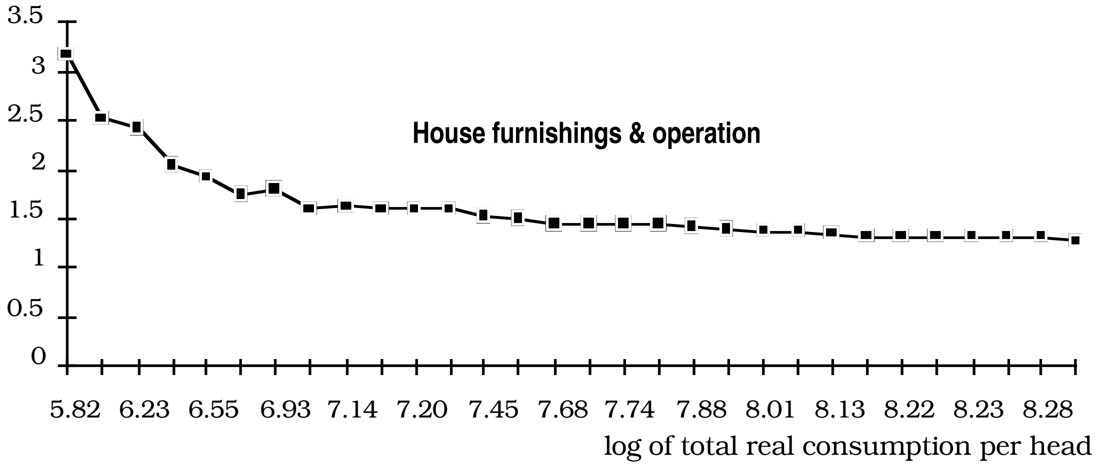
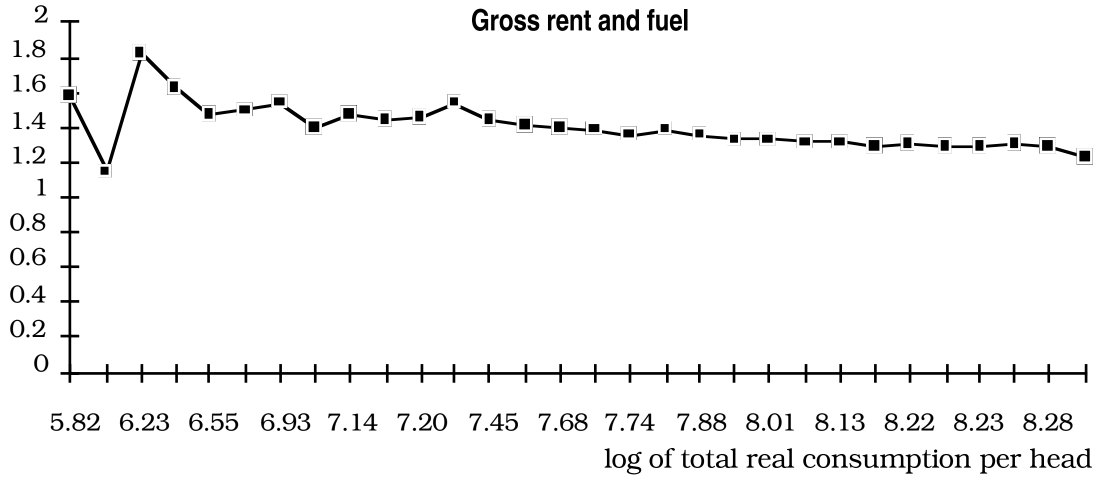


Figure 3.3.3: Estimated total expenditure elasticities as a function of affluence (not standardized for relative price variation)





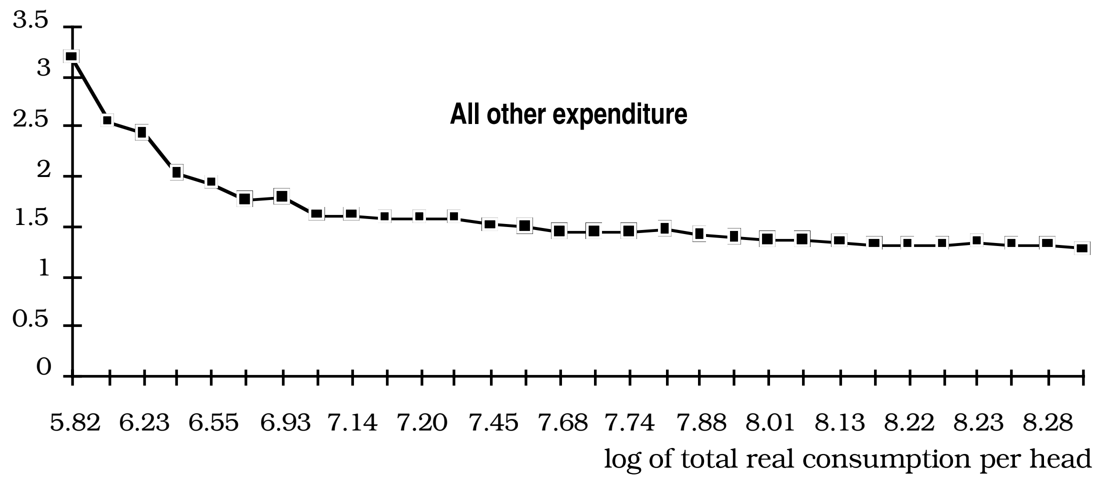


Figure 3.3.3 *(continued)*: Estimated total expenditure elasticities as a function of affluence (not standardized for relative price variation)

3.4 Comparison of the international cross section and the Australian time series

Strict comparison between the international cross section results and the time-series results of Rimmer and Powell (1992) is not possible because of different definitions of the broad commodity groups (see Table 3.1.3). However, in order to make a rough comparison, price variations across countries and over time must be removed and a common measure of total expenditure adopted. Two separate computations were carried out in order to produce synthetic 'samples' in which the relative price variation had been removed: one for the cross section study, and one for the time series study.

For the cross section, prices for the six commodities under study were fixed at their geometric mean (across countries) and for each country nominal total expenditure was adjusted so that the country was 'just as well off'[7] as in the original sample used in the AIDADS estimation above. In the case of the Australian time-series, the relative prices of the commodities were fixed at the same values as in the synthetic cross section and total nominal consumption expenditure was adjusted in each sample year to leave each time-series value of per capita utility constant after the price change.

From the two synthetic samples, budget shares of commodities were obtained as a function of real total consumption expenditure — valued in 1975 international dollars in the case of the cross section study, and in 1984-85 Australian dollars for the time series. Real total consumption expenditure for Australia in 1975 in international dollars was available in Summers and Heston (1984). This figure was used to scale the other years of the Australian study to the 1975 international dollar base.

The budget shares from the cross-section and the time-series synthetic samples are plotted in Figure 3.4.1. In the case of Food, the Australian sample has been extrapolated backward to examine whether at very low income levels the time-series estimate of Food's budget share would be substantially different from the value implied by the cross sectional fit. Although the time-series and the cross section show substantial differences in curvature, there is very little difference in Food's budget share at very low and at very high incomes.

However, the difference in shape significantly colours perceptions of the rate of decline of Food's marginal budget share as a function of real per capita expenditure. Over the thirty or so years of the Australian sample, there was a decline in this MBS from 0.080 to 0.076 (Rimmer and Powell, Table 5.2), whereas the poorest and the richest country's MBSs for Food are estimated at 0.33 and 0.02 respectively. The gap between contemporary Australian behaviour (MBS_{FOOD} = 0.076) and American (MBS_{FOOD} = 0.02) is probably a consequence of the inclusion of the service component of restaurant meals in the Australian (but not the American) data.[8]

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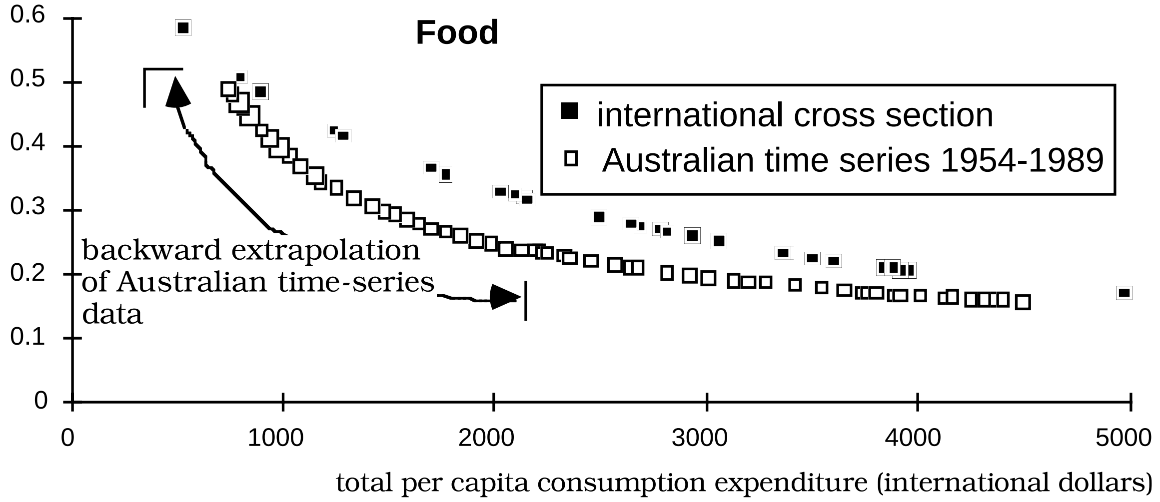
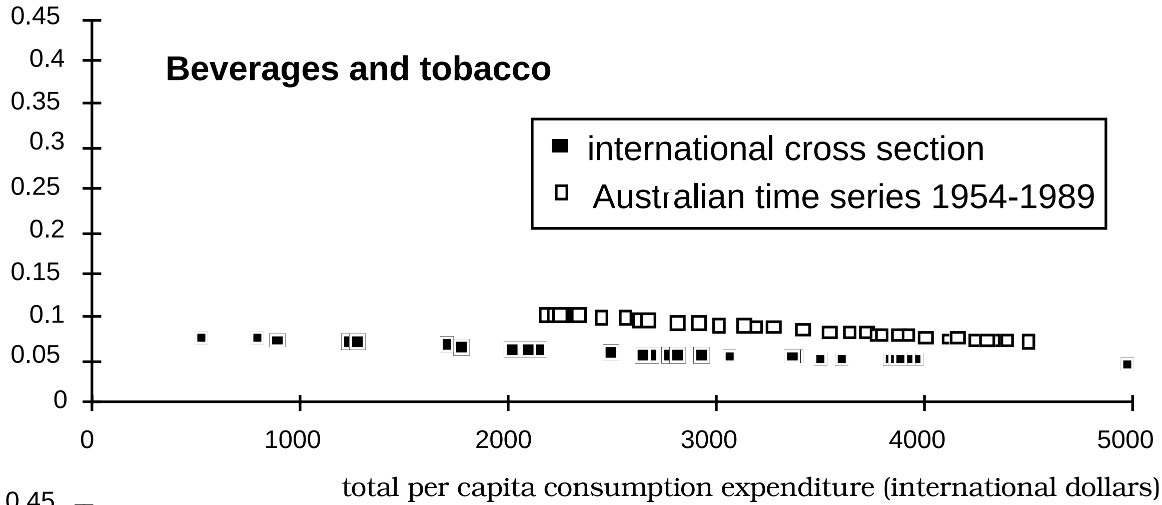
7 In the AIDADS estimation each country's utility is estimated: the first country's utility level is an estimated parameter of the system and the utility levels for the remaining countries are obtained using the scheme set out in Figure 2.4.1.

8 It may also be a reflection of the relative prices at which the MBS were evaluated — the Australian figures quoted above were evaluated at *actual* Australian prices (the price of food is relatively low in Australia).





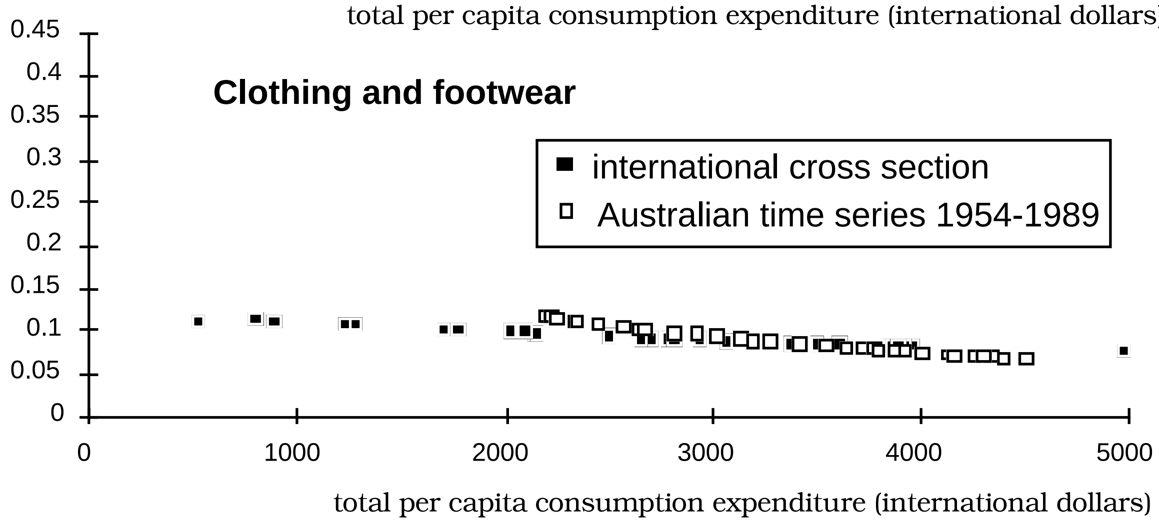
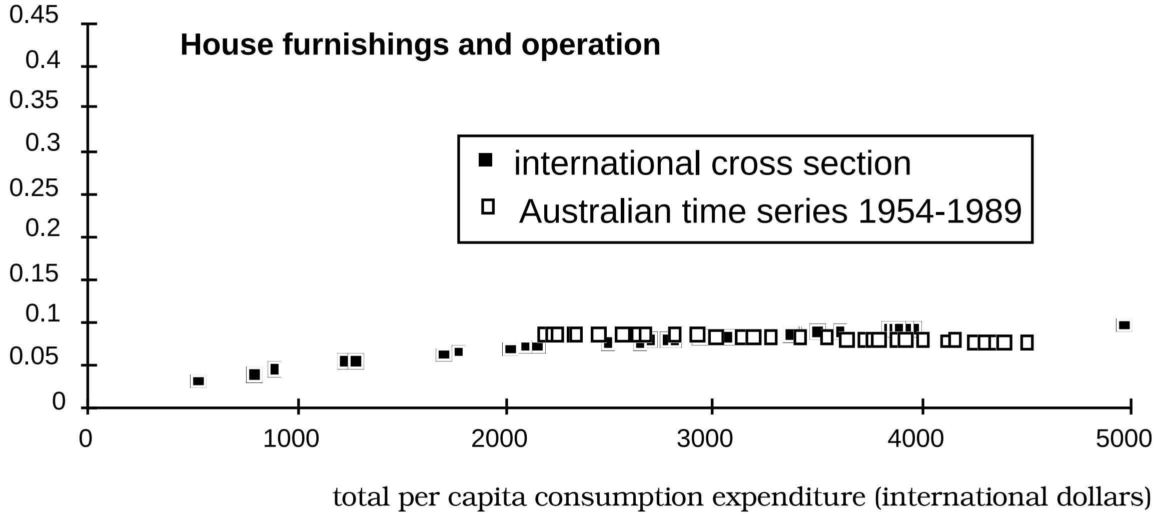
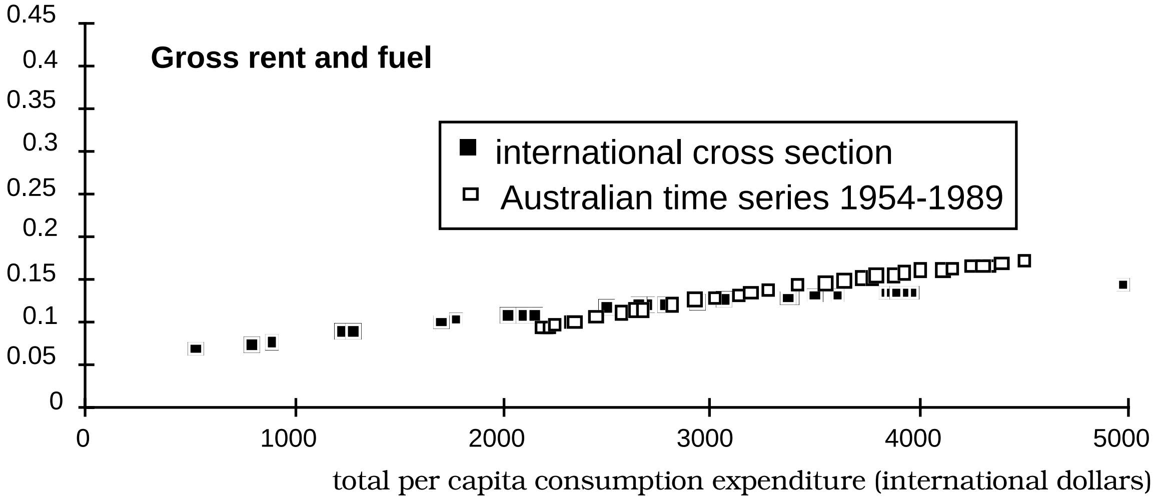


Figure 3.4.1: Comparison of behaviour of estimated budget shares in the international cross section and in the Australian time series data (relative price variation removed). Note that the Australian estimates refer to commodity groups which are not strictly comparable with those for the cross section (see Table 3.1.3).





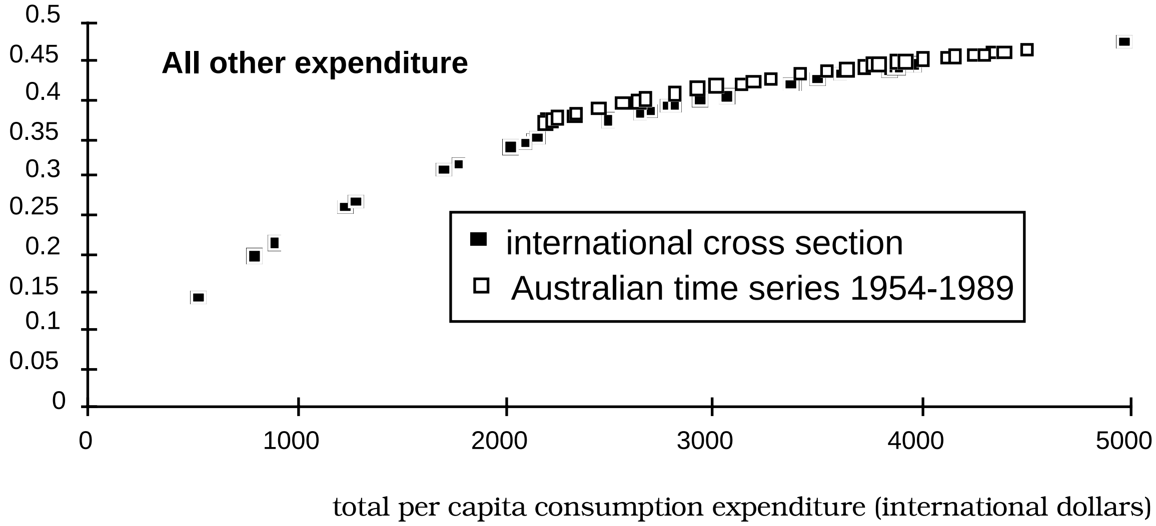


Figure 3.4.1 *(continued)*: Comparison of behaviour of estimated budget shares in the international cross section and in the Australian time series data (relative price variation removed). Note that the Australian estimates refer to commodity groups which are not strictly comparable with those for the cross section (see Table 3.1.3).

References

Adams, Philip D., Ching-Fan Chung and Alan A. Powell (1988) "Australian Estimates of Working's Model under Additive Preferences: Revised Estimates of a Consumer Demand System for Use by CGE Modellers and Other Applied Economists", *Impact Project Working Paper* No. O-61, Industries Assistance Commission, Melbourne, August.

Alaouze, Chris M. (1977) "Estimates of the Elasticity of Substitution between Imported and Domestically Produced Goods Classified at the Input-Output Level of Aggregation", *Impact Project Working Paper* No. O-13, Industries Assistance Commission, Melbourne, October.

Barten, Anton (1968) "Estimating Demand Equations ", *Econometrica*, Vol. 36, No. 2 (April), pp. 213-51.

Cooper, R.J. and K.R. McLaren (1987) "Regular Alternatives to the Almost Ideal Demand System", Monash University, Department of Econometrics and Operations Research, second draft, mimeo (December).

Cooper, R.J. and K.R. McLaren (1988). "Regular Alternatives to the Almost Ideal Demand System". Paper presented to the Sixth Analytic Economics Workshop, Australian Graduate School of Management. Monash University, Department of Econometrics and Operations Research, third draft, mimeo (February). A further revision available in Monash University *Department of Econometrics Working Paper* No 12/88 (September).

Cooper R.J. and K.R. McLaren (1991) "An Empirically Oriented Demand System with Improved Regularity Properties", Monash University *Department of Econometrics Working Paper* No 8/91.

Cooper, R.J. and K.R. McLaren (1992a) "An Empirically Oriented Demand System with Improved Regularity Properties", *Canadian Journal of Economics,* Vol.25, pp. 652-67.

Cooper, R.J. and K.R. McLaren (1992b) "A System of Demand Equations Satisfying Effectively Global Regularity Conditions", Department of Econometrics, Monash University, mimeo (July).

Deaton, Angus and John Muellbauer (1980) "An Almost Ideal Demand System", *American Economic Review,* Vol. 70, pp. 312-26.

Frisch, Ragnar (1959) "A Complete Scheme for Computing All Direct and Cross Elasticities in a Model with Many Sectors", *Econometrica*, Vol. 27, pp. 177-196.

Hanoch, Giora (1975) "Production or Demand Models with Direct or Indirect Implicit Additivity", *Econometrica*, Vol. 43, No. 3 (May), pp. 395-419.

Houthakker, H.S. (1960) "Additive Preferences", *Econometrica*, Vol. 28, No. 2 (April 1960), pp. 244-257.

Kravis, I.B., A.W. Heston and R. Summers (1982) *World Product and Income: International Comparisons of Real Gross Product* (Baltimore: Johns Hopkins University Press).

McLaren, K. R. (1991) "The Use of Adjustment Cost Investment Models in Intertemporal Computable General Equilibrium Models", *Impact Project Preliminary Working Paper* No. IP-48, University of Melbourne, Melbourne, March.

Pearson, K. R. (1991) "Solving Nonlinear Economic Models Accurately via a Linear Representation", *Impact Project Preliminary Working Paper* No. IP-53, University of Melbourne, Melbourne, July.

Selvanathan, Saroja (1991) "The Reliability of ML Estimators of Systems of Demand Equations: Evidence from OECD Countries", *Review of Economics and Statistics*, Vol. 73, pp. 346-53.

Rimmer, Maureen T. and Alan A. Powell (1992) "An Implicitly Directly Additive Demand System: Estimates for Australia", *Impact Project Preliminary Working Paper* No. OP-73, Monash University, Clayton, Vic., Australia, October.

Stone, Richard (1954) "Linear Expenditure System and Demand Analysis: An Application to the British Pattern of Demand", *Economic Journal*, Vol. 64, No. 255 (September 1954), pp. 511-32.

Summers, R. and A. Heston (1984) "Improved International Comparisons of Real Product and its Composition: 1950-1980", *Review of Income and Wealth*, Vol.30, pp.207-68.

Theil, Henri (1965) "The Information Approach to Demand Analysis", *Econometrica*, Vol. 33, No. 1 (January), pp. 67-87.

Theil, Henri (1967) *Economics and Information Theory* (Amsterdam: North-Holland).

Theil, Henri, and Kenneth W. Clements (1987) *Applied Demand Analysis* (Cambridge, Mass: Ballinger).

Working, Holbrook (1943) "Statistical Laws of Family Expenditure", *Journal of the American Statistical Association*, Vol. 38, pp. 43-56.