I.P

IMPACT OF DEMOGRAPHIC CHANGE ON INDUSTRY STRUCTURE IN AUSTRALIA

A joint study by the Australian Bureau of Statistics, the Department of Employment and Industrial Relations, the Department of Environment, Housing and Community Development, the Department of Industry and Commerce and the Industries Assistance Commission

STRUCTURAL CHANGE AND PRIVATE CONSUMPTION : EVIDENCE FROM THE 1974-75 HOUSEHOLD EXPENDITURE SURVEY

by

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General Paper No. G-15 Melbourne December 1978

The views expressed in this paper do not necessarily reflect the opinions of the participating agencies, nor of the Australian government.

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26. An offsetting factor would be the relative increase in wage rates for young persons and females over the period 1971-72 to 1974-75.

27. Note that household types 6 and 8 are affected by unemployment amongst both young adults and married women. Single persons aged less than 30 years make up only about 20 per cent of household type 1.

28. Using weighted estimates of marginal and average budget shares for 1974-75, the estimated "income" elasticities for each commodity are: Food 0.535, Cigarettes and Alcohol 0.877, Clothing 1.281, Housing 0.827, Medical 0.732, Transport 0.760, Luxuries 1.549.

29. Similar conclusions were reached with U.S. data by Houthakker and Taylor (1970), p.280, and by Lluch, Powell and Williams (1977), p.119, with Korean data.

STRUCTURAL CHANGE AND PRIVATE CONSUMPTION : EVIDENCE FROM THE 1974-75 HOUSEHOLD EXPENDITURE SURVEY*

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Using data from the 1974-75 Household Expenditure Survey, estimates of marginal budget shares and "subsistence" expenditures are obtained for thirteen household types chosen on the basis of household composition and age of head. The survey data are reconciled with the national accounts estimates of expenditures, and the adjusted parameter estimates are used to predict national consumption expenditures over the period 1966-67 to 1975-76. The predictions are sensitive to demographic and other structural changes which occurred in the Australian economy over this decade.

I. INTRODUCTION

The influence of demographic and other structural changes on consumption patterns can be detected with reasonable precision only by using cross-section data. To date, analyses of the consumption behaviour of different types of Australian households have been limited to data collected in the 1966-68 household survey undertaken by Macquarie University.[1)] Marked differences in consumption patterns were apparent, and it is one aim of this paper to update previous work by using data from the 1974-75 Household Expenditure Survey (HES) conducted by the Australian Bureau of Statistics. But this paper takes the analysis further and attempts to use the cross-section data to measure the extent to which structural changes in the Australian economy over the decade 1966-67 to 1975-76 affected consumption patterns.

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* This study was carried out in collaboration with the Industries Assistance Commission, Melbourne, as part of the IMPACT project. The views expressed in this paper do not necessarily reflect the opinions of the participating agencies, nor of the Australian government. The data used in this analysis were supplied in computer usable form by the Australian Bureau of Statistics. Particular thanks are due to Tony Wood, Director of the Household Expenditure Survey Section, ABS. The computations, were ably carried out by Alexandra Strzelecki. The work has benefited from discussions with Alan Powell and Ashok Tulpule.

The importance of different consumption behaviour across household types depends on three factors, namely, the magnitudes of the parameter differences, the proportion of households of each type, and relative income or total consumption levels. Each of these factors is examined in turn.

First, a linear demand model based on the Klein-Rubin utility function is fitted to the 1974-75 HES data. Households in the survey are subdivided into various types based on household composition and age of the household head. Separate parameter estimates are presented for thirteen household types and important differences noted. The cross-section data and parameter estimates are then tied to the national accounts such that the model projects exactly the allocation of national private consumption expenditure in the year of the survey.

Next, the adjusted model is used to project the allocation of national consumption over the period 1966-67 to 1975-76 under alternative assumptions about the number of households of each type. By estimating the parameters within a demand systems context estimates of price responses are available for projecting over time. The importance of demographic shifts is measured by comparing the prediction errors based on a 1974-75 demographic structure with those based on the "actual" demographic structure.

Finally, the effects on consumption patterns of changes in income shares resulting from changes in pension payments, unemployment levels and other structural shifts are examined.

15. In no other case was the exclusion of this income class of such importance.

16. In calculating estimates of the Frisch parameter, the following average family sizes are used: type 3, 3.61; type 7, 3.44; type 9, 1.68. Other values are as in table 3.

17. All national accounts data are taken from ABS, Australian National Accounts National Income and Expenditure, 1975-76. The price indexes are rebased from 1966-67 to the year of the HES.

18. See ABS, Social Indicators, No.1, 1976, p.6.

19. Using revised population estimates as at September 1977. The population estimate for June 1971 was revised upwards by 1.4 per cent in the light of the 1976 census results (see ABS, Population and Vital Statistics (Preliminary), September 1977, (Ref.No.3211.0)). Underestimation of households in 1971 would have been greater because single and two person households are more likely to be understated than are larger households.

20. The forecasts would be unaffected by a constant scaling of household numbers in each year (this would involve re-working the estimates in section VI). However, if the rate of change in households numbers is over-estimated, the rate of change in mean household consumption is under-estimated and this affects predictions.

21. Taken from ABS, Population and Vital Statistics (Preliminary) September 1977 (Ref. No. 3211.0). Population estimates for 1966-71 have been revised upwards by 1.4 per cent to reflect under-estimation at the 1971 census.

22. This is consistent with our findings in sections IV and V. Further evidence of changing parameter values was provided by time-series estimation of ELES (with fixed coefficients) using annual national accounts data. Convergence was difficult to achieve and the parameter estimates were unacceptable (for example, negative β_i-values occurred).

23. ABS, Social Indicators, No.1, 1976, p.6.

24. See ABS, Social Indicators, No.1, 1976, p.73.

25. The only additional quantitative evidence available is that from the two income surveys conducted by the ABS in 1968-69 and 1973-74 (see ABS, Income Distribution, 1968-69, Consolidated and Revised Edition, Ref. No. 6505.0, and ABS, Income Distribution, 1973-74, Part 2, Ref. No. 6503.0). However, definitional differences, exclusion of single person households, and the fact that only gross income is recorded make them of little use for our purposes.

Footnotes

1. See, for example, Podder (1971), Kakwani (1976), Williams (1977,1978).

2. This was first proposed by Summers (1959).

3. See, for example, Maddala (1977), p.235.

4. For details, see Powell (1974), Lluch, Powell and Williams (1977), chapter 2, and Williams (1977, 1978).

5. This approach was used by Ryan (1976), and Williams (1977, 1978).

6. In ABS, Household Expenditure Survey, 1975-76 (Preliminary) (Ref. No. 6508.0) the estimated average family size was 3.07 for capital cities and 3.09 for Australia as a whole.

7. See Williams (1977), p.14.

8. Restaurant meals include expenditure on alcohol where this can not be separately identified.

9. The highest value of μ reported in Williams (1977) is 0.50; the lowest value of $-\omega$ was 15!

10. The estimate of $\Sigma\gamma_j^*$, $\Sigma\hat{\gamma}_j^*$ say, is treated as a constant in calculation of standard errors. That is,

$$\text{var } \hat{\gamma}_i = \text{var } \hat{\alpha} + 2(\Sigma\hat{\gamma}_j^*) \text{ cov } (\hat{\alpha}_i, \hat{\beta}_i) + (\Sigma\hat{\gamma}_j^*)^2 \text{ var } \hat{\beta}_i.$$

It follows that the reported standard errors will underestimate the "true" values.

11. See, for example, Lluch, Powell and Williams (1977), p.18.

12. An ABS, Household Expenditure Survey, 1975-76, Preliminary (Ref. No. 6508.0), p.5, average consumption expenditure for all Australian households (excluding localities with a population of less than 500) was estimated to be about 6 per cent below the figure for households living in the capital cities.

13. No re-estimation is required. The Engel curve estimates may be added across commodities.

14. Aggregation of parameter estimates was undertaken in the manner described in Lluch, Powell and Williams (1977), p.117. Selection of 9 household types facilitated the incorporation of this work into the SNAPSHOT model of the IMPACT project. In SNAPSHOT, household total consumption (and income) is treated as endogenous.

II. ESTIMATION METHODS FOR "INCOME" AND PRICE RESPONSES

We consider the Engel curves for each of the n commodities and the aggregate consumption function as forming an (n+2) set of structural equations which may be written as follows:[2]

$$v_{ih} = \alpha_i + \beta_i v_h + \varepsilon_{ih} \quad (i = 1, \ldots, n) , \tag{1}$$

$$v_h = \sum_i v_{ih} , \tag{2}$$

$$v_h = \alpha + \mu y_h + \varepsilon_h , \tag{3}$$

where v_{ih} is the expenditure by the h th household on the i th commodity, v_h is total expenditure, (α_i, β_i) are parameters which satisfy the restrictions that $\Sigma\alpha_i=0$ and $\Sigma\beta_i=1$, y is income, and ε_{ih} and ε_h are error terms. Income is the only exogenous variable and all equations are just-identified.

The reduced form of the model is equation (3) plus

$$v_{ih} = \alpha_i^* + \beta_i^* y_h + u_h, \tag{4}$$

where

$$\alpha_i^* = \alpha_i + \alpha\beta_i, \quad \beta_i^* = \mu\beta_i, \quad \text{and } u_h = (\varepsilon_{ih} + \beta_i\varepsilon_h).$$

Consistent estimates of the structural parameters could be obtained either by two-stage least squares (2SLS) or indirect least squares. In a just-identified model the two are equivalent. These methods are also equivalent to Liviatan's (1961) instrumental variable approach in which (1) is estimated using income as an instrumental variable. The equivalence follows from the interpretation of 2SLS as an instrumental variable estimator in the just-identified case.[3]

The system described above may be interpreted in the context of classical demand analysis. Equations (1) and (4) are the cross-section estimating equations for the linear expenditure system (LES) and the extended linear expenditure system (ELES), respectively, in the absence of price variation across consumers.[4] Under these interpretations

$$\alpha_i = \gamma_i^* - \beta_i \sum_j \gamma_j^* \quad , \tag{5}$$

$$\alpha_i^* = \gamma_i^* - \beta_i^* \sum_j \gamma_j^* \quad , \tag{6}$$

and

$$\alpha = (1 - \mu) \sum_j \gamma_j^* \quad , \tag{7}$$

where $\gamma_i^* = p_i \gamma_i$ represents "subsistence" expenditure on the i th commodity at prices, p_i, prevailing during the survey, and $\Sigma \gamma_j^*$ is total "subsistence" expenditure.

The advantage of a demand systems interpretation is that it permits estimates of price responses to be obtained. This is required in order to predict over time. Within the context of LES/ELES, the γ_i-parameters are the coefficients of the price terms in the expenditure equations. The advantage of ELES over LES is that it enables estimates of the individual γ_i^* to be obtained from estimates of $(\alpha_i, \beta_i, \mu, \alpha)$ using (5) and (7). On the other hand, in cross-section applications it is frequently found that estimates of γ_i^* obtained in this manner are unacceptably large. An alternative approach is to restrict the "subsistence sum," $\Sigma \gamma_j^*$, to the more reliable values obtained from time-series studies, where price variation occurs within the sample. The most convenient

Table A2

COMPARISON OF NATIONAL EXPENDITURE ESTIMATES FROM ABS HOUSEHOLD EXPENDITURE SURVEY AND NATIONAL ACCOUNTS, AUSTRALIA, 1974-75

Commodity	National Expenditure: ABS Survey[1] ($m)	National Expenditure: National Accounts[2] ($m)
Food	7,481	6,190
Vice	2,137	3,041
Clothing	3,214	3,097
Housing	6,573	6,094
Medical	1,989	2,299
Durables	3,098	3,050
Transport	5,607	4,901
Recreation	3,140	1,709
Other	3,295	4,762
Total	36,548[3]	35,143

1) Source: ABS, "Household Expenditure Survey, 1974-75, Bulletin 4: Expenditure Classified by Income of Households", April 1977, The sample is estimated to be drawn from 2.6347 million households and 8.1224 million persons. Blowing up by actual population of 13.696 million yields estimate of Australian Households as 4.443 million. Definitions of commodities are as in table A1. Total Expenditure includes net gambling outlays.

2) Source: ABS, "Australian National Accounts, National Income and Expenditure, 1975-76.

   Housing = Rent + Gas, electricity, fuel + Postal and telephone services
   Recreation = Toys, sporting and travel goods + Entertainment, recreation + Net overseas expenditure
   Other = Newspapers, books etc + Other goods + Education services + Financial services + Other services.

3) Total does not add owing to rounding errors

APPENDIX

Table A1

COMMODITY DEFINITIONS

This Paper	Household Expenditure Survey Medium Level Commodity Code [1]
Food	11 - 45
Vice	46 - 50
Clothing	51 - 60
Housing	1-6, 7-10, 69, 83
Durables	61 - 65, 84 - 86
Medical	70 - 74, 93 - 94
Transport	75 - 82
Recreation	87 - 90, 96, 98
Other	66 - 68, 91 - 92, 95, 97

1) As listed in ABS, Household Expenditure Survey, 1974-75, Bulletin 1, pp. 32-38.

way to do this is to use the relationship between $\Sigma \gamma_j^*$ and the elasticity of the marginal utility of "income" or Frisch "parameter", ω, namely,[5]

$$\Sigma \gamma_j^* = v(1 + \omega^{-1}) \quad . \tag{8}$$

In this paper, sets of (β_i, γ_i^*) estimates are to be obtained for different types of households. The data points relate to household averages for each income class within a given household type. (Data on individual households are not available.)

III. DATA

In the HES complete information on consumers' expenditure and income was collected from about 9,000 households living in capital cities. Details of sampling procedures and precise definitions of variables are contained in ABS, Household Expenditure Survey, 1974-75, Bulletin 1.

In order to fit the linear demand model of section II, data are required on (i) commodity expenditures, (ii) household income, and (iii) household types. Each of these will be discussed briefly in turn. A few summary descriptive statistics are then presented.

(i) Expenditure

The commodity groupings are modified from the broad commodity groupings of the HES in order to increase comparability with work done using the Macquarie data and with the national accounts. The

following nine commodity groups are used: Food, Vice (Alcohol and Cigarettes), Clothing, Housing, Durables, Medical, Transport, Recreation, and Other. Housing includes fuel and power, durables includes expenditure on television and related electrical goods, and medical includes personal care. Further details are contained in the appendix, table A1.

The expenditure concept used is one of cash outlays. Thus expenditure on housing includes mortgage repayments, and expenditure on transport includes purchases of motor vehicles. In work previously undertaken by the author using Macquarie data (see Williams (1977,1978)) estimates of the services provided by housing and cars were used. The differences in the treatment of housing and motor vehicles are less important than they might at first seem because in the Macquarie studies data on individual households were used whereas for this ABS study expenditures are always averaged across households in a given income cell.

The relationship between the HES data and the national accounts estimates of consumption expenditures is taken up later in section VI.

(ii) Household Income

Within each household type households are subdivided into 12 classes on the basis of gross income. (The 6 published income classes have been halved in width.) The y variable used in fitting the linear demand system, however, is household personal disposable income, that is, household income less income taxes and other taxes.

points for 1966-67, but the prediction errors remained relatively large: the median absolute value for the no-relative-change predictions was 9.7 per cent; this was reduced to 8.6 per cent after introducing the demographic and structural changes. Predictions for the first two years of the period (1966-68) were, under all assumptions, markedly worse than those for later years and are suggestive of a once-for-all shift in tastes at this time.

Overall, it may be concluded that, at least at the broad commodity level, (a) cross-section data provide parameter estimates which may be used in predicting over time[29] and (b) improvements in predictions can be made by utilizing information on family formation patterns and on changes in income distribution. In using our results for forward prediction, however, account should be taken of some trends in prediction error that have been revealed by backward prediction.

VIII. CONCLUDING REMARKS

The traditional methods of predicting consumers' expenditures over time employ a single set of parameter estimates and assume an unchanged "income" distribution. This is the "single representative consumer" approach to demand analysis.

In this paper cross-section data have been used to derive sets of "income" and price responses for a number of representative household types. Marked differences in average budget shares and parameter estimates were detected. The quantitative importance of these differences was explored by using the cross-section results to predict national consumption expenditures over the decade 1966-67 to 1975-76 under alternative assumptions about demographic structure and the effects of structural changes on the distribution of "income".

Demographic changes affect primarily the weights given to each household type when aggregating and the effects therefore depend mainly on differences in average budget shares. The importance of changes in "income" distribution, on the other hand, depends primarily on differences in marginal budget shares.

Under the assumption of no relative changes in demographic structure and income distribution the range of prediction errors in 1971-72 was -5.3 per cent (food) to 4.9 per cent (luxuries). The median absolute prediction error was 3.6 per cent. After allowing for demographic and structural changes the range of prediction errors was -3.7 per cent (food) to 2.9 per cent (transport) and the median absolute value was 2.2 per cent. The reductions were also of the order of 1 to 2 percentage

(iii) Household Type

The data available to us from the ABS survey distinguish eight types of household composition and four age-of-head classes. This yields 32 households types which are given in table 1. For each household type information is available on mean household consumption expenditures and mean household disposable income for 12 income classes. In addition, weights are available for converting the sample cell means to population values.

The body of table 1 contains estimates of the number of Australian households in each of the household categories in 1974-75. These figures are based on ABS estimates for capital city households plus an assumption that the average family size of 3.083 for the city sample is appropriate for Australia as a whole. Preliminary results from the Australia-wide 1975-76 HES suggest that the family-size assumption is a valid approximation.[6)]

In practice it is difficult to obtain meaningful estimates for household types which contain fewer than 100 thousand Australian households. This is equivalent to around 200 in the sample. In order to obtain reliable parameter estimates it is also necessary for household income to show reasonable variation with a given household type. Thus it is not possible to obtain estimates for single people aged 65 years and over because they are heavily clustered in the two lowest income classes (less than $4160 per year).

Table 1

ESTIMATED NUMBERS OF HOUSEHOLDS IN AUSTRALIA (IN THOUSANDS), 1974-75

Household Composition	Age of Household Head in Years				Total
	15-29	30-44	45-64	65 and over	
Head only	120	88	230	259	697
2 Adults	364	131	435	309	1,240
Over 2 Adults	41	26	221	57	345
Head and Children	34	80	30	2	145
2 Adults, 1 Child	185	151	123	7	466
2 Adults, 2 Children	154	374	96	3	627
2 Adults, over 2 Children	50	388	72	0	510
Over 2 Adults, Children	24	116	265	8	413
Total	973	1,354	1,471	645	4,443

Notes: The ABS sample was drawn from an estimated population of 2634.7 thousand households. ABS weights provide a breakdown into household types. Figures have been converted to national estimates using the ratio of the average number of persons in Australia in 1974-75 to the number of persons in the population covered by the survey, namely, 13,696/8,122 = 1.6863.

An adult is defined as a person aged 18 years or over.

the leisure time available to retired households.

Allowing for less unemployment and a lower aggregate saving ratio in 1971-72 has further improved the predictions for all goods except transport (row 5 in table 11). The greatest improvements occur for medical and luxuries. The predicted value for medical has been increased as a result of transferring "income" to household types 2, 6 and 8, who spend relatively more at the margin on medical goods than do the remaining groups (except group 9). Predicted expenditure on luxuries is lowered by transferring "income" to household types 5, 6 and 8, where the marginal budget shares for luxuries are lowest.

(iv) Comparison with Naive Predictions

In rows 1 and 6 of table 11 are given the prediction errors which would arise if predictions were made using 1974-75 average budget shares (from the national accounts) multiplied by total national consumption in each year. This is the "naive" prediction, which assumes all "income" elasticities are one, all uncompensated own price elasticities are minus one, and all uncompensated cross-price elasticities are zero. In general, our predictions are considerably better than those obtained using average budget shares. As expected the naive predictions are particularly bad for food, which has an income elasticity well below one, and luxuries, which has an income elasticity well above one.[28] Our predictions for transport and clothing in 1966-67, however, are noticeably worse than the naive predictions.

There were no marked changes in the unemployment rate, the saving ratio or pension payments over the period 1966-67 to 1971-72. The percentage of working wives, however, did increase over the period from 28 per cent to 40 per cent of the work force. To allow for this we lower the mean household consumption of two adult households (types 2 and 5) in 1966-67 by 5 per cent as compared with the values obtained by backward projection of the fully adjusted 1971-72 household consumption shares i.e. adjusted for all three structural changes. As usual, consumption of the other household types is adjusted upwards (by 1.28 per cent). Household types 6 and 8 (mature families) are left unaltered because their consumption levels will also be affected by the longer years of schooling in 1971-72 compared with 1966-67. This affect will tend to offset the changes in the average earnings of wives.

The new projections incorporating the above estimates of changes in relative consumption levels are given in rows 4, 5 (1971-72) and 9 (1966-67) of table 11. There are some marked improvements in prediction errors for 1971-72, but the projections for 1966-67 are little different from those obtained using 1974-75 relative consumption levels (row 8). Allowance for changes in pension payments between 1971-72 and 1974-75 has noticeably improved predictions of expenditure on clothing and leisure in 1971-72. Lowering household "income" levels for "retired" households (types 1 and 9) in 1971-72 has led to an increase in the predicted aggregate expenditure on clothing and a decrease in the predicted aggregate expenditure on luxuries. This is because "retired" households have very low marginal budget shares for clothing and high marginal budget shares for "luxuries". This result is at first a little surprising but reflects the

The above criteria yielded 15 household types for which estimates were obtained. In order to investigate family size effects fully, households consisting of 2 adults, head aged 45-64 years, with either 2, or more than 2 children were also included. Similarities in data and parameter estimates permitted the 17 types to be collapsed into the 13 household groups given in table 2. Similar household types are denoted by common numbers, for example, 2a and 2b; the reason for this will become clearer in section VI.

Table 2

DEFINITIONS OF HOUSEHOLD TYPES

Household Type	Number of Adults	Age of Head in years	Number of Children [1]	Number of data points
1	1	15-64	0	24
2a	2	15-29	0	10
2b	2	30-44	0	11
3a	2	15-44 15-29	1 2	33
3b	2	30-44	2	11
4	2	30-44	> 2	11
5	2	45-64	0	11
6	> 2	45-64	0	11
7a	2	45-64	1	11
7b	2	45-64	2	11
7c	2	45-64	> 2	11
8	> 2	30-64	> 0	10
9	2	65+	0	12

1) Children are defined as persons under 18 years of age.

Early in the analysis it became clear that the consumption and saving behaviour of households in the lowest income class (gross income less than $2080 per year) was unusual, except for households where the head was aged 65 years or more. In particular, mean expenditure was usually higher than the next two or three higher income classes, expenditure on alcohol and cigarettes being particularly high. It seems that a significant proportion of these households were financing a "high income" lifestyle from assets. For this reason they are excluded from the analysis with the exception mention above.

(iv) Summary Measures of the Data

Key characteristics of the data are given in table 3. The breakpoint between "young" and "old" families is placed at 45 years. Within each of these age classifications households are arranged in order of increasing family size.

The highest household incomes are enjoyed by old households with more than two adults (types 6 and 8) and young couples without children (types 2a and 2b). These households frequently contain more than one income earner, typically a working wife and/or working "children". Couples without children (types 1a, 5 and 6) tend to have the highest average propensities to save. On the expenditure side, the proportion of total expenditure devoted to food increases with family size and age of household head. The average budget share for clothing is higher where the household head is aged 45-64 years (around 10 per cent), but it is not much influenced by family size. Expenditure on housing and durable goods is a higher proportion of the budget for young

so that when weighted by w_2 they preserve consistency with the national accounts figures.

It is only possible to make qualitative statements regarding the effects on consumption levels of the lower unemployment and lower saving ratio which existed in 1971-72.[25] In 1974-75 the households with the highest saving ratios were those without children where the head was less than 65 years (types 2 and 5) and those with more than two adults (types 6 and 8). It seems reasonable to postulate that the saving ratios for these groups would be relatively lower in 1971-72 than in 1974-75 and consumption levels relatively higher. An important consideration here is that the savings required for a deposit on a house or land were higher in real terms in 1974-75 than in 1971-72. Unemployment, on the other hand, would particularly affect households with young adults and wives able to work. Households with children (types 3, 4 and 7) are likely to be less affected by unemployment, and thus their relative consumption levels in 1971-72 are probably over-estimated by the backward projections of 1974-75 relative consumption levels.[26]

To test the effects of changes in unemployment and saving, the mean household expenditure levels implied by the no-relative-change assumption of section (i) above are altered for 1971-72 in the following manner: households types 2, 6 and 8 are increased by 10 per cent, type 5 increased by 5 per cent, type 1 increased by 2 per cent after adjustment for pension changes, and types 3, 4 and 7 are scaled down by 9.4 per cent to ensure that the weighted sum (using w_2) of mean consumption expenditures equals the national accounts estimate.[27] These somewhat arbitrary adjustments are meant to represent upper-bounds on changes in relative "incomes". They are designed to test the sensitivity of the expenditure projections to "income" changes.

(iii) Effects of Changes in Relative Total Consumption Levels

Three important structural changes which occurred in the Australian economy over the three years from 1971-72 to 1974-75 are likely to have affected relative consumption levels. These changes were: (a) an increase in unemployment from 1-2 per cent of the labour force in 1971-72 to around 4 per cent in 1974-75, (b) an increase in the household saving ratio from 10.4 per cent to 17.6 per cent, and (c) an increase in cash benefits for pensioners from $818.6 million to $1918.9 million.[24]

The relative shift in income and consumption in favour of recipients of age and invalid pensions is the easiest to incorporate into our projections. These pensions expressed as a ratio of total personal disposable income rose by 1.2 percentage points over the three years, and expressed as a ratio of total personal consumption expenditure rose by 1.8 percentage points. On the assumption that the average propensity to consume of pensioners lies about half-way between unity and the national average, we lower the percentage share of total consumption attributable to households of pensionable age in 1971-72 by 1.5 percentage points from the 1974-75 share given in table 7. This reduction is split between household type 1 (single persons) and type 9 (couples with head 65 years or more, plus an allocation of old single persons) in the ratio one-third to two-thirds, that is, 0.5 percentage points and 1.0 percentage points respectively. The w_2 weights are then used to derive new estimates of mean household consumption for groups 1 and 9. The mean consumption levels of the other household groups are scaled up proportionately

Table 3

CHARACTERISTICS OF DATA, ABS HOUSEHOLD EXPENDITURE SURVEY, AUSTRALIA, 1974-75

	Household Type												
	Single	Young					Old						Retired
	1	2a	2b	3a	3b	4	5	6	7a	7b	7c	8	9
Family Size	1	2	2	3.31	4	5.52	2	3.32	3	4	5.52	5.34	2
Mean Income ($)	6116	11268	11500	8823	9745	10418	8803	14479	10161	10690	10924	15671	4917
Mean Exp. ($)	5388	8751	10254	8190	9039	9645	7142	12016	8539	9451	10899	13492	4342
Av. Prop.Save	.119	.223	.108	.071	.072	.074	.189	.170	.160	.116	.002	.139	.117
Average Budget Shares													
Food	.158	.160	.159	.199	.214	.230	.196	.200	.215	.228	.232	.221	.240
Vice	.067	.059	.066	.055	.054	.048	.072	.067	.051	.053	.042	.061	.054
Clothing	.073	.079	.072	.073	.079	.087	.100	.096	.088	.099	.098	.107	.078
Housing	.232	.230	.212	.230	.191	.186	.164	.107	.152	.158	.126	.124	.178
Durables	.077	.106	.122	.095	.080	.080	.086	.088	.087	.058	.127	.061	.097
Medical	.047	.046	.051	.055	.054	.051	.063	.058	.060	.058	.055	.054	.067
Transport	.128	.171	.127	.152	.151	.142	.142	.199	.148	.144	.119	.182	.114
Recreation	.119	.079	.094	.063	.089	.081	.092	.100	.099	.087	.073	.099	.076
Other	.101	.070	.099	.079	.088	.095	.087	.085	.101	.116	.128	.091	.096

Notes: For key to household types see table 2. All figures are weighted averages. Income is defined as household disposable income expressed at an annual rate; total consumption expenditure is also expressed at an annual rate. Households with gross incomes below $2080 are excluded, except for type 9. For household types 4, 6, 7c and 8, family size relates to all households of that family composition, irrespective of age.

families. Persons living alone devote high average budget shares to recreation (12 per cent).

Compared with the Macquarie data (see Williams (1977), p.14), the average budget shares for food are considerably lower in the ABS survey. For comparable households, the highest value in the ABS survey is equal to the lowest value in the Macquarie survey (23 per cent). The higher budget shares for transport and housing in the ABS survey are probably due largely to differences in definitions of expenditure.

IV. ESTIMATES OF MARGINAL BUDGET SHARES

Estimates of marginal budget shares for the thirteen household types are listed in table 4. They were obtained using weighted two-stage least squares. The method was to perform two successive weighted least squares regressions, where the weights used were the inverses of the population "blow-up" factors as discussed in section III. The first stage yielded predicted values of v from equation (3). These predicted values were then used in equation (1) to obtain consistent estimates of the β_i. The number of observations (on group means) used in each regression is given in the last column of table 2. The potential number of cells is reduced by (a) exclusion of the lowest income class, (b) some cells have no observations, and (c) the third lowest income class in household type 2a was omitted owing to an exceedingly high value for durable good expenditure.

Table 11

THE EFFECTS OF DEMOGRAPHIC CHANGES AND OF SHIFTS IN RELATIVE CONSUMPTION LEVELS ON DEMAND PATTERNS IN AUSTRALIA, 1966-67 and 1971-72

	Assumptions		Percentage Error in Prediction of Expenditure on Commodity						
	Household Weights	Relative Consumption Levels	Food	Vice	Clothing	Housing	Medical	Transport	Luxuries
1971-72									
1.	abs	1974-75	-5.6	-5.7	-1.6	0.7	2.6	-3.6	7.7
2.	w_1	1974-75	-5.3	-3.6	-4.6	3.3	-1.8	0.4	4.9
3.	w_2	1974-75	-4.4	-3.3	-4.2	1.7	-1.5	1.6	4.3
4.	w_2	1971-72 (a)	-4.2	-3.0	-2.2	1.9	-1.5	1.7	3.1
5.	w_2	1971-72 (b)	-3.7	-3.0	-1.8	1.4	-0.7	2.9	2.1
1966-67									
6.	abs	1974-75	-18.8	-10.6	-11.4	13.5	15.1	2.5	12.4
7.	w_1	1974-75	-10.7	-7.3	-15.4	13.0	7.4	9.7	3.5
8.	w_3	1974-75	-8.8	-6.7	-14.9	9.8	8.3	12.5	1.4
9.	w_3	1966-67	-8.6	-6.8	-14.8	10.5	8.2	13.0	0.7

Notes: abs denotes forecasts made using average budget shares as in national accounts estimates for 1974-75.

1971-72(a) denotes adjustments for pensions, 1971-72(b) denotes adjustments for pensions, unemployment and saving ratios.

are altered accordingly from w_1 to w_2. These are given in the second row of table 6. Two adult households (types 2 and 5) have lower weights in 1971-72, whereas the weights for households with more than two adults (types 6 and 8) are increased.

Because the 1966 and 1971 census results are directly comparable it is relatively easy to derive new weights for 1966-67 on the basis of the new 1971-72 weights and the intercensal changes. The new 1966-67 weights are labelled w_3 and are given in the last row of table 6. Compared with 1971-72 the proportion of households with more than two adults has increased (types 6 and 8), whereas the proportions of single person households (types 1 and 9) and two person households (types 2, 5 and 9) have decreased.

Predictions are now carried out for 1971-72 and 1966-67 using the new weights. In projecting, the household total expenditure estimates have been scaled so that their weighted sum is still equal to the national accounts estimate. The revised projections are given in rows 3 and 8 of table 11 in the form of percentage errors. A comparison with the results obtained using w_1 weights (rows 2 and 7 of table 11) shows that all projections are improved using the new weights except those for medical in 1966-67 and transport in both years. The improvements are most marked for food and housing. In both years predicted expenditure on housing is lower using the new weights compared with using w_1. This is a reflection of the greater weights now given to families with more than two adults (who spend a relatively low proportion of income on housing) and the lower weights given to two person households (who spend a relatively low proportion of income on food).

Table 4

2SLS ESTIMATES OF MARGINAL BUDGET SHARES, β_i, AUSTRALIAN HOUSEHOLDS, 1974-75

Commodity	Household Type												
	Single	Young					Old						Retired
	1	2a	2b	3a	3b	4	5	6	7a	7b	7c	8	9
Food	.1091 (.0204)	.1262 (.0230)	.0635 (.0114)	.1194 (.0154)	.1203 (.0181)	.0866 (.0169)	.0664 (.0121)	.1499 (.0156)	.0899 (.0217)	.1053 (.0124)	.0595 (.0169)	.1414 (.0139)	.0673 (.0091)
Vice	.0515 (.0120)	.0411 (.0149)	.0334 (.0149)	.0550 (.0100)	.1215 (.0200)	.0223 (.0059)	.0435 (.0200)	.0593 (.0112)	.0072 (.0161)	.0355 (.0107)	.0257 (.0145)	.0633 (.0081)	.0368 (.0116)
Clothing	.0156 (.0200)	.0594 (.0221)	.0672 (.0305)	.1388 (.0129)	.0810 (.0140)	.1054 (.0187)	.2834 (.0523)	.1249 (.0157)	.1157 (.0221)	.1096 (.0259)	.0993 (.0298)	.1247 (.0142)	.0527 (.0196)
Housing	.1883 (.0438)	.2166 (.0422)	.3015 (.0776)	.2180 (.0251)	.1546 (.0251)	.1276 (.0203)	.1424 (.0140)	.1287 (.0171)	.0568 (.0423)	.2127 (.0219)	.0955 (.0230)	.0731 (.0236)	.0667 (.0333)
Durables	.1131 (.0587)	.2841 (.1166)	.2331 (.1054)	.0378 (.0430)	.0503 (.0385)	.1819 (.0419)	.1132 (.0274)	.1103 (.0284)	.1750 (.0634)	.0851 (.0302)	.3444 (.0383)	.0688 (.0161)	.4617 (.1042)
Medical	.0223 (.0102)	.0418 (.0092)	.0369 (.0136)	.0329 (.0073)	.0457 (.0105)	.0310 (.0053)	.0288 (.0097)	.0639 (.0051)	.0399 (.0134)	.0433 (.0085)	.0426 (.0118)	.0429 (.0074)	.0651 (.0193)
Transport	.1335 (.0354)	.0933 (.0581)	.0798 (.0419)	.1069 (.0286)	.0447 (.0381)	.1306 (.0385)	.0720 (.0200)	.1442 (.0320)	.1842 (.0278)	.0677 (.0268)	.0707 (.0182)	.2051 (.0175)	.0855 (.0332)
Recreation	.2554 (.0867)	.0874 (.0400)	.0522 (.0472)	.1064 (.0205)	.2355 (.0353)	.1598 (.0270)	.1645 (.0226)	.1151 (.0109)	.1091 (.0581)	.1684 (.0307)	.0779 (.0239)	.1694 (.0263)	.0558 (.0334)
Other	.1112 (.0508)	.0501 (.0273)	.1323 (.0261)	.1848 (.0175)	.1465 (.0203)	.1547 (.0278)	.0858 (.0192)	.1037 (.0138)	.2221 (.0565)	.1724 (.0328)	.1845 (.0296)	.1114 (.0185)	.1082 (.0161)

Notes: Estimates of asymptotic standard errors are given in parentheses.
The household type codes are explained in table 2.

All of the 117 estimates of the marginal budget shares reported in table 4 lie between 0 and 1; 90 per cent of them are significantly different from zero at the 5 per cent level. The β_i-estimates for food are all significant at the 1 per cent level. Overall, the β-values are determined with more precision than were those based on the Macquarie data as reported in Williams (1977, pp. 15 and 17). This is particularly so for housing, and vice (alcohol and cigarettes).

Only a few patterns emerge when comparing estimates for young households (head 15-44 years) with those for old households (45-64 years). Where children are present there is a tendency for older families to have lower marginal budget shares for recreation and higher marginal budget shares for durables than comparable young families. These findings are the exact opposite of those found with the Macquarie data![7)] Possible explanation for the different results include the differences in the break points between young and old families (35 years was used in the Macquarie paper), the use of individual household observations in the Macquarie data, and the introduction of colour television in 1974-75. Comparing young and old households consisting of just two adults, the results show that the β_i-estimates are higher among young households for housing and durables, and lower for clothing and recreation. Retired couples (type 9), however, have a very high β-value for durables, although the estimate for housing is very low.

Households with more than two adults (types 6 and 8) exhibit a surprisingly high marginal propensity to spend on food: the β-

for all commodity groups other than luxuries the greatest error occurs in 1966-67, the year furthest from the survey year. The model underestimates consumption on food, alcohol and cigarettes, and clothing, and the degree of underestimation increases with time (projecting backwards). Expenditure on housing is over-estimated and the degree of overestimation increases with time. Overall, the projections are noticeably worse in the first two years, i.e. 1966-68. This is suggestive of changes in tastes and once-for-all shifts in consumption shares.[22)] It would therefore appear that the Macquarie results, based on data collected over the period 1966-68, must be used circumspectly.

We now proceed to examine the effects of changes in the relative importance of each household type and of changes in relative "incomes". Projections will be confined to the years 1971-72 and 1966-67. Demographic census data is available for these years and 1971-72 is also the base year of the SNAPSHOT model of the IMPACT project.

(ii) Demographic Effects

The published data on households from the 1966 and 1971 censuses[23)] is not directly comparable with our definitions of household types. This is because in the census (a) adults are defined as persons 16 years and over compared with 18 and over in the survey and (b) a basic subdivision is one based on whether the household contains a spouse, whereas in the survey only the number of adults is specified. Nevertheless, broad movements can be detected and the household weights for 1971-72

Table 7

CONSUMPTION SHARES, 1974-75

	Household Type								
	1	2	3	4	5	6	7	8	9
Consumption Share	.0685	.1303	.2107	.1324	.0897	.1129	.0584	.1508	.0564

Table 8

PERCENTAGE ERROR IN PROJECTING CONSUMPTION EXPENDITURES, AUSTRALIA, 1966-67 TO 1975-76

	Commodity						
Year	Food	Vice	Clothing	Housing	Medical	Transport	Luxuries
1966-67	-10.7	-7.3	-15.4	13.0	7.4	9.7	3.5
67-68	- 8.8	-7.1	-12.7	11.8	6.4	4.0	4.1
68-69	- 7.5	-6.6	- 9.8	9.2	4.8	2.1	4.3
69-70	- 6.6	-5.9	- 6.9	7.9	4.6	-0.9	4.2
70-71	- 5.0	-5.6	- 6.4	5.2	-0.9	-1.5	5.9
71-72	- 5.3	-3.6	- 4.6	3.3	-1.8	0.4	4.9
72-73	- 4.0	-2.8	- 3.9	2.3	-2.7	1.0	3.8
73-74	- 1.0	-1.9	- 5.6	1.9	0.9	0.1	1.9
74-75	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75-76	0.4	0.9	6.4	-2.5	-10.3[1)]	2.2	0.4

1) 1975-76 price index for medical falls by 18.7 percent owing to the introduction of Medibank.

values are around 0.15. This reflects a high propensity for restaurant meals and take-away foods.[8)]

The number of children in the household exerts few regular influences on estimates of the marginal budget shares. For young households there is a tendency for the β-values for recreation to increase with family size and those for housing to decrease with family size. For old households there is a tendency for the β-value for clothing to decrease with family size. Elsewhere the family size effect is irregular. No strong patterns emerged in the Macquarie study either (see Williams (1977),p.18).

V. ESTIMATES OF SUBSISTENCE PARAMETERS

The quickest way to ascertain the reasonableness of the ELES cross-section estimates of the subsistence parameters is to examine the coefficients of the aggregate consumption function (3). Using the HES data, estimates of the marginal propensity to consume, μ, the subsistence-sum, $\Sigma\gamma^*$, and the implied values of the Frisch parameter, ω, represented a considerable improvement on those obtained by the author using the Macquarie data[9)], but they still departed from the values usually obtained from time-series data. The μ-values tended to be too low (one-half lay in the interval 0.5 to 0.6) and the ω-estimates (see last row of table 5) larger in absolute value than the -2 consistently reported in time-series studies for developed countries, including Australia.

Since an important aim of this paper is to forecast expenditures over time, we replace the cross-section estimates of ω and $\Sigma\gamma^*$ with estimates derived from time-series studies.

Lluch, Powell and Williams (1977, pp.74-82), using time-series estimates of ELES for 14 countries, arrived at a relationship between ω and GNP per head which implies an ω value of -1.81 for Australia in 1974-75. For this result to hold at the mean per capita expenditure ($2,671) for all households in the ABS survey,

$$\omega = -31.0\ (v/f)^{-.36}\ , \qquad (9)$$

where f = family size. Equation (9) is used to derive the value of ω for each household type. The estimates are given in the second last line of table 5. They range from -2.11 to -1.41. Estimates of $\Sigma\gamma_j^*$ are then obtained using equation (8). The individual γ_i^* are obtained by combining these values of $\Sigma\gamma_j^*$ with the two-stage least squares estimates of α_i and β_i, using equation (5). The estimates are reported in table 5, together with estimates of their asymptotic standard errors.[10] Only about 50 per cent of the γ_i^*-estimates are significant, where significance is defined as occurring when the point estimate exceeds twice its estimated standard error. The estimates are particularly bad for durables, recreation, and other, where all but 2 of the 39 values are insignificant. The γ_i^*-estimates for two-adult households, head 15-44 years (types 2a and 2b) are particularly badly determined: this probably reflects the heterogeneity of lifestyles amongst these households. In all cases, however, the γ_i^*-estimates for food are significant. Negative values of γ_i^* are concentrated in the "luxury" commodity groups durables and recreation, but no negative values are significantly different from zero. The γ_i^*-estimates lose their "subsistence" interpretation when they are negative, and imply own-price elasticities which are greater

To aggregate forecasts for each household type, estimates of the number of households falling into each category are required. Estimates at the end of 1965-66 and the end of 1970-71 are available from census data. The estimates of total households from the censusus, however, are not consistent with the estimates derived from the 1974-75 household survey which were discussed in section II. The survey-based estimate of 4.443 million households and the June 1971 census estimate of 3.671 million households[18] together imply an annual rate of growth in households of 5.6 per cent over the period. The comparable figure for population growth was only 1.6 per cent.[19] Since all that matters in our analysis is the rate of change in the number of households,[20] new estimates of total households prior to 1974-75 are derived by projecting backwards the estimates for that year. In projecting back we use published population estimates[21] and assume that the average family size increases by 0.05 per annum. The latter figure compares with the intercensal estimate of 0.041 between the 1971 and 1966 censuses.

(i) Predictions using 1974-75 weights

The simplest procedure to adopt in predicting expenditure over time is to use 1974-75 values for both the distribution of household types (w_1 weights) and relative "incomes". These two assumptions imply unchanged consumption shares, which are given in table 7. The percentage errors involved in predicting in this manner are given in table 8. The projections show that

Adjusted estimates of the parameters of interest, β_i and γ_i, may now be obtained as detailed above.[16] Together with the household weights and with total consumption expenditure and number of households in Australia in 1974-75 given, the adjusted parameter values predict exactly the 1974-75 national expenditures on each commodity. We now explore how well the estimated model tracks actual expenditures on the seven commodities in earlier years.

VII. PREDICTIONS OF EXPENDITURES

Predictions over the decade from 1966-67 to 1975-76 will be compared with actual expenditures. In all predictions it will be assumed that the parameter estimates remain unchanged. For each household type h, then, mean projected expenditure on good i in the forecast year f is obtained from the underlying linear expenditure model, that is,

$$\bar{v}_{ih(f)} = \gamma_{ih} p_{ih(f)} + \beta_{ih} \left(\bar{v}_{h(f)} - \sum_j \gamma_{jh} p_{jh(f)} \right) .$$

Price indexes (1974-75 = 1.000) are obtained from the implicit deflators in the national accounts, supplemented by sub-sections of the consumer price index.[17] Direct estimates of $\bar{v}_{h(f)}$ are not available. They must be approximated using total national consumption expenditure in the forecast year, the $\bar{v}_h$ values for 1974-75, and knowledge of structural changes which occurred in the economy.

Table 5

2SLS ESTIMATES OF SUBSISTENCE EXPENDITURES, γ_i^*, AUSTRALIAN HOUSEHOLDS, 1974-75

	Household Type												
	Single	Young					Old						Retired
Commodity	1	2a	2b	3a	3b	4	5	6	7a	7b	7c	8	9
Food	434	674	1170	1102	1364	1818	1109	1294	1399	1623	2207	1945	891
	(118)	(215)	(126)	(141)	(185)	(188)	(97)	(208)	(208)	(134)	(520)	(211)	(47)
Vice	162	282	438	209	-85	359	323	363	404	320	321	365	151
	(70)	(139)	(165)	(91)	(204)	(65)	(150)	(505)	(154)	(115)	(185)	(123)	(61)
Clothing	334	350	255	-16	335	357	-531	223	190	385	537	534	223
	(116)	(206)	(337)	(118)	(142)	(207)	(418)	(210)	(212)	(279)	(380)	(214)	(102)
Housing	529	769	12	926	1001	1213	545	337	1023	430	856	1138	626
	(254)	(395)	(859)	(230)	(257)	(225)	(112)	(228)	(405)	(236)	(293)	(358)	(173)
Durables	-20	-712	-426	612	484	-63	114	239	-105	123	-471	317	-606
	(340)	(1089)	(1168)	(394)	(393)	(465)	(219)	(378)	(606)	(326)	(488)	(244)	(542)
Medical	166	161	260	303	273	355	324	220	318	327	371	417	148
	(59)	(86)	(151)	(67)	(107)	(59)	(78)	(68)	(128)	(92)	(150)	(113)	(101)
Transport	179	959	725	777	1155	776	699	1316	372	1022	910	962	305
	(205)	(543)	(463)	(262)	(389)	(428)	(77)	(426)	(266)	(290)	(233)	(265)	(172)
Recreation	-336	187	585	44	-301	46	-66	351	320	-18	371	106	204
	(502)	(374)	(523)	(188)	(360)	(300)	(181)	(146)	(556)	(331)	(305)	(398)	(174)
Other	117	324	64	-170	105	213	242	255	-206	229	401	414	174
	(294)	(255)	(311)	(160)	(207)	(138)	(153)	(183)	(541)	(354)	(377)	(280)	(84)
Sum	1567	2994	3083	3787	4331	5074	2760	4599	3715	4450	5503	6199	2115
Imposed -ω	1.41	1.52	1.43	1.86	1.92	2.11	1.63	1.62	1.77	1.89	2.02	1.85	1.95
ELES -ω	4.7	7.0	4.5	19.0	12.5	10.3	4.6	3.4	4.0	5.4	35.0	5.0	7.6

Notes: Estimates are in dollars per household per year in 1974-75 prices. Asymptotic standard errors are given in parentheses. For key to code for household types see table 2.

than one in absolute value.[11] The γ_i^* results reported in this paragraph virtually duplicate the Macquarie findings as presented in Williams (1977, p.24).

Age of household head again influences "subsistence" expenditures. For households consisting of two adults only, the γ_i^*-estimates for clothing and recreation are lower for the two oldest age groups (45-64, 65 years and over). For two-adult households with a given number of children, the γ_i^*-estimates for food, clothing and recreation are higher for old households (head 45-64 years) than for young households, but lower for durables, although the γ_i^*-estimates for durables are badly determined. Note that the estimates of the subsistence sum are similar for both young and old households with a given number of children so that the differences in the γ_i^*-estimates would seem to largely reflect age differences in children. For a given household type, low γ_i^*-estimates for durables tend to be accompanied by correspondingly high estimates for recreation, and vice-versa. A similar pattern occurs with the β-estimates. It follows that expenditure on the composite good durables-recreation would show greater stability over households than that of its two components.

Household "subsistence" expenditure on food increases with family size and ranges from around $400 (in 1974-75 prices) for single person households to $2,200 for household type 7c (2 adults, head 45-64, 3 or more children). Per capita subsistence expenditure on food is relatively constant once allowance is made for differences in the age of the household head. Where the head is aged 15-44 years, per capita subsistence expenditure on food is estimated to be around $350 (except for type 2b). The comparable

and over (259 thousand). In addition, 60 thousand single persons aged 45-64 years had incomes below $2080 per year, and were excluded from the regressions.[15] These 310 thousand single "retired" households are allocated proportionally to type 1 (single persons) and type 9 (retired couples), whose consumption patterns they resemble. Mean consumption figures are scaled down accordingly for types 1 and 9; marginal budget shares are left unaltered; and the intercept terms, α_i, are adjusted to ensure that the Engel curves pass through the sample means. The remaining household types for which parameter estimates are not available (see table 1) are allocated on the basis of similarities of family composition and expenditures. In these cases differences in income and expenditure are relatively unimportant so they are left unaltered. The resultant set of weights, w_1, are given in the first row of table 6.

Table 6

HOUSEHOLD WEIGHTS

Weight	Year	Household Type [1]								
		1	2	3	4	5	6	7	8	9
w_1	1974-75	.1292	.1175	.2049	.1148	.1031	.0777	.0543	.0930	.1056
w_2	1971-72	.140	.100	.205	.110	.090	.090	.050	.110	.105
w_3	1966-67	.125	.095	.205	.110	.090	.103	.050	.122	.100

1) See table 2 for code to household types.

$$\alpha^a_{ih} = k_i \bar{v}_{ih} - \beta^a_{ih} (\ell_h \bar{v}_h) = k_i \alpha_{ih} + [k_i \beta_{ih} \bar{v}_h - \beta^a_{ih} \ell_h \bar{v}_h] .$$

The term in square brackets denotes the correction factor which arises because of different consumption patterns across income classes for a given household type. In practice it is relatively unimportant.

Estimates of adjusted total expenditure are used to obtain adjusted estimate of the Frisch parameter and the subsistence sum. Finally, the adjusted estimates of the individual subsistence expenditures are given by

$$\gamma^a_{ih} = \alpha^a_{ih} + \beta^a_{ih} \sum_j \gamma^a_{jh} .$$

The one task remaining to make the above procedure operational is to select the household weights, w_i. Firstly, to simplify the task the number of household types is reduced to 9 by grouping in a manner implied by the numbering in table 2. Thus, for example, types 2a and 2b are aggregated into type 2.[14] The household types which are amalgamated exhibit the smallest differences in income levels and demand parameters. Parameter estimates for type 7c, which has a small weight in the population, are not used.

The estimated number of Australian households in each of the 9 groups in 1974-75 ranges from 219 thousand (group 7) to 864 thousand (group 3) and in total represent about 85 per cent of households. In order to predict national aggregates some assumptions are required about the remaining 15 per cent of households. The major omission is single persons aged 65 years

figure for households where the head is over 44 years of age is around $430. Estimates for households with other than two adults lie between these two values. The main difference from the Macquarie findings is that subsistence expenditure on food is now a much lower percentage of total subsistence expenditure, for all household types. In Williams (1977, p.26) it was reported that subsistence expenditure on food was about 45 per cent of total subsistence expenditure for all household types considered in the Macquarie analysis. In table 5, the corresponding percentage varies from 23 (type 2a) to 42 (type 9).

There is a tendency for the γ^*_i-estimates for clothing to increase with family size, particularly for old households. The γ^*_i-estimates for housing tend to be lower for households without children (types 1, 2a, 2b, 5, 6, 9). Both findings are in accord with the Macquarie results.

VI. RECONCILING CROSS-SECTION DATA WITH THE NATIONAL AGGREGATES

Prior to examining the forecasting ability over time of the cross-section estimates of demand behaviour it is necessary to "tie" the cross-section data to the national accounts data. The two may differ because of measurement error in the cross-section data, or because of differences in commodity definitions. An attempt has been made to minimize the latter by choosing appropriate commodity definitions in the cross-section work.

The HES estimates of total consumption expenditure are only 4 per cent above the national accounts estimates and this difference can be explained by the lower incomes of households

not living in capital cities.[12] However, differences are more marked for individual commodities (see appendix, table A2). In particular, expenditure on alcohol and cigarettes is under-estimated by 30 per cent in the HES. On our definitions, expenditure on recreation is over-estimated in the survey by nearly $1,500 million and expenditure on other is under-estimated by a similar amount. Part of the problem here is the wide variety of expenditure included under "holidays" (and thus under recreation) in the survey. Partly for this reason and partly for the reasons advanced in section V (indeterminancy of γ_i^*-estimates, off-setting movements in recreation and durables), the commodities durables, recreation and other are now combined into a single group which will be called "luxuries."[13]

In prediction, the assumption is made that for a given commodity the "true" national accounts value of expenditure by a household is proportional to expenditure on the good as measured by the HES. The proportion is assumed to be constant for all household types and income levels, but to vary across commodities. Expenditure on each good is therefore scaled by a factor k_i which is calculated as follows.

Let $\bar{v}_{ih}$ be the mean recorded expenditure on the ith good by the h th household type in the survey; w_h be the weight attached to the h th household type in the population, where $\Sigma_h w_h = 1$; and v_i^* be average household expenditure on the ith good from the national accounts. Then the scaling factors, k_i, are defined as $k_i = v_i^* / \Sigma_h w_h \bar{v}_{ih}$.

Since the allocation of expenditure across commodities varies by household type, the proportional adjustment to the mean levels of total consumption expenditure, $\bar{v}_h$, will vary by household type. The relevant scaling factors are given by $\ell_h = \Sigma_i (k_i \bar{v}_{ih}) / \bar{v}_h$.

Now since our underlying model is linear (see equation (1)), the above assumptions imply a simple procedure for adapting our parameter estimates, without re-estimating, in a manner which ensures that the model reproduces national expenditure on each good in 1974-75 if total expenditure in that year is given. Multiplication of the dependent variables in the model by k_i implies that the previously estimated coefficients (α_{ih}, β_{ih}) should be divided by k_i. Similarly, multiplication of the explanatory variable by ℓ_h implies dividing the estimates of β_{ih} by ℓ_h. The net effect on the slope coefficient would therefore seem to be a multiplication by k_i/ℓ_h. But this is only an approximation. Average budget shares differ across income classes for a given household type. Because of this, scaling by k_i/ℓ_h will not ensure that the marginal budget shares sum exactly to one. The sum of scaled consumption on each commodity equals scaled total consumption at the mean, but not necessarily for each income class. To restore the allocation property the adjusted marginal budget shares, β_{ih}^a, are defined as

$$\beta_{ih}^a = \frac{k_i \beta_{ih}}{\ell_h} \Bigg/ \sum_j \frac{k_j \beta_{jh}}{\ell_h} = \frac{k_i \beta_{ih}}{\Sigma_j k_j \beta_{jh}}$$

Similarly, the adjusted intercept terms, α_{ih}^a, are defined such that the estimated line holds exactly at mean values, that is,