AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

MONASH

OP-79

# CENTRE of POLICY STUDIES and the IMPACT PROJECT

Eleventh Floor
Menzies Building
Monash University Wellington Road
CLAYTON Vic 3168 AUSTRALIA

Telephone:
(03) 905 2398, (03) 905 5112

from overseas:
61 3 905 2398
or
61 3 905 5112

Fax numbers:
(03) 905 2426, (03)905 5486

from overseas:
61 3 905 2426 or 61 3 905 5486

e-mail
impact@vaxc.cc.monash.edu.au

10/14/94

*Contributed paper presented at the 1994 Australasian Meeting of the Econometric Society, University of New England, Armidale, NSW, July 13-15, 1994*

LIBRARY
OCT 3 1995
WITHDRAWN
AUSTRALIAN FOUNDATION OF ECONOMICS

## ENGEL FLEXIBILITY IN HOUSEHOLD BUDGET STUDIES: Non-parametric Evidence versus Standard Functional Forms

by

Maureen T. RIMMER
and
Alan A. POWELL

*Impact Project, Monash University.*

Preliminary Working Paper No. OP-79 June 1994

ISSN 1031 9034

ISBN 0 7326 0717 5

The Centre of Policy Studies (COPS) is a research centre at Monash University devoted to quantitative analysis of issues relevant to Australian economic policy. The Impact Project is a cooperative venture between the Australian Federal Government and Monash University, La Trobe University, and the Australian National University. During the three years January 1993 to December 1995 COPS and Impact will operate as a single unit at Monash University with the task of constructing a new economy-wide policy model to be known as *MONASH*. This initiative is supported by the Industry Commission on behalf of the Commonwealth Government, and by several other sponsors. The views expressed herein do not necessarily represent those of any sponsor or government.

## *ABSTRACT*

At least since 1980 when Deaton and Muellbauer's famous Almost Ideal Demand System (AIDS) was published, the emphasis in applied demand analysis has been on a flexible specification of substitution effects. Recent theoretical work by Cooper and McLaren (1992a&b) and Cooper, McLaren and Parameswaran (1993) has put more emphasis on effectively globally regular systems which allow greater flexibility in the treatment of Engel effects. Current empirical work (e.g., Chatterjee and Ray, 1992) continues to use a relatively inflexible treatment of Engel effects.

Following Lewbel's (1991) lead, in the present paper we attempt to evaluate the need for a more flexible treatment by examining Engel effects in the Australian Household Expenditure Survey for 1988-89 from an agnostic position in which the form of the Engel response is entirely data-determined. We do this using non-parametric procedures in the statistical package S-Plus. Contrary to common practice (and confirming Lewbel's empirical results for U.K. and U.S. data), we find evidence of non-monotonic responses of budget shares with increasing income. This argues in favour of more flexible forms for Engel curves such as those explored by Rimmer and Powell (1992a&b) (or more generally, in recent work by Cooper and McLaren). Using the same methodology, we also carry out a brief exploration of the influence of demographic effects on household Engel responses.

## CONTENTS


| | | page |
|---|---|---|
| Abstract | | i |
| 1. | Introduction | 1 |
| 2. | Data | 2 |
| 2.1 | Editing the Expenditure Data | 3 |
| 2.2 | Demographic Dimension of the Data Set | 9 |
| 3 | The Results | 10 |
| 3.1 | Non-parametric Engel Responses over the whole Data Set | 12 |
| 3.2 | Non-parametric Engel Responses over the Demographically Partitioned Data Set | 14 |
| 4 | Concluding Remarks and Research Perspective | 16 |
| References | | 33 |
| Appendix 1 | Mapping of HES Commodities into the Aggregated Commodities of Table 1 | 35 |


## TABLES


| | | |
|---|---|---|
| Table 1 | Household Expenditure Commodities aggregated from HES | 3 |
| Table 2 | Household Current Expenditure Commodities used in this Study | 4 |
| Table 3 | Household Categories | 5 |
| Table 4 | Hedonic Regressions for Imputation of Housing Rent | 6 |
| Table 5 | Major Items showing Negative Expenditure | 6 |
| Table 6 | Demographic Variables used in Hedonic Regressions to Eliminate Negative Expenditure on Items 13 and 15 | 7 |
| Table 7 | Households with Recorded Zero Commodity Expenditure | 8 |
| Table 8 | Demographic Variables For Demographic Data Set | 10 |


## FIGURES


| | | |
|---|---|---|
| Figure 3.1: | Scatter Plots of Budget Shares against Total Expenditure – HES data, 1988-89 | 17 |
| Figure 3.2: | Non-Parametric Regressions of Budget Shares on Total Expenditure | 21 |
| Figure 3.3: | Engel responses of budget shares in a Linear Expenditure System with three commodities | 12 |
| Figure 3.4: | Sum across commodities of fitted budget shares in Figure 3.2 | 13 |
| Figure 3.5(a): | Possible shape of Engel response of budget shares in an effectively globally regular demand system (AIDADS) [after Rimmer and Powell (1992a)] | 13 |
| Figure 3.5(b): | Possible shape of Engel response of budget shares in an effectively globally regular demand system (AIDADS) [after Rimmer and Powell (1992a)] | 14 |
| Figure 3.5(c): | Possible shape of Engel response of budget shares in an effectively globally regular demand system (AIDADS) [after Rimmer and Powell (1992a)] | 14 |
| Figure 3.6 | Budget Share Regressions for Three Demographic Groups | 24 |

# *ENGEL FLEXIBILITY IN HOUSEHOLD BUDGET STUDIES:*

## *Non-parametric Evidence versus Standard Functional Forms*

by

Maureen T. Rimmer and Alan A. Powell*

*Monash University*

### *1. Introduction*

For the past three decades key issues in demand analysis have been flexibility in specification and the incorporation of demographic influences. More recently attention has focussed on the attainment of flexibility without sacrificing regularity.

In the estimation of demand systems for a dozen or so generic commodities at the top level of aggregation (categories like 'Fruit and vegetables', 'Clothing and footwear', ...), typically directly additive preferences have been imposed on the underlying utility function. The most celebrated additive-preference demand system, Stone's (1954) *Linear Expenditure System* (LES), has at least one drawback for empirical work; namely the constancy of marginal budget shares (MBSs) [1] — a liability shared with the Rotterdam system (Barten, 1968; Theil, 1965, 1967). Holbrook Working (1943) provided a parsimonious yet empirically successful way of allowing marginal budget shares to respond to income levels; his is the Engel specification adopted within an additive preference framework by Theil and Clements (1987) and in Deaton and Muellbauer's (1980) *almost ideal demand system* (AIDS).

Working's formulation and AIDS share the problem that under large changes in real income, budget shares can stray outside the [0,1] interval — defying global regularity. It was such irregular behaviour that led Cooper and McLaren (1991, 1992a) to modify the AIDS system to become MAIDS, a system with regular properties over a much wider subset of price-expenditure space and to propose (1992b, 1993) a new class of *effectively globally regular* (EGR) demand systems which offer very flexible specifications of Engel effects. Rimmer and Powell (1992a, 1992b) have estimated an EGR system, AIDADS (*an implicitly directly additive demand system*), using both Australian time series data and international comparisons data.

Lewbel (1991) proposed that a non-parametric approach should be used as a 'pre-specification tool' in the estimation of demand systems. Lewbel's definition of the rank of a demand system is equivalent to the number of independent price indices required for a global specification of the indirect utility function. He suggests and association between this rank and the flexibility of Engel curves. Using U.S. and U.K. official survey data for 1970-84 and for 1982 respectively he

---

* The authors are grateful to Tim R. L. Fry for his constructive comments and for drawing their attention to several of the references cited below, and to Keith R. McLaren for helpful comments, and general encouragement. The errors are our own.

1 Let $x_i$ stand for the quantity of i demanded, $p_i$ for its price, and M for total nominal expenditure. By the ith marginal budget share we mean $p_i \partial x_i / \partial M$.

found overwhelming support for non-monotonic behaviour of budget-share curves (against income), which he interpreted as implying rank > 2. This degree of Engel flexibility is not present in the most commonly used parametric demand systems (which all have rank 2).[2]

Moving to a more flexible framework and greater disaggregation incurs a cost in parameter requirements and with it estimating difficulties. The introduction of demand systems in which households are differentiated by attributes also mitigates against a parsimonious specification.

The introduction of demographics into household demand systems was pioneered by Barten (1964). Since then several methods for including demographics have been explored — see for example Pollak and Wales (1981, 1992), Ray (1983) and Muellbauer (1977). Rimmer and Powell (1993) have discussed the implementation of demographics in an EGR demand system.

Given the heavy parameter requirements of flexible demand systems with demographic enhancement it is not perhaps surprising that current practice in empirical work with demographically enriched demand systems is to incorporate relatively inflexible treatments of Engel effects; see, for example Chatterjee and Ray (1992) who estimated a demand system from the Australian Household Expenditure Survey (HES).

The aims of this paper are to assess:

- *the need for a more flexible Engel specification of consumer demand systems.* This is done by examining the form of the Engel effects in the HES data set for 1988-89 from an agnostic position in which the fitted responses are entirely data-determined; as well as
- *the need to include demographics in empirical demand systems.* We approach this by partitioning the households in this HES data set according to a demographic criterion, reestimating the Engel responses, and comparing these for the different demographic groups.

These examinations are done using non-parametric procedures in the statistical package S-Plus[3].

The remainder of this paper is structured as follows. In Section 2 the data is described. Section 3 contains the results and the conclusion is in Section 4.

## 2. *Data*

The 1988-89 Household Expenditure Survey (HES) contains detailed socio-economic and demographic data on 7,225 households and the 27,329 individuals that make up these households, as well as expenditure by household individuals on 421 commodities. There are 542,405 separate expenditure entries in the HES.

Historically, household demand systems have been developed under the assumption that the household is a single-entity decision maker that maximizes its utility subject to a budget constraint, where the behaviour depends on commodity prices and total household expenditure alone. In such a system, demographic

---

2 The authors do not know of any demand systems of rank 2 with budget-share curves which are not monotonic in income.

3 *S-Plus for Windows* has been developed by Statistical Sciences, Inc., Seattle, Washington USA. It is distributed in Australia by the CSIRO Division of Mathematics and Statistics, Macquarie University Campus, North Ryde, NSW.

attributes such as household composition, age of head of household, region etc., play no part. Clearly though, demographic factors do play a role in household demand: for example, households which include children will demand more toys.

The introduction of demographics challenges the notion that the household has a single-entity decision maker: in reality there may be more than one budget constraint and more than one household member making purchasing decisions. The complications introduced by such an approach are considerable and probably beyond the reach of our data set. But more to the point, we do not fit an expenditure *system* in this paper; rather we fit, as single equations, budget share regressions for a set of commodities spanning household consumption. With this relatively rich-in-degrees-of-freedom data set, we really do attempt to *'Let the data speak!'*

### *2.1 Editing the Expenditure Data*

Whilst the data is relatively abundant, it is not limitless, nor are the resources available to us for its analysis; moreover, it is relatively noisy. To preserve some level of parsimony, we aggregated the more than 400 HES expenditure items into just 21 commodities. They are listed in Table 1.

Table 1
*Household Expenditure Commodities aggregated from HES*

| | |
|---|---|
| 1 | Bread, cereal & grain products |
| 2 | Meat & fish |
| 3 | Dairy, eggs & oil products |
| 4 | Sugar, preserves and confectionery |
| 5 | Fruit & vegetables |
| 6 | Other food & non-alcoholic drinks |
| 7 | Alcohol |
| 8 | Cigarettes & tobacco |
| 9 | Clothing & footwear |
| 10 | Housing expenditure (consumption) |
| 11 | Fuel (not including motor vehicle) |
| 12 | Furniture & other household durables |
| 13 | Private transport |
| 14 | Public transport (surface) |
| 15 | Public transport (air) |
| 16 | Leisure goods & services |
| 17 | Other goods |
| 18 | Other services |
| 19 | Privately purchased health |
| 20 | Housing expenditure (capital) |
| 21 | Capital goods & services |

The mapping of the HES expenditure items into the 21 aggregate commodities of Table 1 is given in Appendix 1. Each HES expenditure item is mapped to a single aggregate commodity with the exception of HES expenditure

item 105 (Household and Contents Insurance (selected dwelling)) — which is partitioned equally into commodity 10 (Housing expenditure (consumption)), and commodity 12 (Furniture and Other Household Durables). The tenth aggregate commodity, Housing expenditure (consumption), represents the consumption costs of housing and consists of rent, water and general rates, body corporate payments and maintenance and repair related payments. For renting households this aggregate commodity 10 primarily consists of rent, although in some cases rate payments, etc., are made by renters and are included in this commodity. Such payments are treated as virtual rent (i.e., it is assumed that a higher rent would otherwise have been paid).

On inspection of the HES expenditure data for the 21 commodities in Table 1 it is discovered that over 7000 households have a zero expenditure on either Public transport (surface), commodity 14, or Public transport (air), commodity 15. Since these two commodities can be naturally combined this aggregation is performed to form a new commodity, Public transport, which has 4162 zero entries.

The last two commodities in Table 1 are capital expenditure rather than consumption expenditure and are therefore omitted from this study with total household expenditure being adjusted accordingly. With these changes there are 18 commodities in this study over which households allocate their consumption expenditure. These commodities are shown in Table 2.

Table 2

| *Household* | *Current Expenditure Commodities used in this Study* |
|---|---|
| 1 | Bread, cereal & grain products |
| 2 | Meat & fish |
| 3 | Dairy, eggs & oil products |
| 4 | Sugar, preserves and confectionery |
| 5 | Fruit & vegetables |
| 6 | Other food & non-alcoholic drinks |
| 7 | Alcohol |
| 8 | Cigarettes & tobacco |
| 9 | Clothing & footwear |
| 10 | Housing expenditure (current) |
| 11 | Fuel (not including motor vehicle) |
| 12 | Furniture & other household durables |
| 13 | Private transport |
| 14 | Public transport |
| 15 | Leisure goods & services |
| 16 | Other goods |
| 17 | Other services |
| 18 | Privately purchased health |

The households in the study are partitioned into 15 groups according to type of occupancy and broad demographic status. These household types are described in Table 3.

For the households that own or are buying their residence, Commodity 10 — Housing expenditure (consumption) — does not adequately reflect the flow of housing services, as there is no rent component. To rectify this situation hedonic regressions were conducted on Housing expenditure (consumption) for each of the 5 renting household types listed in Table 3. In these regressions, reported in Table 4, Housing expenditure (consumption) is regressed on a constant, the number of bedrooms in the residence, the location of the dwelling and a dummy variable taking the value one if the residence is rented from the government and zero otherwise. The results of these regressions were used to obtain imputed Housing expenditure (consumption) for the households that own or are buying their residence.

The only exception to this procedure was for households whose residence is a caravan. For such caravan-renting households a regression, involving as a dependent variable the number of bedrooms, would be inappropriate. As the total number of households residing in caravans is only 88 out of the 7225 households it was decided to assign to the non-renting caravan dwellers (75 in number) the average Housing expenditure (consumption ) of the 13 renting caravan dwellers. With this task completed a data set containing consumption expenditure on 18 commodities by 7225 households partitioned into 15 household types became available.

Table 3

*Household Categories*

| | Nature of occupancy | Household status |
|---|---|---|
| 1 | owned outright or rent free | single parent with dependent(s) |
| 2 | owned outright or rent free | married couple with 1 income unit |
| 3 | owned outright or rent free | married couple with >1 income unit |
| 4 | owned outright or rent free | single person |
| 5 | owned outright or rent free | all other |
| 6 | being bought | single parent with dependent(s) |
| 7 | being bought | married couple with 1 income unit |
| 8 | being bought | married couple with >1 income unit |
| 9 | being bought | single person |
| 10 | being bought | all other |
| 11 | renting | single parent with dependent(s) |
| 12 | renting | married couple with 1 income unit |
| 13 | renting | married couple with >1 income unit |
| 14 | renting | single person |
| 15 | renting | all other |

On inspection of this expenditure data it was discovered that there were over 300 households that showed negative expenditure on one or more commodities and indeed that 28 households had negative or zero total expenditure. The households with non-positive total expenditure were omitted from this study, bringing the total number covered here to 7197. Apart from two isolated instances, the cases of negative commodity expenditure were confined to the two commodities listed in Table 5.

Table 4
*Hedonic Regressions for Imputation of Housing Rent*

Regression Equation:

$$h = \alpha_1 a_1 + \alpha_2 a_2 + \alpha_3 a_3 + \beta b + \gamma g + \varepsilon$$

where $\alpha_1$, $\alpha_2$, $\alpha_3$, $\beta$ and $\gamma$ are parameters, $\varepsilon$ is the error term and

| | | |
|---|---|---|
| h | = | housing expenditure (consumption) |
| $a_1$ | = | 1 if area of residence = city (0 otherwise) |
| $a_2$ | = | 1 if area of residence = urban (0 otherwise) |
| $a_3$ | = | 1 if area of residence = rural (0 otherwise) |
| b | = | no. of bedrooms in the residence and |
| g | = | a dummy variable taking the value one if the residence is rented from the government (zero otherwise) |

| Type of household | Sample size | Parameter estimates | | | | | |
|---|---|---|---|---|---|---|---|
| | | $\alpha_1$ | $\alpha_2$ | $\alpha_3$ | $\beta$ | $\gamma$ | $\bar{R}^2$ |
| Single parent with dependants | 231 | 97.28 | 76.15 | 85.75 | 4.28 | -60.07 | .53 |
| | | (11.31) | (8.36) | (5.13) | (1.35) | (15.25) | |
| Married couple, 1 income units | 692 | 94.01 | 74.80 | 49.45 | 8.40 | -48.03 | .21 |
| | | (14.30) | (9.90) | (4.92) | (3.43) | (12.16) | |
| Married couple, > 1 income units | 476 | 91.60 | 52.44 | 22.61 | 13.51 | -50.58 | .24 |
| | | (3.69) | (1.97) | (0.71) | (1.77) | (4.57) | |
| Single person | 113 | 69.81 | 48.91 | 35.78 | 8.48 | -46.24 | .32 |
| | | (17.20) | (9.51) | (3.67) | (4.20) | (13.25) | |
| Other | 343 | 97.90 | 71.72 | 26.80 | 13.49 | -62.01 | .23 |
| | | (9.95) | (6.23) | (1.06) | (3.65) | (8.14) | |

* $|t|$ values shown in parentheses

Table 5
*Major Items showing Negative Expenditure*

| Commodity | Description | No. cases of negative expenditure |
|---|---|---|
| 13 | Private transport | 230 |
| 15 | Leisure goods and services | 146 |

The two isolated cases of households with negative expenditure on commodities other than numbers 13 and 15 were removed, bringing the number of households left in the study to 7195.

Negative expenditure on commodities 13 and 15 can occur because the data collected is "net" expenditure: households selling a car or boat, for example, may well show substantial negative expenditure.

To overcome this problem we conducted hedonic regressions. These regressions are of Commodity 13 or 15 expenditure (positive values only) on a number of variables from the HES: 18 dummy variables and 3 other variables were used. These are listed in Table 6.

Table 6

*Demographic Variables used in Hedonic Regressions to Eliminate Negative Expenditure on Items 13 and 15*

| No. Variables | Variable name |
|---|---|
| 1 | no. of persons in household |
| 1 | no. of employed persons in household |
| 1 | total expenditure of household |
| 15 | household type (Table 3) |
| 3 | area of dwelling (city, urban, rural) |

The regression coefficients so obtained were used to impute a positive expenditure value for each household with negative actual expenditure on these commodities. We based these imputations upon the following assumptions:

(i) that the only households in the HES selling assets under commodity numbers 13 and 15 in the period of record are those with negative expenditures recorded against those items;

(ii) that no recorded positive expenditures on these commodities represent purchases of capital items *except* those which lie *two or more standard deviations* above the fitted regression estimate of the conditional mean (for a household with the same characteristics and total expenditure as the household recording high expenditure). To 'finance' the changes in total (within commodity, across households) expenditure caused by the imputation of positive expenditure to households with recorded negative expenditure on these commodities, enough of the excess expenditure above the two-standard-deviation limit was removed from each of the relevant positive-expenditure households and notionally redistributed to households with negative expenditure so as to keep total (within commodity, across households) expenditure on each of commodities 13 and 15 unchanged at their recorded values.

Having dealt with negative commodity expenditure by households, we are still left with individual commodity expenditures of zero magnitude. Methods for dealing with this have been proposed by Wales and Woodland (1983), Lee and Pitt (1986) and by Pudney (1989). The last-mentioned notes (p. 158) that quite

sophisticated statistical methods (e.g., based on censored regressions) have been developed without much regard to the economic genesis of the problem. He lists three possible circumstances in which a decision-maker may not purchase a particular item during the survey period of record. Paraphrased, they are:

i. the observation period is too short;
ii. the agent had no option to make the purchase (item temporarily unavailable in local stores);
iii. the agent is at a genuine corner solution.

Below we attribute all of the zero recorded purchases just to item (i). We realize that in the case of commodities 7 and 8 (Alcohol and Cigarettes and tobacco) there may be some genuine corners involved.

The problem of zero recorded expenditure in the HES is considerable: see Table 7 below. In addressing this problem our assumption is that households do not necessarily purchase in the (weekly) survey period what they consume. For example, a household might purchase most of its food requirements once a fortnight while consumption is even across the fortnight: this could result in zero entries for one or more of commodities 1 through 7 in Table 2.

Table 7
*Households with Recorded Zero Commodity Expenditure*

| | Commodity | No. households with zero expenditure* | Useable sample size |
|---|---|---|---|
| 1 | Bread, cereal & grain products | 80 | 7115 |
| 2 | Meat & fish | 357 | 6838 |
| 3 | Dairy, eggs & oil products | 96 | 7099 |
| 4 | Sugar, preserves and confectionery | 508 | 6687 |
| 5 | Fruit & vegetables | 227 | 6968 |
| 6 | Other food & non-alcoholic drinks | 58 | 7137 |
| 7 | Alcohol | 2482 | 4713 |
| 8 | Cigarettes & tobacco | 4290 | 2905 |
| 9 | Clothing & footwear | 1983 | 5212 |
| 10 | Housing expenditure (current) | 7 | 7188 |
| 11 | Fuel (not including motor vehicle) | 134 | 7061 |
| 12 | Furniture & other household durables | 367 | 6828 |
| 13 | Private transport | 581 | 6614 |
| 14 | Public transport | 4162 | 3033 |
| 15 | Leisure goods & services | 957 | 6238 |
| 16 | Other goods | 96 | 7099 |
| 17 | Other services | 98 | 7097 |
| 18 | Privately purchased health | 628 | 6567 |

* total no. of households is 7195

To rectify this divergence between the time frame of purchase and consumption we proceed as follows. Firstly we separate expenditure data by commodities (see Table 2) and by household type (see Table 3). We further separate these by quarter of enumeration (to remove seasonality effects) to give

1060 expenditure cells (18×15×4). We denote by $E_{ijk}$ the total expenditure on commodity i by all households of type j with quarter of enumeration k.

We describe households belonging to household category j (see Table 3) enumerated in quarter k as being of type (j,k). We assume that (j,k)-type households who actually purchase i, take longer than the survey week to "consume" their purchases. In particular, we assume that consumption is spread over $1/p_{ijk}$ weeks, where $p_{ijk}$ is the proportion of i-purchasing households of type (j,k) to all households of type (j,k). The total amount of i consumed in the survey week by households purchasing i in that week is thus reckoned to be $p_{ijk}E_{ijk}$.

We further assume that the total amount of i purchased by (j,k)-type households is equal to the total amount consumed by all (j,k)-type households. The households of type (j,k) that do not purchase i are assumed to consume an equal share of the remainder of $E_{ijk}$; that is, $(1-p_{ijk})E_{ijk}$ is distributed equally among households of type (j,k) that did not make purchases during the survey week. These changes in expenditure patterns are neutral in total expenditure on commodity i over households of type (j,k).

With these adjustments complete, the expenditure data was converted to budget shares. The resultant data set includes income and budget shares for the 18 aggregate consumption commodities for each household, yielding an observation matrix of dimension 18 × 7195: 17 independent budget shares plus total expenditure for each household.

Because the zero-purchase households all are allocated an equal share of the expenditure by positive-expenditure households that is reckoned to be in excess of current requirements, the zero-purchase observations on their own provide no basis for estimating the response of expenditure by the zero-purchase group to changes in total expenditure. The inclusion of these data points in the sample would bias the estimates of Engel effects for the remaining households. Accordingly, the estimates reported graphically below are based only on the positive-expenditure households. Note that these households have had their total expenditure adjusted in the manner described above.

### *2.2 Demographic Dimension of the Data Set*

We now concentrate on demographic dimensions of the data set. The HES contains detailed information about the household unit and the persons that comprise it. For each household 139 separate descriptive items are recorded, with an additional 50 for each person in the household. Our task is to extract from this mass of information enough detail to obtain a household profile that may be useful for a consumption demand study. The chosen demographic data items are listed in Table 8 below.

Item 1 of Table 8 refers to the 15 household types from Table 3. Note that there are possible truncation errors involved in items 2—13 in Table 8, because in the HES codes for these items, the code 4 represents 4 *or more* persons. The total number of demographic variables described in Table 8 is 44. It is not likely that the data would allow estimation of the separate effects of so many demographic variables. So we use the method of Principal Components to capture the variability of the data in an empirically tractable fashion.

This method identifies and ranks the linear combinations of the 44 demographic variables that most capture the generalized variance of the data. The top ranked principal component accounts for 98 per cent of the generalized variance and we adopt it here as our single composite demographic variable. The demographic variable from Table 8 that is closest to this adopted demographic variable

(in the sense of having the highest pair-wise correlation with it; r = 0.99) is item 17: hours worked by adults per number of adults.[4] In Section 3 we will seek to identify if demand patterns across income are affected by our chosen composite demographic variable.

Table 8

*Demographic Variables For Demographic Data Set*

| Item | Demographic Variable | No. Variables |
|---|---|---|
| 1 | household type | 15 |
| 2 | no. of persons < 2 | 1 |
| 3 | no. of persons 2—4 | 1 |
| 4 | no. of persons 5—12 | 1 |
| 5 | no. of persons 13—14 | 1 |
| 6 | no. of full-time students 15—24 | 1 |
| 7 | no. of other persons 15—24 | 1 |
| 8 | no. of persons 25—44 | 1 |
| 9 | no. of persons 45—54 | 1 |
| 10 | no. of persons 55—59 | 1 |
| 11 | no. of persons 60—64 | 1 |
| 12 | no. of persons 65—75 | 1 |
| 13 | no. of persons >75 | 1 |
| 14 | quarter of enumeration | 4 |
| 15 | femininity (fraction of adults[5] that are female) | 1 |
| 16 | country of birth of head | 8 |
| 17 | hours worked by adults/ no. adults | 1 |
| 18 | area of dwelling (city, urban, rural) | 3 |

## 3 *The Results*

We use the statistical package S-Plus to fit non-parametric regressions of budget shares for each commodity i (i = 1, 2, ..., 18) against total household expenditure. S-Plus is a data analysis package with rich graphical capabilities and extensive statistical tools. It allows for an almost totally data driven approach to the establishment of the regression relationship.

4 Clearly, the first principal component of the demographic date set is strongly linked to labour market participation of the household. In a demand-systems approach to the analysis of this data set this would imply indirect linkages via the budget constraint.

5 For the purposes of this study an adult is a person 16 years or older.

Our budget share data are:

$$\{(w_{ih}, y_h)\}\ , \qquad (i=1,2, \ldots,18 \text{ and } h=1,2, \ldots,7195)$$

where $y_h$ is the total expenditure of household h and $w_{ih}$ is its budget share of commodity i.

A scatter plot of this data is given in Figure 3.1 (which starts on page 17)[6]. Note that our scatter diagrams include the observations on imputed expenditures by households recording zero expenditures. As the set of 7195 data points per commodity is beyond our printing capacity, the data for each commodity is divided into two sub-samples. This is done by ranking the households according to level of total expenditure and then distributing alternative observations between them. We show scatter plots for both sub-samples in the case of commodities 1–4; in the interests of brevity, for other commodities we show only the first sub-sample.

On inspection of Figure 3.1 it is clear that these scatter plots are insufficient to establish an interpretable regression relationship. Attention is distracted by extreme points while the intensity of the very dense patches within the mass of the data is not discernible. A preselected parametric model might be too restricted in formulation or dimension to fit unexpected features in the data. Moreover, given the noisiness of the data, many functional forms seem likely to be capable of fitting the data more or less equally well (or badly). On the other hand, S-Plus has several smoothing non-parametric techniques in which the functional form of the regression curve is flexible and data-determined.

The Engel relationships can be modelled by writing budget shares as a function of household income:

$$W_{ih} = f_i(Y_h) + \varepsilon_{ih} \qquad (i = 1, 2, \ldots, 18 \text{ and } h = 1, 2, \ldots, 7195) \tag{3.1}$$

where upper case is used to distinguish random variables in the underlying (population) relationship from sample realizations, where the functional form of the regressions $f_i$ is left unspecified, and where the $\varepsilon_{ih}$ are zero-mean random errors assumed to be independent of the $Y_h$.

The smoothing algorithm used here is Supersmoother described in Chapter 17 of the *S-Plus for Windows User's Manual Vol. 2.* For each commodity i Supersmoother seeks to provide a good estimate of the conditional mean

$$f_i(y_h) = E(W_{ih} | Y_h = y_h) \tag{3.2}$$

where $(W_i, Y)$ are assumed to be jointly distributed random variables. Supersmoother allows for a locally adaptive amount of smoothing that adjusts appropriately to changing curvature of $f_i$ and changing variability of the $\varepsilon_i$. Less smoothing is employed for regions of greater curvature of $f_i$ or of smaller variance of $\varepsilon_i$ and more smoothing is employed for regions of smaller curvature of $f_i$ or greater variance of $\varepsilon_i$. Underlying Supersmoother is a *symmetric k-nearest neighbour linear least squares* fitting procedure. The value of k is optimally chosen for each $y_h$ using a cross-validation technique described in the *Manual.*

---

6 Note: In Figures 3.1, 3.2, 3.4 and 3.6, the units on the horizontal axis are current dollars per household per week.

### 3.1 *Non-parametric Engel Responses over the Whole Data Set*

Figure 3.2 (which starts on page 21) contains the smoothed regression curves obtained using Supersmoother applied to the data described above. Note that, for the reasons discussed in Section 2.1, these regressions are based only on households recording non-zero expenditure for the commodity in question. The available sample size consequently varies by commodity and is indicated in the last column of Table 7. For commodities 1—4, plots of the fitted regressions are given for each of two sub-samples. Note that only one regression is fitted for each commodity; the results are split (along the lines described above) purely for display purposes. Not surprisingly, there is hardly any discernible difference between the sub-samples.

For commodities 5 through 18, on pages 22–23 we show the fitted non-parametric regressions either for the whole sample (when the number of households reporting non-zero expenditure on the commodity in question does not exceed 4000), or for a half sample (when this number exceeds 4000). The number of data points *displayed* in each fitted curve is shown ("D = ...") in Figure 3.2.

Demand systems with constant marginal budget shares yield monotonic curves in the *budget share* × *total expenditure* space. The Linear Expenditure System provides an example which is illustrated in Figure 3.3. Virtually all commonly used demand systems, whether based on additive preferences or not, yield monotone plots in this space.

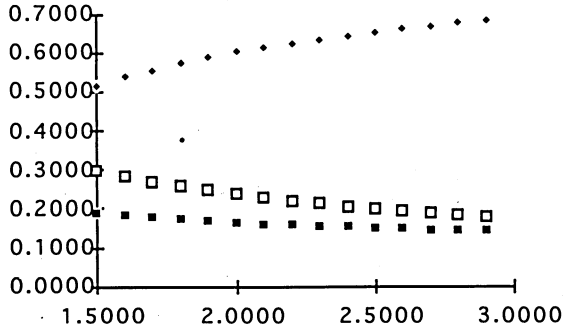



Figure 3.3: Engel responses of budget shares in a Linear Expenditure System with three commodities.

As Supersmoother is used on share data for *individual* commodities, the system requirement that the budget shares sum across commodities to unity does not apply to the fitted regressions. The actual sum of the smoothed budget shares across households is given in Figure 3.4. Note that since the relevant sample for the estimation of this sum is the intersection of the single-commodity samples (which are restricted just to households actually purchasing the commodity in question during the survey week), these estimates of the sum of budget shares are necessarily based on a restricted sample size, namely, 609 households.

If the smoothed budget shares depicted in Figure 3.2 were normalized by dividing each estimated conditional mean $W_i$ through by the corresponding

conditional sum over commodities of all budget shares, thus imposing a minimal theoretical restriction on an otherwise data driven analysis, the qualitative picture emerging would remain substantially the same.

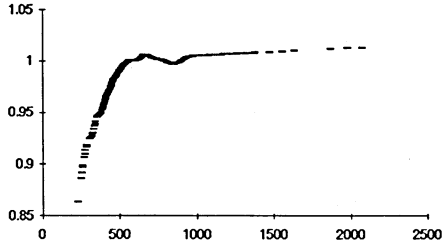



Figure 3.4: Sum across commodities of fitted budget shares in Figure 3.2

While visual inspection of Figure 3.2 reveals that some of the fitted non-parametric regression curves could well be consistent with constant marginal budget shares (for example, the food commodities 2, 3, 7 and 8)[7] — others, notably items 6, 10, 13 and 18 (Other food and non-alcoholic drinks, Housing expenditure (current), Private transport and Privately purchased health), almost certainly could not. Non-monotonic behaviour seems to be strongly suggested by the data.

There is at least a *prima facie* case, however, that some or all of these curves could be accommodated by effectively globally regular systems of sufficient parameter dimensionality. The plots shown for AIDADS in Figure 3.5 are suggestive. The AIDADS system has Lewbel rank 3 and permits the Engel flexibility which he observed was necessary to accommodate U.S. and U.K. survey data. The commonly used consumer demand systems (e.g., CES, LES, AIDS) have Lewbel rank 2 and do not possess such flexibility.

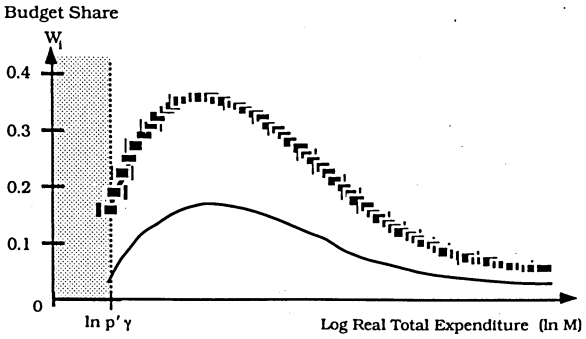



Figure 3.5(a): Possible shape of Engel response of budget shares in an effectively globally regular demand system (AIDADS) [after Rimmer and Powell (1992a)]

*... Figure 3.5 continues on next page*

7 In the case of the LES, a zero marginal budget share yields a rectangular hyperbola in the *budget share* × *total expenditure* space.

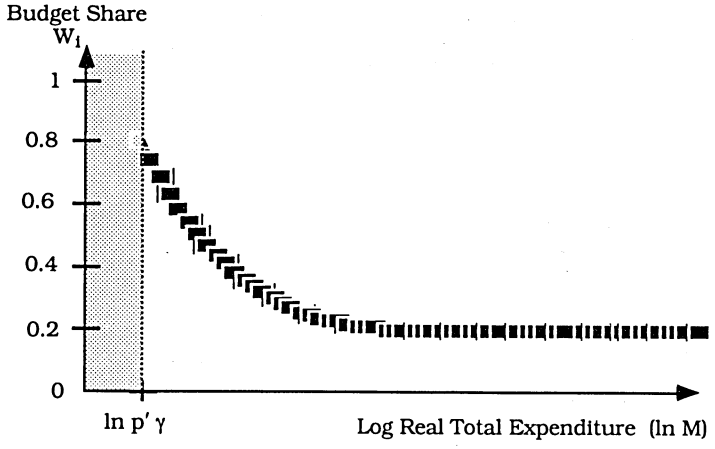



Figure 3.5(b) Possible shape of Engel response of budget shares in an effectively globally regular demand system (AIDADS) [after Rimmer and Powell (1992a)]

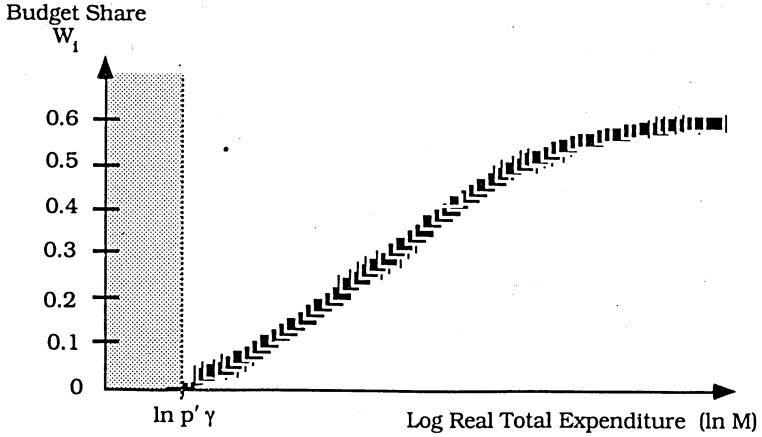



Figure 3.5(c) Possible shape of Engel response of budget shares in an effectively globally regular demand system (AIDADS) [after Rimmer and Powell (1992a)]

### *3.2 Non-parametric Engel Responses over the Demographically Partitioned Data Set*

We now investigate the empirical question as to whether Engel responses are affected by demographics. This is done visually in Figure 3.6 (pp. 24–32) where the non-parametric regressions are reestimated for each of the three demographic groups explained below.

The 7195 households remaining in the study were ranked according to the value of the estimated first principal component of the demographic data set described above. The ranked data was then split into a lower, a middle and an upper $33\frac{1}{3}$ percentile group: these are the LOW, MEDIUM and HIGH groups for which separate regressions are reported in Figure 3.6 (pages 24–32). Note that these regressions (as before) are based only on households recording positive expenditure during the survey week on the commodity in question. Consequently sample sizes (noted on the diagrams — "N = ...") vary between commodities. Also note that expenditures have been re-scaled downwards as described in Section 2.1.

The correlation between total expenditure and our adopted demographic variable is quite low (0.12). Consequently, the income spreads and densities are approximately the same for each of the three demographic groups.

At face value the variations in Engel responses with changing demography are of small through moderate magnitudes. Moreover, it is not clear whether the first principal component of the demographic data set necessarily would reveal more variation (in this sense) than lower-order components. It is possible that *discriminant analysis* (see, e.g., Dhrymes, 1970) would yield a more fruitful approach to estimation of the demographic effects. Suppose (for the sake of illustration) that (as in Figure 3.6) we attempt to identify just three demographically defined subpopulations with varying Engel response patterns.

Let $x_h$ (h = 1, 2, ..., 7195) represent the vector of demographic attributes of the $h^{th}$ household, and let $\mathcal{X}_1$, $\mathcal{X}_2$ and $\mathcal{X}_3$ be *acceptance sets* for sub-populations 1, 2 and 3. These sets are defined such that if $x_h \in \mathcal{X}_j$ , then the $h^{th}$ household is allocated to subpopulation j (j= 1, 2, 3). We want to partition the population into sub-populations which display the greatest possible diversity of Engel responses. The $\mathcal{X}_j$ induce a partition of the sample into just three sub-samples.

Our non-parametric regressions yield estimates of $E(W_{ih}|Y_h = y_h)$ (for brevity hereafter written as $E(W_i|y_h)$ ). These estimates as denoted by a 'hat', ^. Thus $\hat{E}(W_i|y_h)$ is the estimated conditional mean budget share of commodity i when total expenditure is equal to the value recorded for the $h^{th}$ household. In Figure 3.2 these conditional means are estimated across all 7195 households.

Instead of estimating across all households (as in Figure 3.2) we can (as in Figure 3.6) estimate separately across households within different subsamples. By

$$\hat{E}_{x_h \in \mathcal{X}_j}(W_i|y_h) \tag{3.3}$$

denote the conditional mean of the budget share for commodity i estimated from all households h that are allocated to sub-population j. Let $\hat{E}(W_i|y_h)$ (as above) be the conditional mean across the whole, unpartitioned, sample. The spirit of the discriminant analysis approach would have us search for acceptance sets $\mathcal{X}_1$, $\mathcal{X}_2$ and $\mathcal{X}_3$ that maximize diversity; i.e., that maximize:

$$(3.4) \qquad \varphi = \sum_{i=1}^{18} S_i \sum_{j=1}^{3} \sum_{y_h:\, x_h \in \mathcal{X}_j} \{\hat{E}_{x_h \in \mathcal{X}_j}(W_i|y_h) - \hat{E}(W_i|y_h)\}^2$$

where the $S_i$ are weights reflecting importance placed on different commodities.

A common practical approach in discriminant analysis is to define the acceptance sets by intervals on the real line — in our case (say) $(-\infty, L_1)$, $[L_1, L_2)$, $[L_2, \infty)$ — in conjunction with a linear aggregator, L, of the demographic data. Thus L maps the demographic data into the real line. The problem of identifying and estimating demographic influences on Engel responses then is solved formally by maximizing $\varphi$ in (3.4) with respect to the vector L and the points $L_1$ and $L_2$ defining the boundaries of the sets $\mathcal{X}_1$, $\mathcal{X}_2$ and $\mathcal{X}_3$. We have not so far explored the solution to this problem.[8]

### *4. Concluding Remarks and Research Perspective*

The non-parametric evidence in Figure 3.2 strongly suggests that currently widely used consumer demand systems have Engel specifications which lack sufficient flexibility to capture the stylized facts. In particular, the plot of budget shares against total expenditure may not be monotonic; nor in theory is there any need for it to be so (see Figures (3.5(a)). These results are consistent with the findings of Lewbel (1991). Newer effectively globally regular systems of sufficient dimensionality promise a better treatment.

Our exploratory demographic results in Figure 3.6 are based on extracting the first principal component of the demographic data set. They suggest that demographic effects may be important in some cases; however, the evidence is less clear, and must await further work in which measures of precision are computed for the fitted non-parametric regressions. They also suggest that some previously documented demographic responses may be compromised by the inadequate Engel specification used in their estimation.

An alternative (hopefully more powerful) discriminant-analytic approach to the demographic dimension of Engel responses has been sketched in the last section. We plan to investigate this further.

We have reported results from just one of the algorithms available in S-Plus for non-parametric regression. Some testing of sensitivity to the choice of algorithm is planned for the future. We also plan to investigate more formally the concordance between the fitted non-parametric regressions and effectively globally regular systems (such as AIDADS).

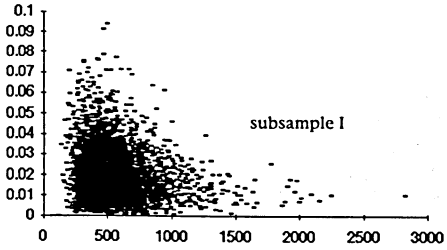
---

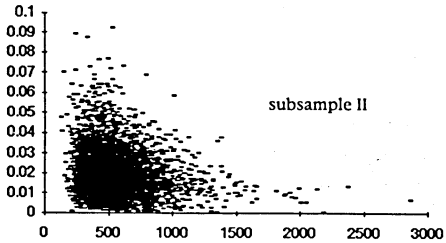
8 The discriminant-analytic approach, like the rest of this paper, emphasises the maxim: "let the data speak!". It is possible (even likely) that although the information content of the data is sufficient to extract Engel curves, it may not suffice for discrimination into demographically defined sub-populations with different consumption behaviour.

Some elements of parametric procedures from the demand systems approach (such as translation and/or scaling) may need to be invoked. Semi-parametric representations of $E(W_i|y_h)$ may be useful in the solution of (3.4).

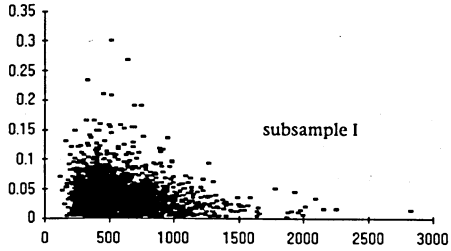
*Figure 3.1:* ***Scatter Plots of Budget Shares against Total Expenditure — HES data, 1988-89***

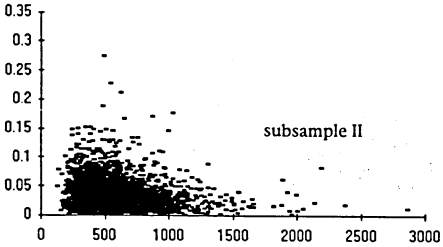
commodity 1



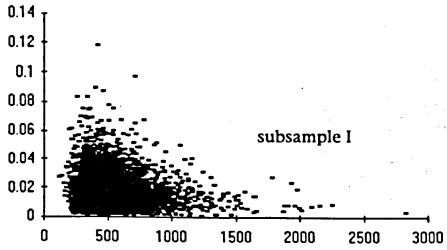



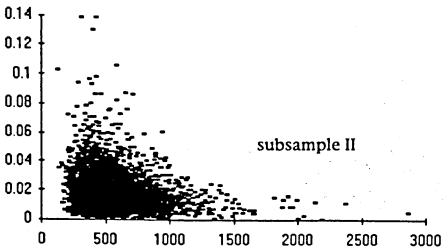

commodity 2



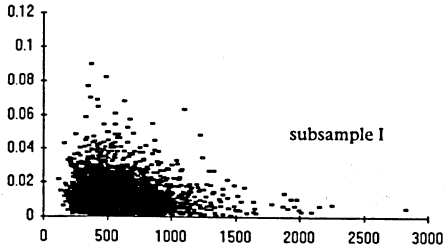




commodity 3




commodity 4



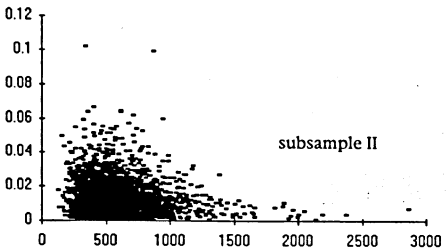



*Figure 3.1: Scatter Plots (continued)*

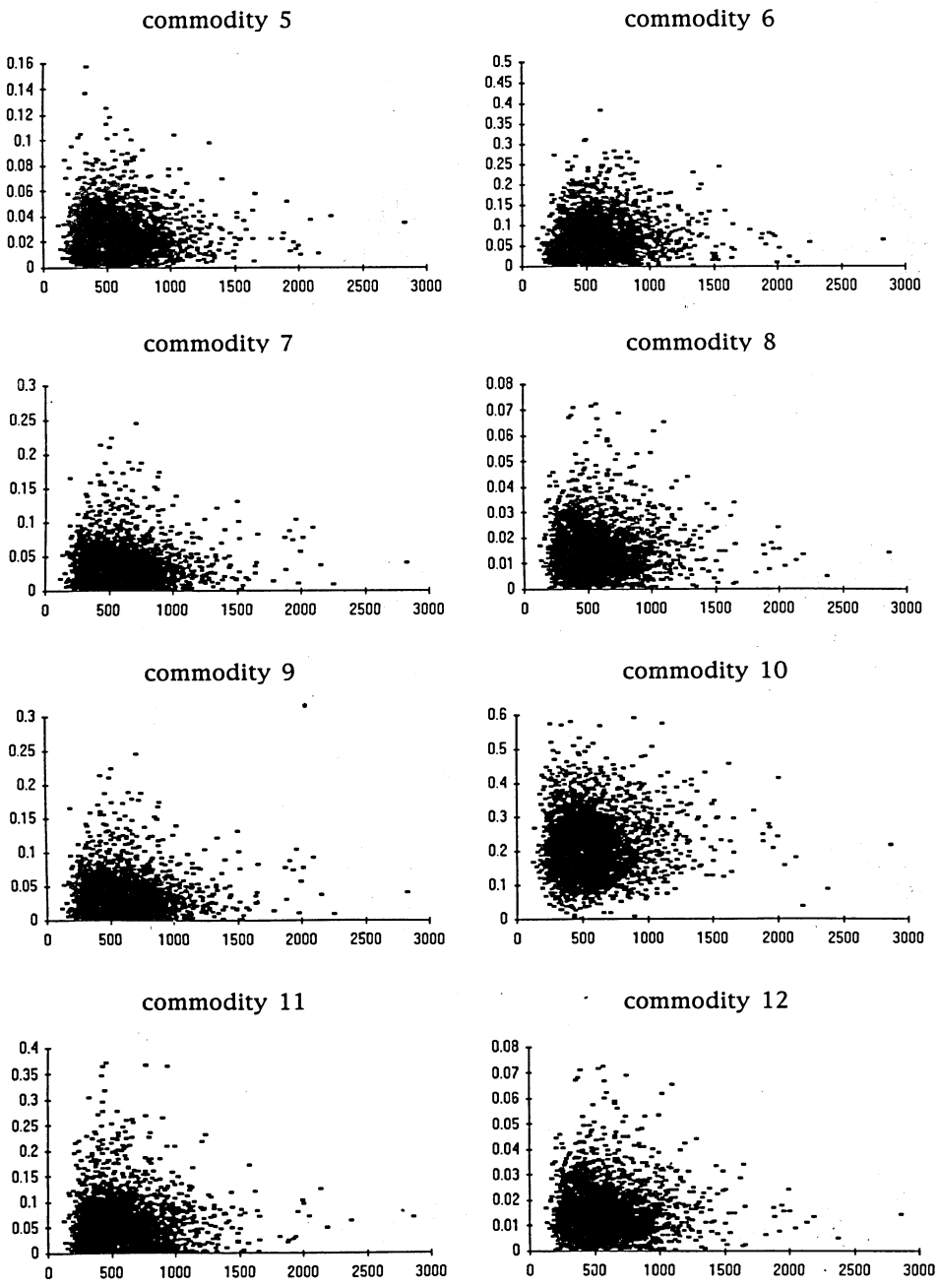
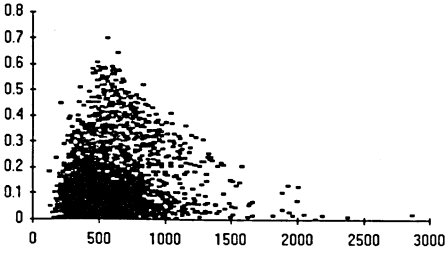
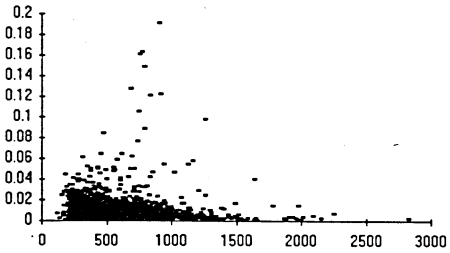


*Figure 3.1: Scatter Plots (continued)*

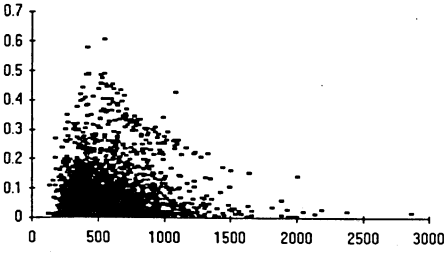
commodity 13



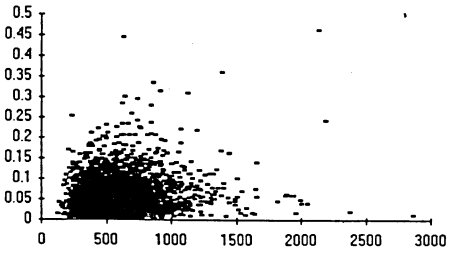

commodity 14



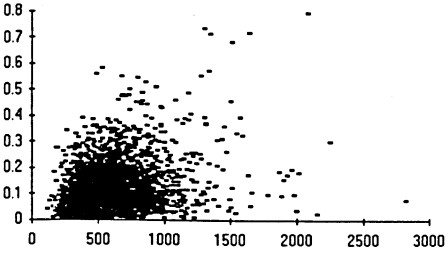

commodity 15




commodity 16




commodity 17




commodity 18

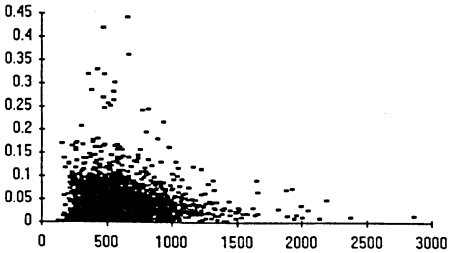
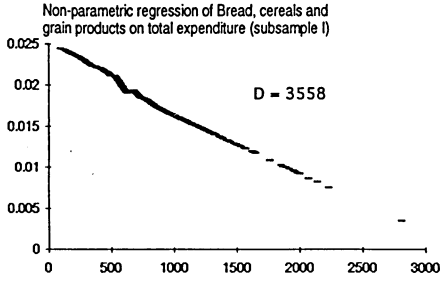
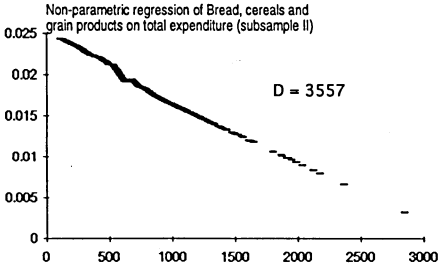


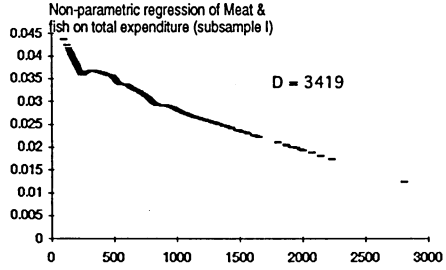
***Figure 3.2: Non-Parametric Regressions of Budget Shares on Total Expenditure***

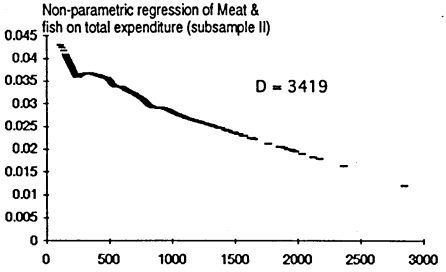
commodity 1



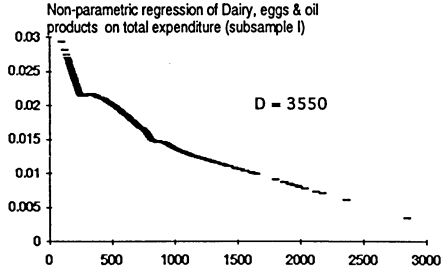



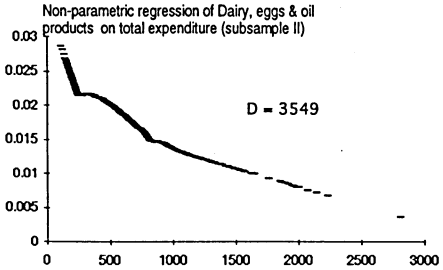

commodity 2



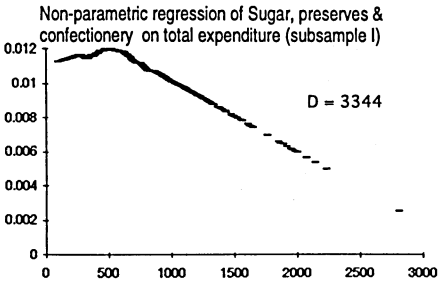




commodity 3




commodity 4



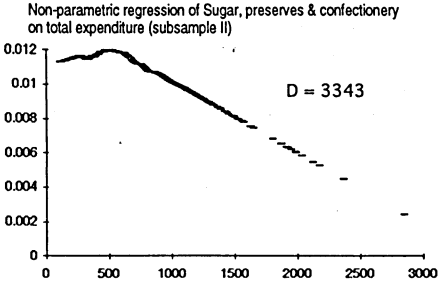
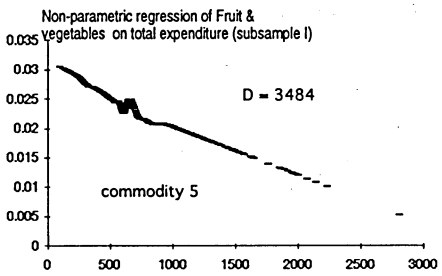
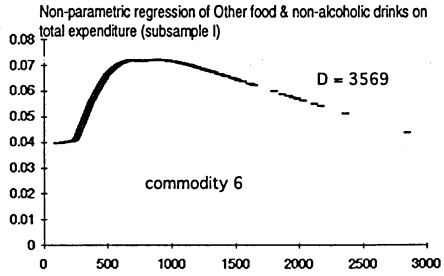
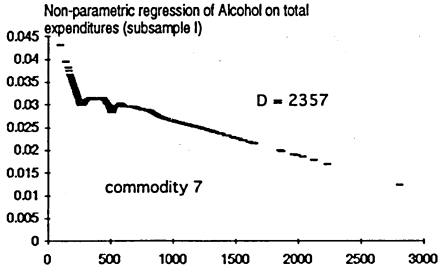
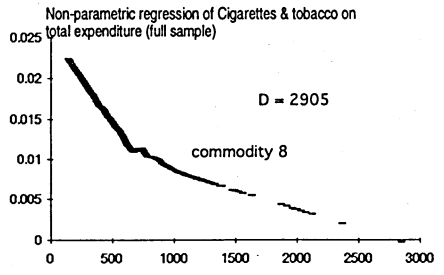



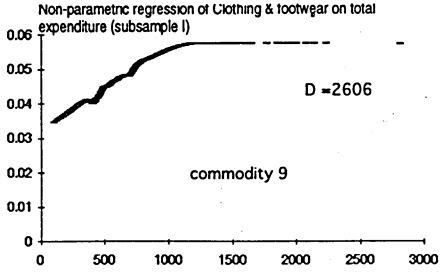
*Figure 3.1: Scatter Plots (continued)*

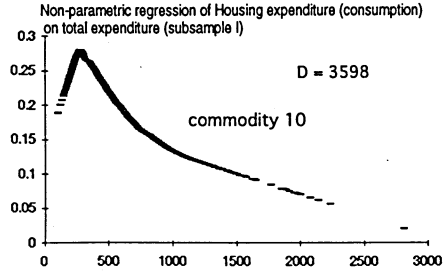


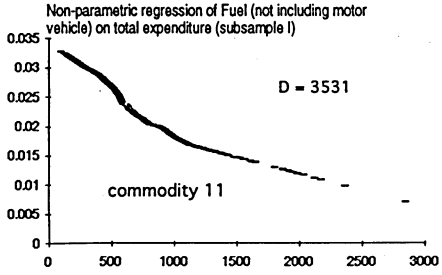



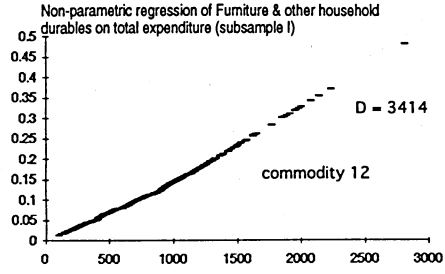
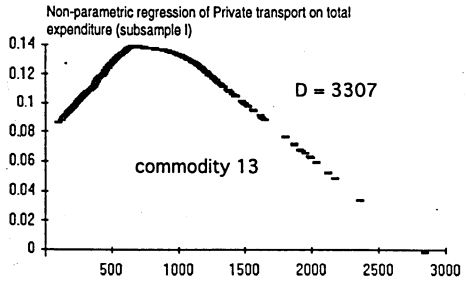
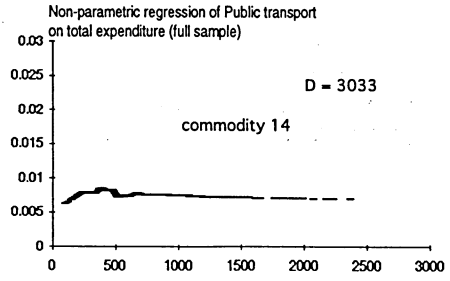
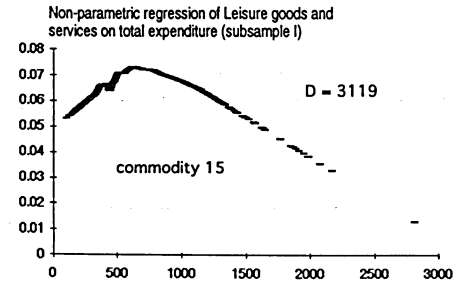
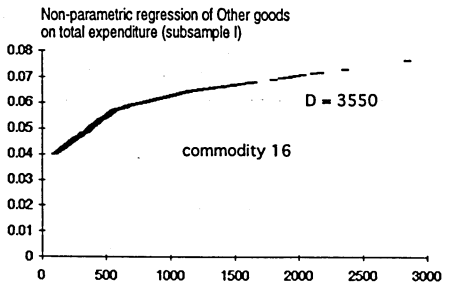



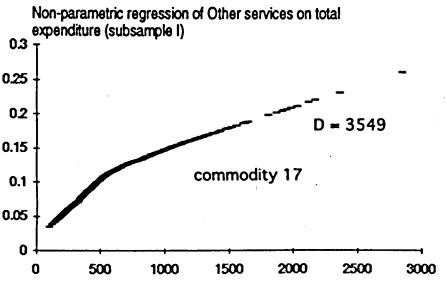
*Figure 3.2: Non-parametric regressions (continued)*



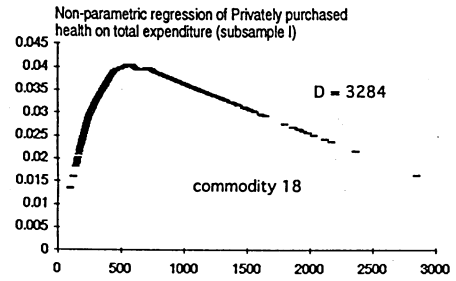
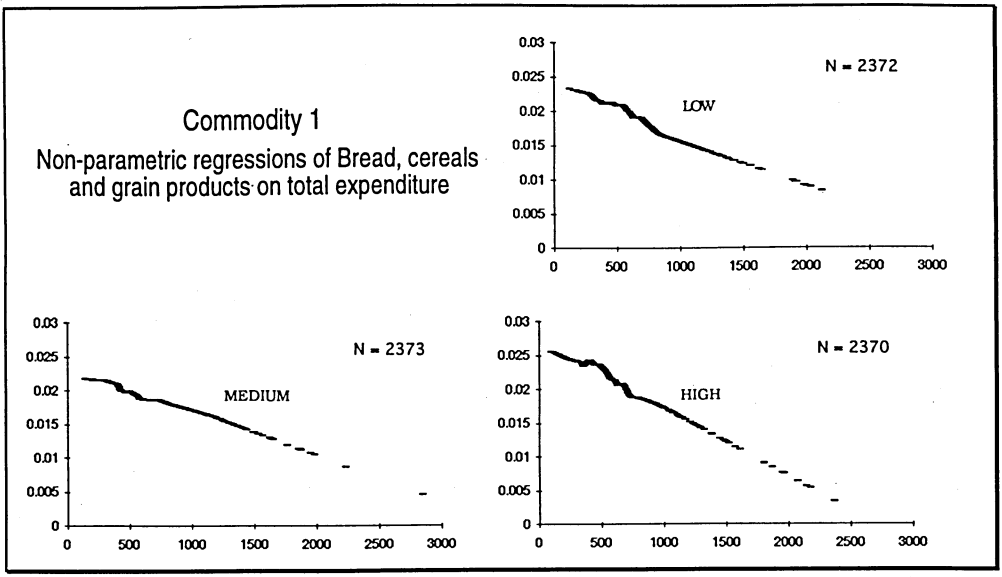



***Figure 3.6: Budget Share Regressions for Three Demographic Groups***



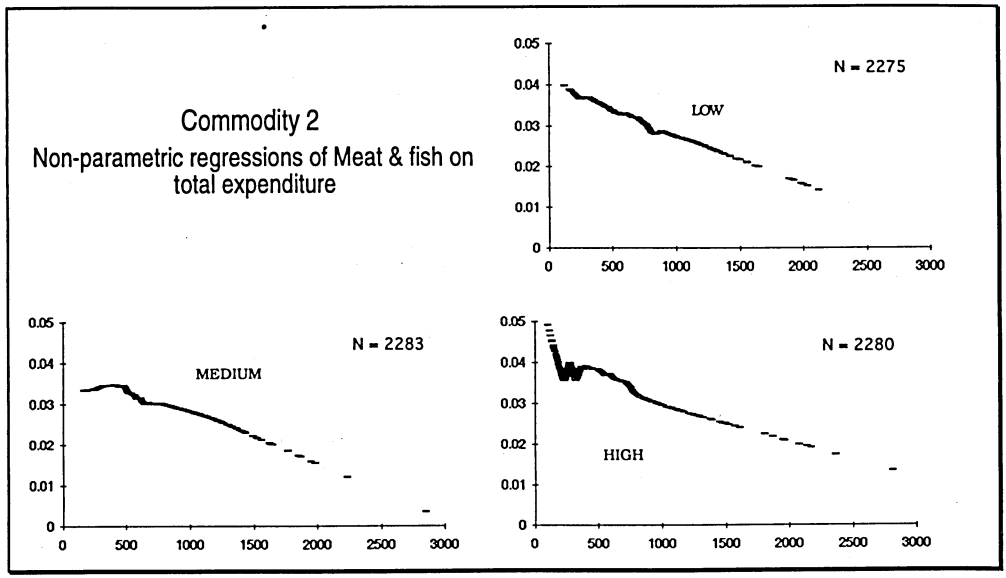
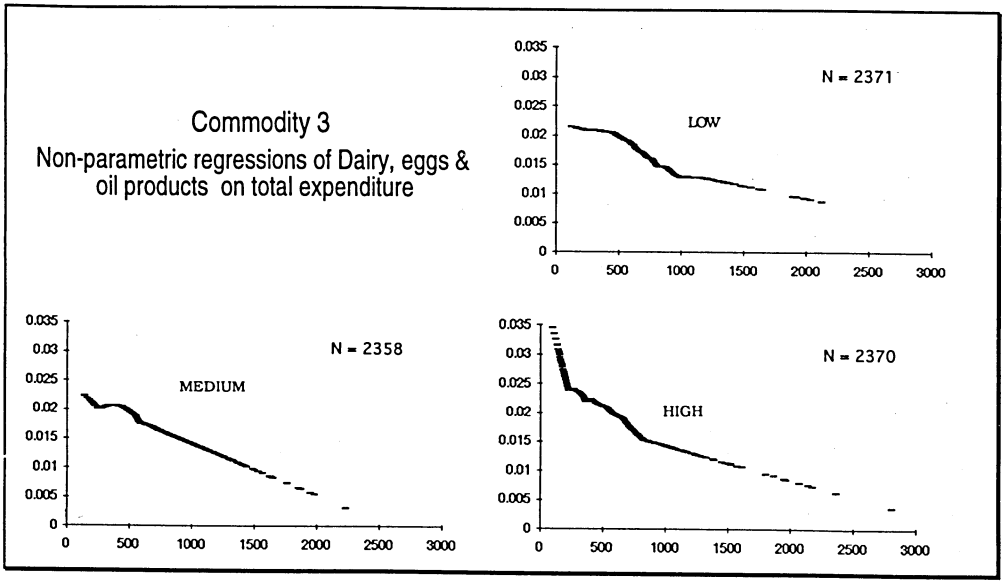



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



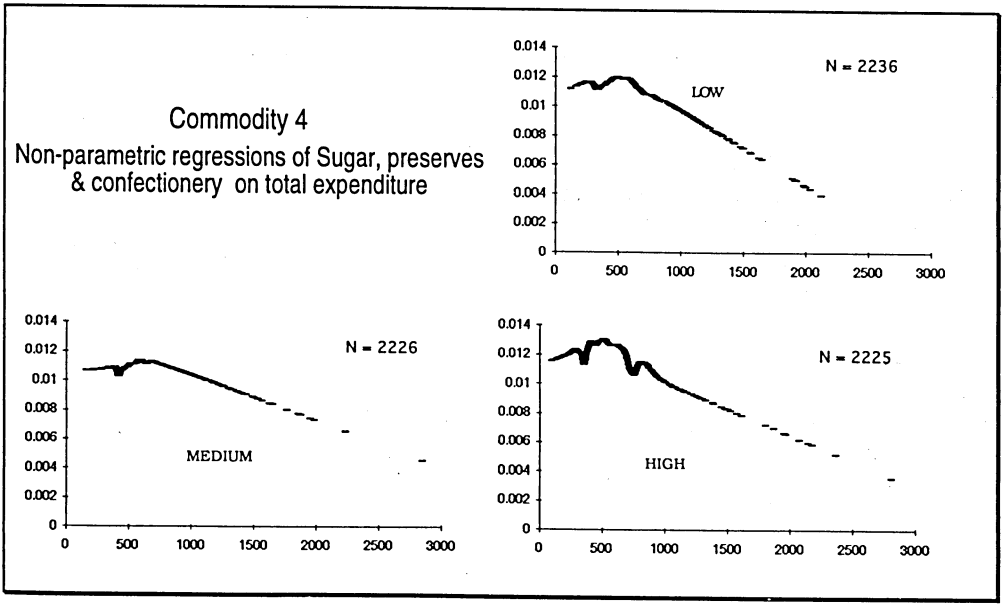
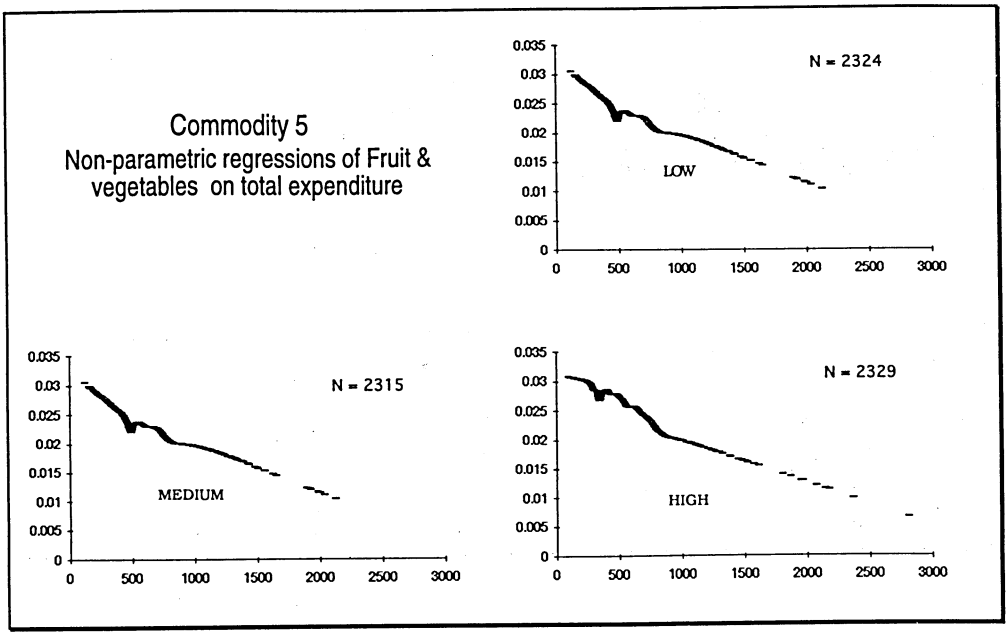



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



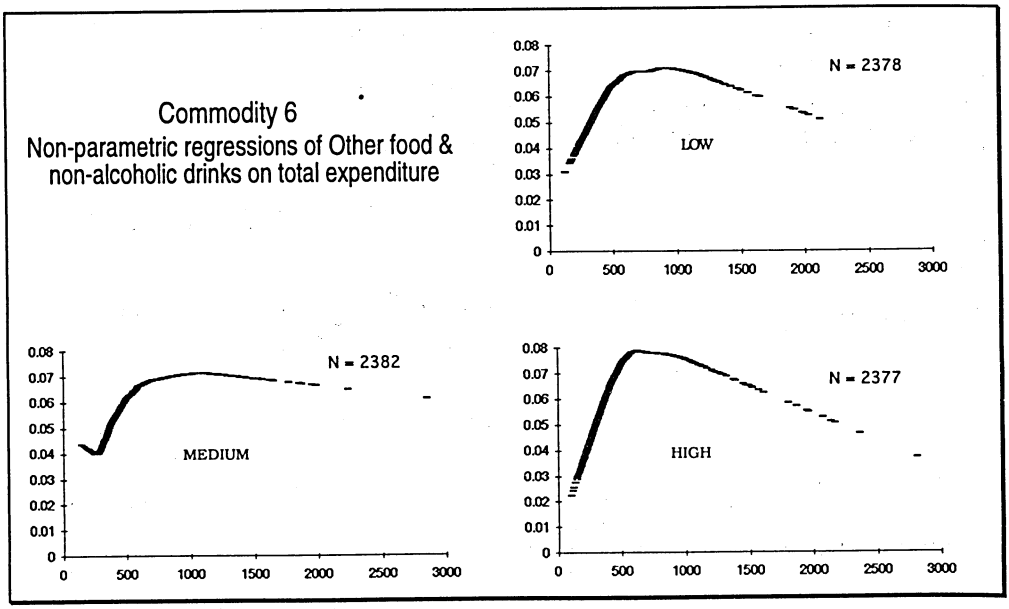
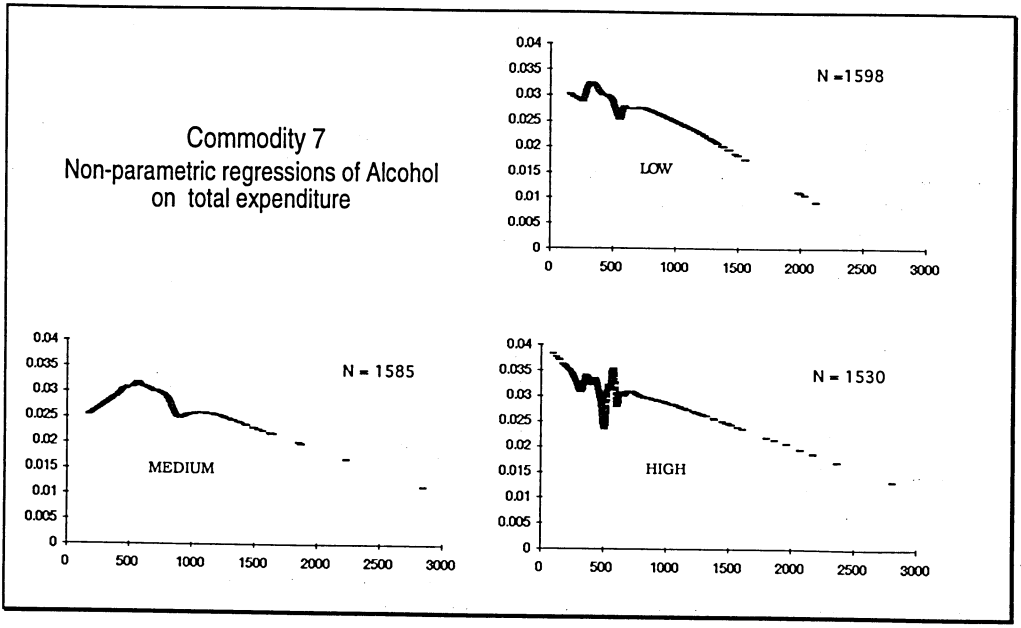



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



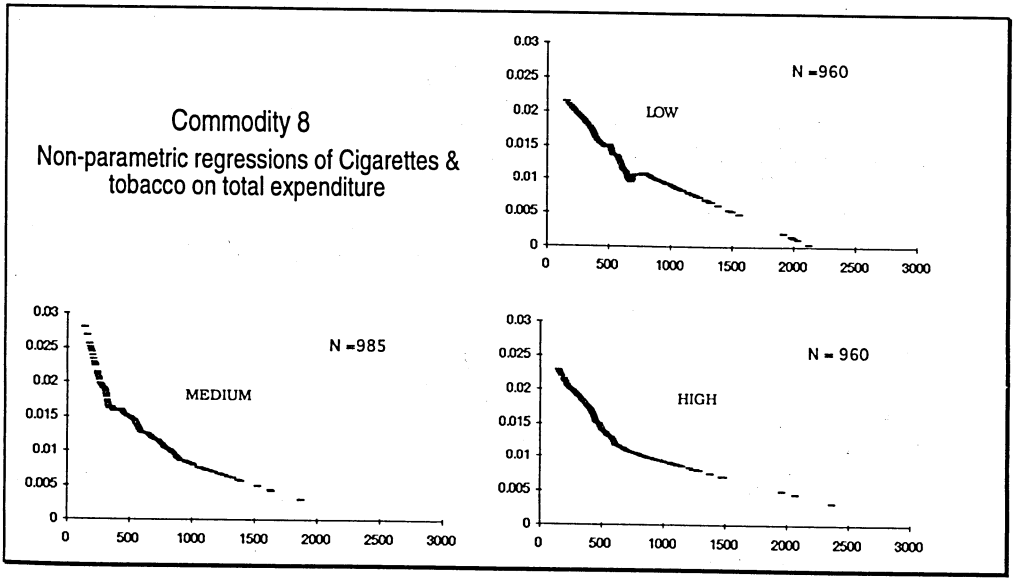
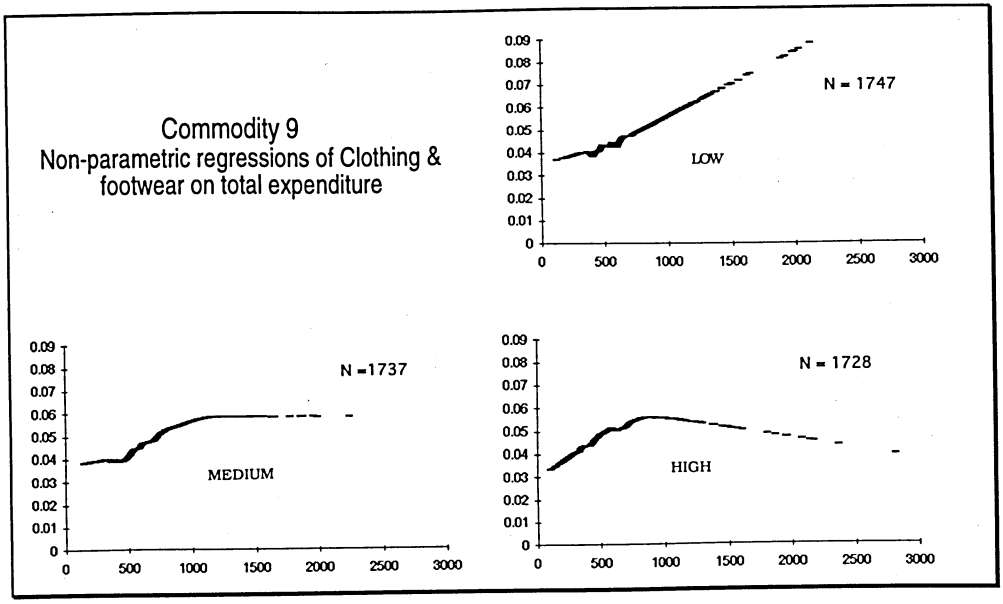



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



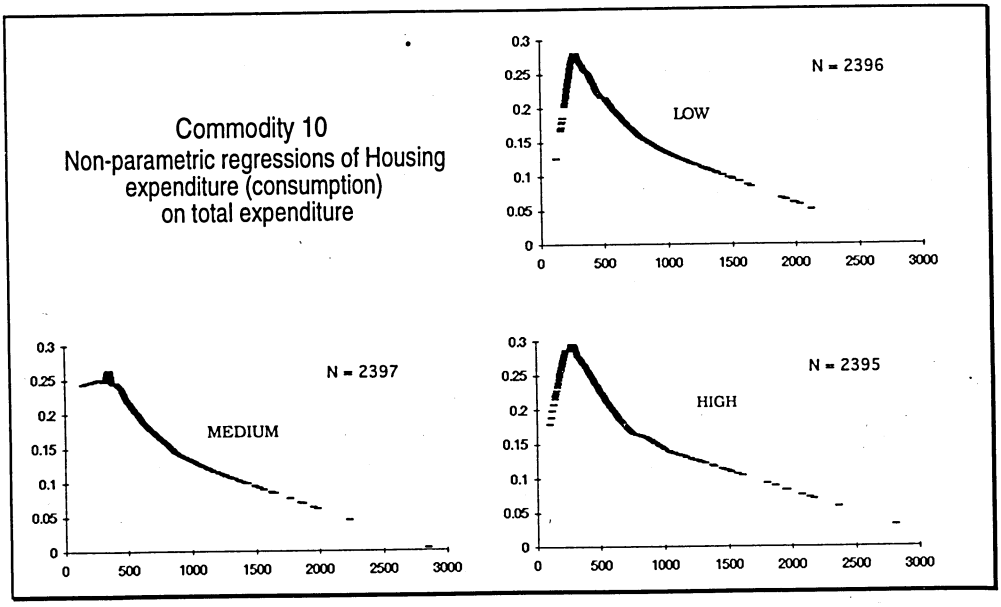
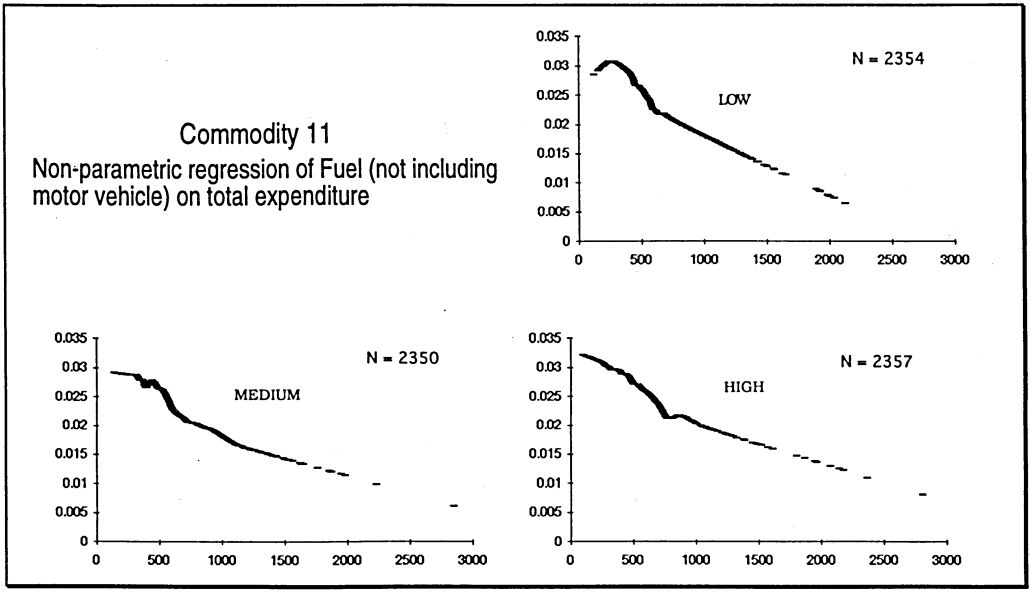



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



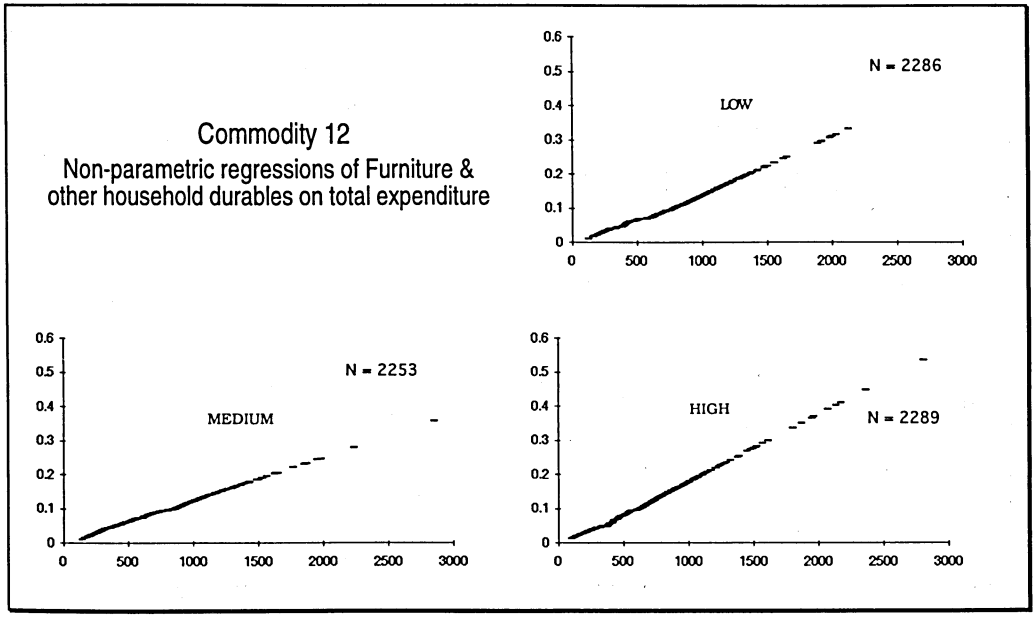
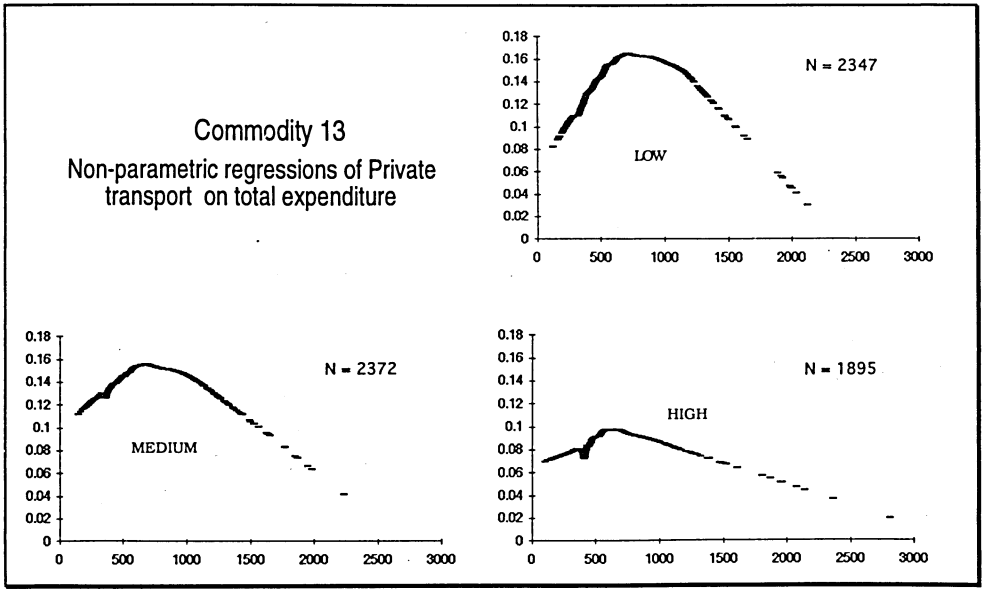



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



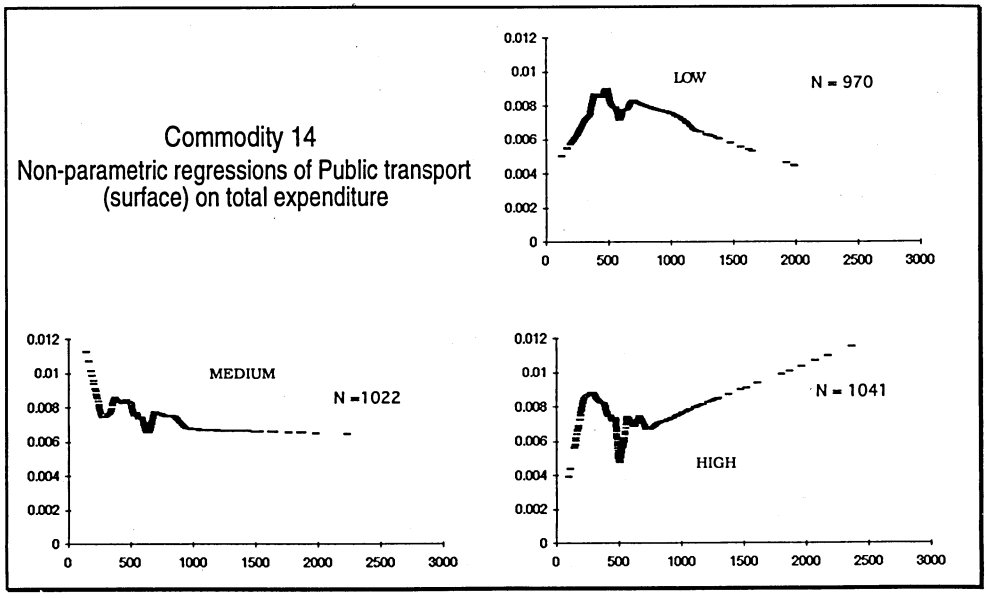
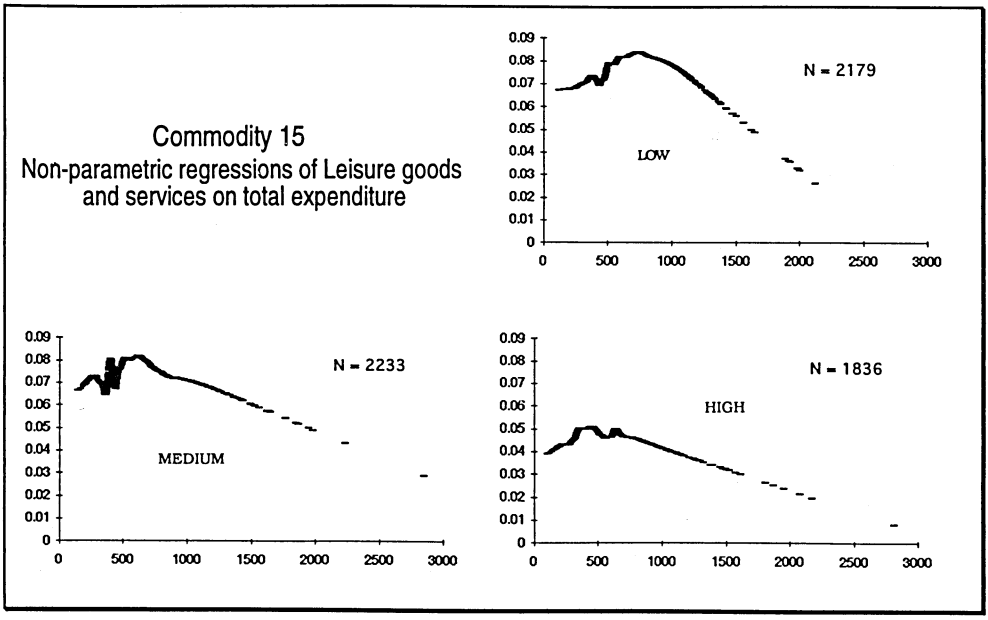



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



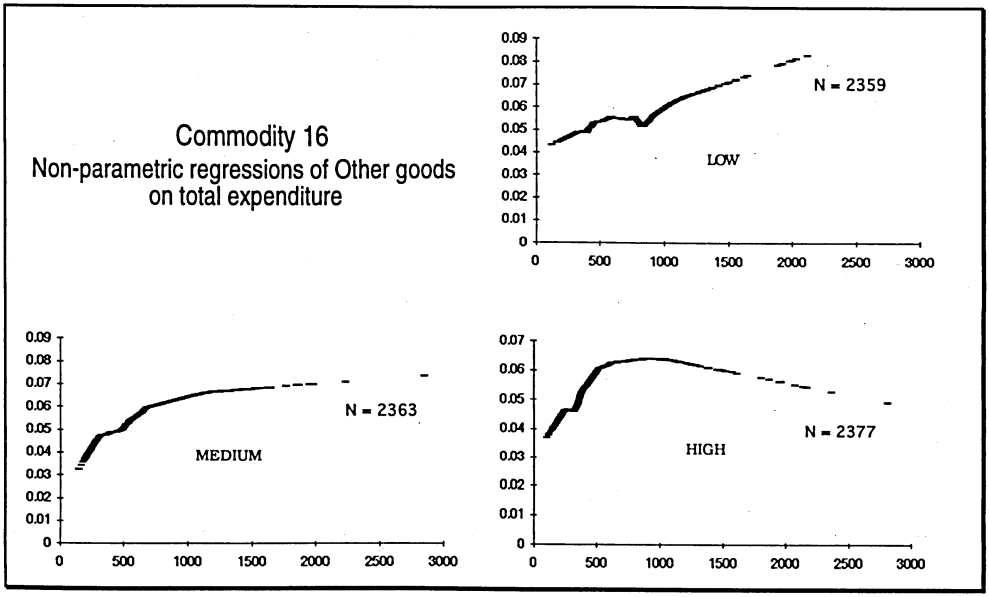
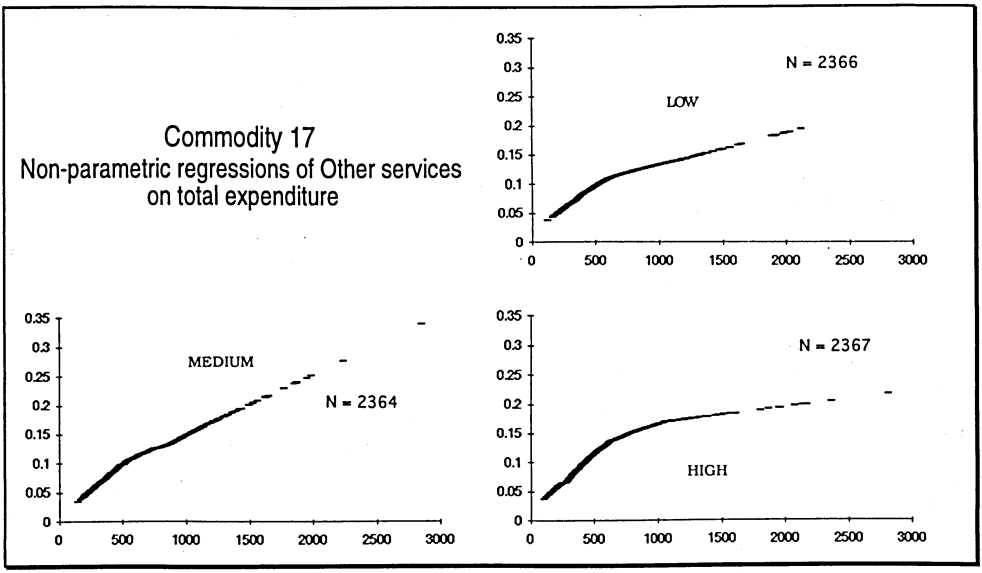
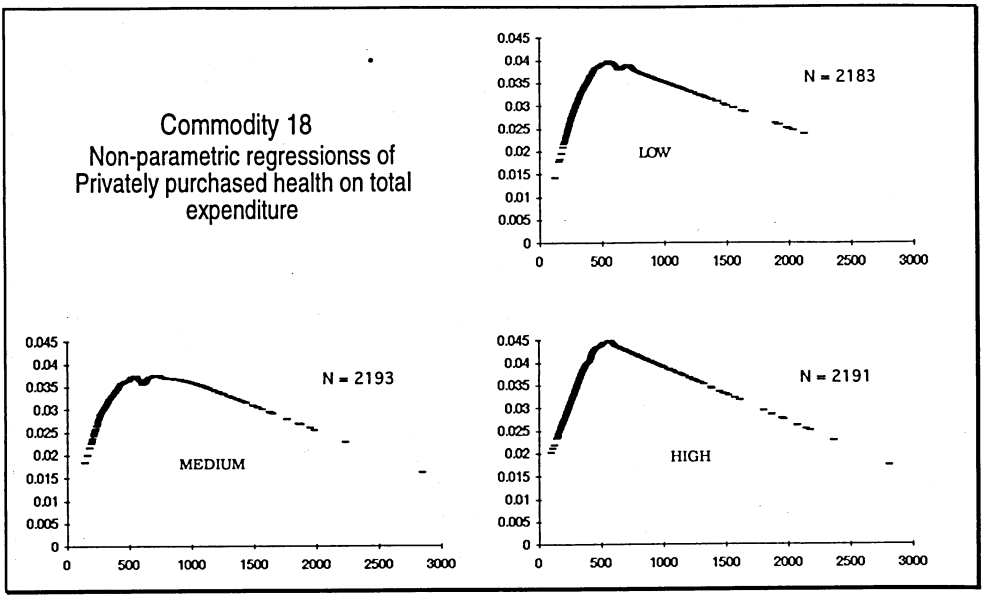



*Figure 3.6: Budget Share Regressions by Three Demographic Groups (continued)*



## *References*


Barten, A.P. (1964) "Family Composition, Prices and Expenditure Patterns". In P.E. Hart, G. Mills and J.K. Whitaker (eds), *Econometric Analysis for National Economic Planning*, 16th Symposium of the Colston Society (London: Butterworths).

Barten, A.P. (1968) "Estimating Demand Equations", *Econometrica*, Vol. 36, No. 2 (April), pp. 213-251.

Chatterjee, S. and R. Ray (1992) "Estimating Complete Demand Systems on Household Budget Data: Evidence for Australia and New Zealand", University of Western Australia, Department of Economics, Discussion Paper No. 92.12 (July).

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", Monash University, *Department of Econometrics Working Paper* No. 11/92 (September).

Cooper, R.J., K.R. McLaren and Priya Parameswaran (1994) "A System of Demand Equations Satisfying Effectively Global Curvature Conditions", *Economic Record* Vol. 70, No. 208, pp. 26-35 (March).

Deaton, A. and J. Muellbauer (1980) "An Almost Ideal Demand System." *American Economic Review*, Vol. 70, pp. 312-326.

Dhrymes, Phoebus J. (1970)*Econometrics* (New York: Harper and Row), pp. 65-71.

Lee, Lung-Fei and Mark M. Pitt (1986) "Microeconometric Demand Systems with Binding Nonnegativity Constraints: The Dual Approach", *Econometrica*, Vol. 54, No. 5, pp. 1237-1242 (September).

Lewbel, A. (1991) "The Rank of Demand Systems: Theory and Nonparametric Estimation", *Econometrica*, Vol. 59, No. 3 (May), pp. 711-730.

Muellbauer, J. (1977) "Testing the Barten Model of Household Compositional Effects and the Cost of Children", *Economic Journal*, Vol. 87, pp. 460-487.

Pollak, R.A. and T. J. Wales (1981) "Demographic Variables in Demand Analysis", *Econometrica*, Vol. 49, No. 6, pp.1533-1551.

Pollak, R.A. and T. J. Wales (1992) *Demand Systems Specification and Estimation* (Oxford University Press).

Pudney, Stephen (1989) "Zero Expenditures and Corner Solutions", Ch. 4 in his *Modelling Individual Choice —The Econometrics of Corners, Kinks and Holes*, pp. 138-186, (Oxford: Basil Blackwell).

Ray, R. (1980) "Analysis of a Time Series of Household Expenditure Surveys for India.", *Review of Economics and Statistics*, Vol. 62, No. 4, pp. 595-602.

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

Rimmer, Maureen T. and Alan A. Powell (1992b) "Demand Patterns across the Development Spectrum, *Impact Project Preliminary Working Paper* No. OP-75, Monash University, Clayton, Vic., Australia, October.

Rimmer, Maureen T. and Alan A. Powell (1993) "The Inclusion of Demographics in Household Demand Systems", Monash University, Impact Project, unpublished research memorandum.

Stone, Richard (1954) "Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand", *Economic Journal* 64 (255): 511-527 (September).

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 and Chicago: Rand-McNally).

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

Wales, T.J. and A.D. Woodland (1983) "Estimation of Consumer Demand Systems with Binding Non-Negativity Constraints" *Journal of Econometrics*, Vol. 21, pp. 263-285, (North-Holland).

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

Appendix 1: *Mapping of HES Commodities into the Aggregated Commodities of Table 1*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 101 | Rent payments (selected dwelling) | 10 |
| 102 | Mortgage payments – interest component | 21 |
| 103 | Water and sewerage rates (selected dwelling) | 10 |
| 104 | General rates (selected dwelling) | 10 |
| 105 | House and contents insurance (selected dwelling) | 10 & 12 |
| 106 | Repairs and maintenance – payments to contractors (materials and labour) (selected dwelling) | 10 |
| 107 | Repairs and maintenance – materials only (selected dwelling) | 10 |
| 108 | Interest payments on loans for alterations and additions (selected dwelling) | 21 |
| 109 | Body corporate payments (selected dwelling) | 10 |
| 121 | Electricity (selected dwelling) | 11 |
| 122 | Electricity (other dwellings) | 11 |
| 123 | Mains gas | 11 |
| 125 | Bottled gas | 11 |
| 126 | Heating oil | 11 |
| 127 | Kerosene and paraffin | 11 |
| 128 | Wood (for fuel) | 11 |
| 129 | Fuels, n.e.c. | 11 |
| 151 | Bread – home delivered | 1 |
| 152 | Bread – not home delivered | 1 |
| 153 | Flour | 1 |
| 154 | Cakes, tarts and puddings (fresh or frozen) | 1 |
| 155 | Biscuits | 1 |
| 156 | Cake, biscuit, pudding and bread mixes | 1 |
| 157 | Breakfast cereals | 1 |
| 158 | Pasta (spaghetti, noodles, etc.) | 1 |
| 159 | Rice | 1 |
| 160 | Cereals, n.e.c. | 1 |
| 161 | Ham | 2 |
| 162 | Bacon | 2 |
| 163 | Canned meat (other than bacon and ham) | 2 |
| 164 | Sausages (not continental) | 2 |
| 165 | Processed meat (frozen) | 2 |
| 166 | Processed meat (not frozen or canned) | 2 |
| 167 | Beef and veal | 2 |
| 168 | Mutton and lamb | 2 |
| 169 | Pork (excl. bacon and ham) | 2 |
| 170 | Poultry | 2 |
| 171 | Game | 2 |
| 172 | Offal | 2 |
| 173 | Meat not processed, n.e.c. | 2 |
| 174 | Meat, undefined | 2 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 175 | Fresh fish and other fresh seafood | 2 |
| 176 | Frozen fish and other frozen seafood | 2 |
| 177 | Canned and bottled fish and other canned and bottled seafood | 2 |
| 178 | Processed fish and other processed seafood, n.e.c. | 2 |
| 180 | Fresh eggs | 3 |
| 181 | Fresh milk and cream – home delivered | 3 |
| 182 | Fresh milk and cream – not home delivered | 3 |
| 183 | Cheese | 3 |
| 184 | Butter | 3 |
| 185 | Powdered milk | 3 |
| 186 | Dairy products and eggs, n.e.c. | 3 |
| 187 | Margarine | 3 |
| 188 | Edible oils and fats, n.e.c. | 3 |
| 189 | Fresh citrus fruit | 5 |
| 190 | Fresh stone fruit | 5 |
| 191 | Fresh apples and pears | 5 |
| 192 | Fresh fruit, n.e.c. | 5 |
| 193 | Fresh fruit, undefined | 5 |
| 194 | Canned, frozen and bottled fruit | 5 |
| 195 | Dried fruit | 5 |
| 197 | Nuts | 5 |
| 198 | Fresh potatoes | 5 |
| 199 | Fresh onions | 5 |
| 200 | Fresh root vegetables, n.e.c. | 5 |
| 201 | Fresh tomatoes | 5 |
| 202 | Fresh vegetables, n.e.c. | 5 |
| 203 | Fresh vegetables, undefined | 5 |
| 204 | Frozen vegetables | 5 |
| 205 | Other processed vegetables | 5 |
| 207 | Sugar | 4 |
| 208 | Marmalades, jams and conserves | 4 |
| 209 | Honey | 4 |
| 210 | Syrups | 4 |
| 211 | Jellies and desserts n.e.c. | 4 |
| 212 | Potato crisps and other savoury confectionery | 4 |
| 213 | Chocolate confectionery | 4 |
| 214 | Ice confectionery | 4 |
| 215 | Other confectionery | 4 |
| 216 | Tea (packaged) | 6 |
| 217 | Coffee (packages) | 6 |
| 218 | Canned and packeted soup | 6 |
| 219 | Proprietary food drinks, n.e.c. | 6 |
| 220 | Spices and herbs | 6 |
| 221 | Sauces and salad dressings | 6 |
| 222 | Spreads and mixes, n.e.c. | 6 |
| 223 | Food additives, n.e.c. | 6 |
| 224 | Baked beans and canned spaghetti | 6 |
| 225 | Canned and bottled baby foods | 6 |
| 226 | Frozen prepared meals | 6 |
| 227 | Prepared meals, n.e.c. | 6 |
| 229 | Food, n.e.c. | 6 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 230 | Food, undefined | 6 |
| 231 | Soft drings and aerated waters | 6 |
| 232 | Fruit juice | 6 |
| 233 | Vegetable juice | 6 |
| 234 | Juices, undefined | 6 |
| 235 | Cordials | 6 |
| 236 | Milk based beverages, not packaged/boxed n.e.c. | 6 |
| 237 | Non-alcoholic beverages, undefined | 6 |
| 238 | Meals in restaurants, hotels, clubs, etc. | 6 |
| 239 | Snacks, take-away food (not frozen) | 6 |
| 240 | School lunch money | 6 |
| 261 | Beer for consumption off licensed premises | 7 |
| 262 | Beer for consumption on licensed premises | 7 |
| 263 | Beer, undefined | 7 |
| 264 | Wine for consumption off licensed premises | 7 |
| 265 | Wine for consumption on licensed premises | 7 |
| 266 | Wine, undefined | 7 |
| 267 | Spirits for consumption off licensed premises | 7 |
| 268 | Spirits for consumption on licensed | 7 |
| 269 | Spirits, undefined | 7 |
| 270 | Alcoholic beverages, n.e.c. for consumption off licensed premises | 7 |
| 271 | Alcoholic beverages, n.e.c. for consumption on licensed premises | 7 |
| 272 | Alcoholic beverages, undefined | 7 |
| 281 | Cigarettes | 8 |
| 282 | Other tobacco | 8 |
| 283 | Other tobacco items | 8 |
| 301 | Suits, men's | 9 |
| 302 | Coats, men's | 9 |
| 303 | Trousers, men's (excl. jeans) | 9 |
| 304 | Jeans, men's | 9 |
| 305 | Cardigans, jumpers, sweaters and pullovers, men's | 9 |
| 306 | Shirts, men's | 9 |
| 307 | Singlets, underpants and briefs, men's | 9 |
| 308 | Sleepwear, men's | 9 |
| 309 | Men's clothing, n.e.c. | 9 |
| 310 | Men's clothing, undefined | 9 |
| 311 | Dresses, suits, skirts, trousers, women's (excl. jeans) | 9 |
| 312 | Jeans, women's | 9 |
| 313 | Coats, women's | 9 |
| 314 | Cardigan, jumpers, pullovers, sweaters, twinsets, etc., women's | 9 |
| 315 | Foundation garments | 9 |
| 316 | Singlets, spencers, slips, petticoats, briefs and underpants, women's | 9 |
| 317 | Sleepwear, women's | 9 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 318 | Women's clothing, n.e.c. | 9 |
| 319 | Women's clothing, undefined | 9 |
| 320 | Boys' singlets, underpants, briefs and sleepwear | 9 |
| 321 | Boys' clothing, n.e.c. | 9 |
| 322 | Girls' singlets, spencers, slips, petticoats, briefs, underpants and sleepwear | 9 |
| 323 | Girl's clothing, n.e.c. | 9 |
| 324 | Infant's clothing | 9 |
| 325 | Children's and infants' clothing, undefined | 9 |
| 326 | Men's hosiery | 9 |
| 327 | Women's hosiery | 9 |
| 328 | Children's and infant's hosiery | 9 |
| 329 | Hats and other reference headwear | 9 |
| 330 | Clothing accessories (e.g. ties, gloves, handkerchiefs) | 9 |
| 331 | Clothing materials | 9 |
| 332 | Haberdashery | 9 |
| 333 | Clothing n.e.c. and undefined | 9 |
| 334 | Men's footwear | 9 |
| 335 | Women's footwear | 9 |
| 336 | Children's and infants' footwear | 9 |
| 337 | Footwear, undefined | 9 |
| 338 | Dry cleaning and laundering of clothes | 18 |
| 339 | Clothing repairs | 18 |
| 340 | Footwear repairs | 18 |
| 341 | Hire of clothing and footwear | 18 |
| 351 | Kitchen furniture | 12 |
| 352 | Bedroom furniture | 12 |
| 353 | Lounge and dining room furniture | 12 |
| 354 | Outdoor and garden furniture | 12 |
| 355 | Other furniture | 12 |
| 356 | Carpets | 12 |
| 357 | Floor rugs, mats and matting | 12 |
| 358 | Vinyl and other sheet floor coverings | 12 |
| 359 | Floor tiles | 12 |
| 360 | Bed linen | 12 |
| 361 | Blankets and travelling rugs | 12 |
| 362 | Bedspreads and continental quilts | 12 |
| 363 | Pillows and cushions | 12 |
| 364 | Towels and face washers | 12 |
| 365 | Table and kitchen linen | 12 |
| 366 | Curtains | 12 |
| 367 | Blinds | 12 |
| 368 | Other household textiles | 12 |
| 369 | Paintings, carvings and sculptures | 12 |
| 370 | Other furnishings and ornaments | 12 |
| 371 | Cooking stoves, ovens, hot plates and | 12 |
| 372 | Refrigerators and freezers | 12 |
| 373 | Washing machines | 12 |
| 374 | Air-conditioners | 12 |
| 375 | Dishwashers | 12 |
| 376 | Clothes dryers | 12 |
| 377 | Other electrical household appliances | 12 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 378 | Other non-electrical household appliances | 12 |
| 380 | Tableware (e.g. crockery) | 12 |
| 381 | Glassware | 12 |
| 382 | Cutlery | 12 |
| 383 | Cooking utensils | 12 |
| 384 | Cleaning utensils | 12 |
| 385 | Kitchen utensils, n.e.c. | 12 |
| 386 | Lawnmowers (incl. electric) | 12 |
| 387 | Gardening tools | 12 |
| 388 | Other tools | 12 |
| 389 | Household durables, n.e.c. and undefined | 12 |
| 401 | Nails, screws and other fasteners | 10 |
| 402 | Household soaps and detergents | 17 |
| 403 | Household polishers | 17 |
| 404 | Other household cleaning agents | 17 |
| 405 | Paper products (tissue paper, serviettes, toilet paper) | 17 |
| 406 | Trees, shrubs and plants | 17 |
| 407 | Gardening products, n.e.c. | 17 |
| 408 | Swimming pool chemicals | 17 |
| 409 | Household non-durables, n.e.c. | 17 |
| 410 | Household non-durables, undefined | 17 |
| 411 | Postal charges | 18 |
| 412 | Telephone telegram charges | 18 |
| 413 | Pest control services | 18 |
| 414 | Gardening services | 18 |
| 415 | Housekeeping and cleaning services (including ironing) | 18 |
| 416 | Household services, n.e.c. | 18 |
| 417 | Child care services – institution | 18 |
| 418 | Child care services, n.e.c. | 18 |
| 419 | Child care services, undefined | 18 |
| 421 | Carpet cleaning | 18 |
| 423 | Repair and maintenance of soft furnishings | 12 |
| 424 | Repair and maintenance of household appliances | 12 |
| 425 | Repair and maintenance of tools | 10 |
| 426 | Repair and maintenance of household durables, n.e.c. | 12 |
| 428 | Hire of tools | 10 |
| 430 | Hire of household durables, n.e.c. | 12 |
| 431 | Household appliance repairs insurance | 12 |
| 451 | Hospital, medical and dental insurance | 19 |
| 452 | Ambulance insurance (separate insurance) | 19 |
| 453 | Sickness and personal accident insurance | 19 |
| 454 | General practitioner doctor's fees | 19 |
| 455 | Specialist doctor's fees | 19 |
| 456 | Dental charges | 19 |
| 457 | Optician's fees (including spectacles) | 19 |
| 458 | Practitioner's fees, n.e.c. | 19 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 459 | Prescriptions | 19 |
| 460 | Proprietary pain relievers (powders, liquids and tables etc.) | 19 |
| 461 | Proprietary ointments and lotions | 19 |
| 462 | Proprietary medicines, n.e.c. | 19 |
| 463 | Creams, tablets and medicines, undefined | 19 |
| 464 | Surgical dressings | 19 |
| 465 | Therapeutic appliances and equipment | 19 |
| 466 | Pharmaceutical products, n.e.c. | 19 |
| 467 | Medicines, pharmaceutical products, undefined | 19 |
| 468 | Hospital charges | 19 |
| 469 | Health charges, n.e.c. | 19 |
| 501 | Purchase of motor vehicle (other than motor cycle) | 13 |
| 502 | Purchase of motor cycle | 13 |
| 503 | Purchase of caravan (other than selected dwelling) | 13 |
| 504 | Purchase of trailer | 13 |
| 505 | Purchase of iicycle | 13 |
| 506 | Petrol | 13 |
| 507 | Diesel fuel | 13 |
| 508 | LPG and other gas fuels | 13 |
| 509 | Oils, lubricants and additives | 13 |
| 510 | Compulsory registration and insurance of motor vehicle (other than motor cycle) | 13 |
| 511 | Other insurance of motor vehicle (other than motor cycle) | 13 |
| 512 | Compulsory legistration and insurance of motor cycle, caravan and trailer | 13 |
| 513 | Other insurance of motor sysle, caravan and trailer | 13 |
| 514 | Batteries | 13 |
| 515 | Tyres and tubes | 13 |
| 516 | Motor vehicle electrical accessories (purchased separately) | 13 |
| 517 | Vehicle parts, n.e.c. (purchased | 13 |
| 518 | Vehicle accessories, n.e.c. (purchased separately) | 13 |
| 519 | Crash repairs | 13 |
| 520 | Vehicle servicing (including parts and labour) | 13 |
| 521 | Driver's licence | 13 |
| 522 | Parking fees | 13 |
| 523 | Driving lessons | 13 |
| 524 | Subscriptions to motor organisations | 13 |
| 525 | Vehicle hire and leasing expenses (non-holiday) | 13 |
| 526 | Vehicles charges, (including hire of accessories n.e.c.) | 13 |
| 527 | Rail fares | 14 |
| 528 | Bus and tram fares | 14 |
| 529 | Water transport fares | 14 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 530 | Combines bus/tram/rail/ferry fares | 14 |
| 531 | Public transport fares, undefined | 14 |
| 532 | Taxi fares | 14 |
| 533 | Air fares | 15 |
| 534 | Removalist fees | 18 |
| 535 | Freight charges, n.e.c. | 18 |
| 551 | Television | 12 |
| 552 | Television aerial | 12 |
| 553 | Radio, stereo, hifi equipment | 12 |
| 554 | Video cassette recorder and equipment | 12 |
| 555 | Home computer equipment | 12 |
| 556 | TV games | 12 |
| 557 | Blank video cassettes | 12 |
| 558 | Pre-recorded video cassettes and discs | 12 |
| 559 | Records (audio) | 12 |
| 560 | Audio-cassettes and tapes | 12 |
| 561 | Electronic components, n.e.c. and undefined | 12 |
| 563 | Books | 12 |
| 564 | Newspapers (excluding specialist newspaper type magazines) | 17 |
| 565 | Magazines and comics | 17 |
| 566 | Other printed material | 17 |
| 567 | Photographic equipment | 16 |
| 568 | Photographic film and chemicals (including developing) | 17 |
| 569 | Sunglasses (excluding optical) | 17 |
| 570 | Optical goods n.e.c. | 16 |
| 571 | Studio and other professional photography | 18 |
| 572 | Musical instruments and accessories | 16 |
| 573 | Purchase of boat | 16 |
| 574 | Boat parts and accessories | 16 |
| 575 | Aeroplane purchase, parts and operation (including registration etc.) | 16 |
| 576 | Toys | 16 |
| 577 | Camping equipment | 16 |
| 578 | Sports equipment, n.e.c. | 16 |
| 579 | Recreational equipment, n.e.c. | 16 |
| 580 | Lottery tickets | 16 |
| 581 | Lotto type games and instant lotteries (scratch cards) | 16 |
| 582 | TAB, on course betting, etc. | 16 |
| 583 | Poker machines and ticket machines | 16 |
| 584 | Blackjack, roulette and other Casino-type games | 16 |
| 585 | Gambling, n.e.c. | 16 |
| 586 | Gambling, undefined | 16 |
| 587 | Hire of television | 12 |
| 588 | Hire of video cassette recorder | 12 |
| 589 | Hire of video cassette tape | 12 |
| 590 | Membership of video cassette libraries | |
| 591 | Repairs to audio-visual equipment | 12 |
| 592 | Repair insurance for audio-visual equipment | 12 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 593 | Repair of optical | 16 |
| 594 | Repair of sports equipment | 16 |
| 595 | Repair of other recreational equipment | 16 |
| 596 | Registration and insurance of boat | 16 |
| 597 | Heaalth and fitness studio charges | 16 |
| 598 | Sporting club subscriptions | 16 |
| 599 | Squash court hire charges | 16 |
| 600 | Ten pin bowling charges | 16 |
| 601 | Skiing fees and fares | 16 |
| 602 | Green fees (golf, bowls, croquet, etc.) | 16 |
| 603 | Sports lessons | 16 |
| 604 | Sports equipment hire | 16 |
| 605 | Hire of other recreational equipment | 16 |
| 606 | Sports services charges, n.e.c. | 16 |
| 607 | Spectator admission fees to sport | 16 |
| 608 | Cinema admission charges | 16 |
| 609 | Live theotre admission charges | 16 |
| 610 | Admission fees and cover charges (dances, night clubs, etc.) | 16 |
| 611 | National park and zoo fees | 16 |
| 612 | Art gallery and museum fees | 16 |
| 613 | Day trips and other excursions, n.e.c. | 16 |
| 614 | Amusement arcade machines | 16 |
| 615 | Club and association subscriptions (excl. sports clubs) | 16 |
| 616 | Cultural and other non-sporting lessons | 16 |
| 617 | Entertainment and recreation charges, n.e.c. and undefined | 16 |
| 619 | Animal purchases | 17 |
| 620 | Animal food | 17 |
| 621 | Veterinary charges | 18 |
| 622 | Anamil minding charges | 18 |
| 623 | Animal charges and expenses, n.e.c. | 18 |
| 624 | Air fares (Aust. holiday) | 16 |
| 625 | Rail fares (Aust. holiday) | 16 |
| 626 | Bus fares (Aust. holiday) | 16 |
| 627 | Other fares (including vehicle hire) (Aust. holiday) | 16 |
| 628 | Holiday petrol (for holidays of 4 or more nights) (Aust. holiday) | 16 |
| 629 | Motel and hotel charges (Aust. holiday) | 16 |
| 630 | Holiday flat and house charges (Aust. holiday) | 16 |
| 631 | Caravan park fees and hire of caravan (Aust. holiday) | 16 |
| 632 | Other accommodation charges (Aust. holiday) | 16 |
| 633 | Airfare inclusive package tours (Aust. holiday) | 16 |
| 634 | Other package tours (Aust. holiday) | 16 |
| 635 | Air fares (overseas holidays) | 16 |
| 636 | Other fares (overseas holidays) | 16 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 637 | Motel and hotel charges (overseas holidays) | 16 |
| 638 | Other accommodiation charges (overseas holidays) | 16 |
| 639 | Airfare inclusive package tours (overseas holidays) | 16 |
| 640 | Other package tours (overseas holidays) | 16 |
| 661 | Toothpaste, toothbrushes and other oral hygiene products | 17 |
| 662 | Toilet soap | 17 |
| 663 | Talcum powders and deodorants | 17 |
| 664 | Toiletries and cosmetics, n.e.c. | 17 |
| 665 | Shavers, hairdryders and other personal | 17 |
| 666 | Hair services (male) | 18 |
| 667 | Hair services (female) | 18 |
| 668 | Hair services(undefines) | 18 |
| 669 | Other personal care services | 18 |
| 701 | Watches and clocks | 17 |
| 702 | Jewellery, n.e.c. | 17 |
| 703 | Travel goods, handbags, umbrellas, wallets, etc. | 17 |
| 704 | Pens, paper, stationery and writing pads | 17 |
| 705 | Stationery equipment, n.e.c. | 17 |
| 706 | Ice | 17 |
| 707 | Miscellaneous commoodities, n.e.c. | 17 |
| 708 | Interest payments on fixed term loans | 18 |
| 709 | Interest payments on credit card purchases (commodities and services) | 18 |
| 710 | Interest payments on credit caard cash advances | 18 |
| 711 | Primary school fees (government) | 18 |
| 712 | Primary school fees (independent) | 18 |
| 713 | Secondary school fees (government) | 18 |
| 714 | Secondary school fees (independent) | 18 |
| 715 | Tertiary education fees | 18 |
| 716 | Fees ppaid to other educational institutions | 18 |
| 717 | Private education tuition fees | 18 |
| 718 | Payments for other property – general council rates | 18 |
| 719 | Other payments for other property | 18 |
| 720 | Government duties and charges (separately identified) | 18 |
| 721 | Financial institution charges n.e.c. | 18 |
| 722 | Alimony and maintenence payments | 21 |
| 723 | Cash gifts and donations to charity | 18 |
| 724 | Pocket money and allowances | 21 |
| 725 | Union dues and professional association subscriptions | 21 |
| 726 | Legal fees | 18 |
| 727 | Fees, n.e.c. | 18 |
| 728 | Fines | 21 |

*continued ...*

| HES no. | HES Description | Aggregated Commodity of Table 1 |
|---|---|---|
| 729 | Personal belongings insurance | 18 |
| 731 | Personal advertising | 18 |
| 732 | Non-holiday Accommodation | 21 |
| 734 | Repair of miscellaneous commodities | 18 |
| 735 | Miscellaneous services, n.e.c. | 18 |
| 751 | Income tax | 21 |
| 752 | Mortgage payments – principal (selected dwelling) | 20 |
| 753 | Principal component of mortgage payment for other property | 20 |
| 754 | Purchase of selected dwelling/property (excl mrtg paymts, incl outright purch/depos/net sale | 20 |
| 755 | Additions and extensions | 20 |
| 756 | Interral renovations | 20 |
| 757 | Insulation | 20 |
| 758 | Inground swimming pool | 20 |
| 759 | Outside building | 20 |
| 760 | Landscape contractor | 20 |
| 761 | Outside improvements, n.e.c. | 20 |
| 762 | Capital housing costs, n.e.c. | 20 |
| 771 | Superannuation and annuities | 18 |
| 772 | Life insurance | 18 |

LIBRARY
MAR 20 1995
GIANNINI FOUNDATION OF
AGRICULTURAL ECONOMICS