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HOUSEHOLD HEADSHIP IN AUSTRALIA: FURTHER
DEVELOPMENTS TO THE IMPACT PROJECT'S
ECONOMETRIC MODEL OF HOUSEHOLD HEADSHIP

by

Pamela Williams

and

Dennis Sams

IMPACT Project Research Centre

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

IMPACT PROJECT RESEARCH CENTRE 153 Barry Street, Carlton 3053

Postal Address: Impact Centre, University of Melbourne, Parkville, Vic., 3052, Australia

Phones: (03) 345 1844 extensions 7417 & 7418
After hours (03) 341 7417 or 341 7418.

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HOUSEHOLD HEADSHIP IN AUSTRALIA : FURTHER DEVELOPMENTS

TO THE IMPACT PROJECT'S ECONOMETRIC MODEL OF HOUSEHOLD HEADSHIP :

by

Pamela Williams and Dennis Sams *

1. INTRODUCTION

This paper forms an integral part of the analysis within the IMPACT Project¹ of the economic, demographic and social changes affecting the structure of the Australian economy. The specific aim of this paper is to analyse, and to devise methods for making projections of, the number of households in Australia.

Since the turn of the century, there have been substantial increases in the numbers of households and extensive changes in their characteristics. These changing characteristics are to a considerable extent captured by the changing features of the heads of these households. The observed growth in the number of households over time can be partitioned into the effects arising from (a) the growth of the population and changes in its distribution between demographic groups, and (b) the growth in the household headship ratios² for each demographic group. Under the assumption that these two components of the growth in households are independent, we can adopt a comparatively simple two-stage method for the projections of households.³

* The authors would like to thank Alan Powell for his comments and suggestions.

1. For background material on the IMPACT Project, see Alan A. Powell, The IMPACT Project : An Overview, First Progress Report of the IMPACT Project, Volume 1 (Canberra: Australian Government Publishing Service, 1977).
2. The household headship ratio is the proportion of people in any given population category who are heads of households.
3. For full details of alternative projection techniques, see United Nations, "Methods of Projecting Households and Families", Manual VII, Population Studies No. 54 (ST/SDA/Ser A/54), Sales No. E73 XIII, 2.

This method, which is used in the majority of projections of households, involves the projection of the headship ratios for each population category and the separate projection of the population in each category. Then, by multiplication of the headship ratios and corresponding populations, we can derive the projected numbers of households whose head belongs to each of the population categories. Such projections are usually based almost entirely on past headship and population trends,¹ and hence do not attempt to identify explicit factors which influence people in their decision to head a separate household.

At the IMPACT Project, an econometric model of household headship was developed using data from the 1961, 1966 and 1971 Censuses.² In this model, the household headship ratios for a number of demographic groups are explained in terms of the economic variables expected to influence the headship decisions of the people within those groups. The IMPACT Project also has a facility for the projection of the Australian population based on an econometric model of fertility, family formation and female labour force participation.³ It was hoped that, by projecting populations and household headship ratios using the

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1. For some Australian examples, see Department of Environment, Housing and Community Development, A Method for the Projection of Households and Dwelling Completions 1975-2000 (Canberra: Australian Government Publishing Service, 1977) and R. Riner and H.M. Bingham, Household Formation Projections (Melbourne: Melbourne Metropolitan Board of Works, 1975).
 2. See P.J. Williams and R.C. Brooks, "An Econometric Model of Household Headship," IMPACT Preliminary Working Paper No. BP-14, Melbourne, July 1978.
 3. See Dennis Sams, "The Demographic Core of the IMPACT Project : An Overview," IMPACT Preliminary Working Paper No. BP-18, Melbourne, September 1979 and Dennis Sams and Pam Williams, "The IMPACT Project's Facility for Disaggregated Population Projections : A Brief Exposition and Progress Report," IMPACT Preliminary Working Paper No. BP-22, Melbourne, May 1980.

models discussed above, it would be possible to produce projections of the numbers of households in Australia on the basis of scenarios of possible movements in relevant socio-economic variables.

However, simulations to 1976 of the econometric model of household headship were not satisfactory when compared to the Census data for 1976 which became available after the econometric model was completed. It appeared that divergences between the economic environment of the mid-1970's and that which existed during the 1960's and early 1970's (the sample period on which the original model was estimated) were such that the model required extensive respecification. The respecification presupposes a re-examination of the economic determinants of household headship. It was also decided that the respecified model should, in the interests of clarity, deal principally with the demand for household headship, with the supply of housing having little influence. It is the purpose of this paper to explain the respecification of the econometric model of household headship, to document how this respecification developed from the previous model and to report upon the performance of the newly specified model.

The paper has been structured as follows: in Section 2, a short discussion is given of the changes in the number of households and in household headship ratios in Australia over the period 1961 to 1976; in Section 3, the previously reported model is described briefly and its performance is evaluated; in Section 4 we discuss the data requirements for the new econometric model and in Section 5 we present its respecification. In Section 6, the results of the estimation of the respecified model are reported and in Section 7 we describe the results of an illustrative projection to 1980. We close with some concluding remarks in Section 8.

2. HOUSEHOLD HEADSHIP IN AUSTRALIA, 1961 TO 1976

Before describing the model which we have developed, we shall attempt, in this section, to give an overview of the broad changes in the numbers of households and in household headship ratios which the model purports to explain. The model has been specified to explain and project household headship ratios for a disaggregation of sixty four demographic groups of the Australian population. Such data are available at four Census dates - June 30 in 1961, 1966, 1971¹ and 1976² - and, at a lower level of disaggregation, for two survey dates - November 1978³ and August 1980⁴. The Census data, disaggregated by 2 sexes, 4 marital states (never married, married, divorced and widowed and 8 age groups (15-19, 20-24, 25-34, 35-44, 45-54, 55-59, 60-64 and 65 and over), are used in the estimation of the model. In this section we discuss the changes which have occurred in these data but we restrict our discussion to changes in households and household headship disaggregated separately by marital status and by age.⁵ In Tables 1 to 4, we present the Census data disaggregated, firstly, by sex and marital status and, secondly, by sex and age group. In Tables 1 and 3

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1. See Department of Environment Housing and Community Development, Household Head to Population Ratios and Marital Status Proportions; 1961, 1966 and 1971 (Canberra: Australian Government Publishing Service, January 1977), p. 49.
 2. Department of Housing and Construction, Preliminary Household Head and Population Data, 1976 (Canberra: Department of Housing and Construction, Building Division, 1978).
 3. Australian Bureau of Statistics, Survey of House Rental and Ownership, Cat. No. 8710.0, November 1978.
 4. Australian Bureau of Statistics, Survey of Housing Occupancy and Costs, Australia, Cat. No. 8724.0, August 1980.
 5. An excellent historical analysis of household formation was prepared by O.B. Di Iulio for the National Population Inquiry, and further information should be sought there: O.B. Di Iulio, "Household Formation: 1911-2001; An Historical Analysis and Projection", National Population Inquiry Working Paper No. 24, April 1976.

TABLE 1 : HOUSEHOLDS, POPULATION AND HOUSEHOLD HEADSHIP RATIOS FOR AUSTRALIAN MALES AND FEMALES BY MARITAL STATUS, 1961, 1966, 1971 AND 1976

	Never Married		Married ¹		Divorced		Widowed		All	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Households ²										
1961	113.4	80.1	2144.6	94.6	15.3	21.4	63.8	248.8	2337.1	444.9
1966	134.2	95.1	2402.6	108.4	20.0	28.9	70.1	292.5	2627.0	525.0
1971	172.9	116.0	2753.3	126.2	32.5	45.2	80.9	343.6	3039.6	630.9
1976	247.8	157.5	2997.2	145.2	58.7	77.5	82.1	374.4	3385.8	754.6
Population ^{2,3}										
1961	1099.8	772.9	2432.9	2439.0	38.6	43.3	116.1	408.6	3687.4	3663.9
1966	1246.2	899.7	2667.4	2664.6	42.9	51.1	122.1	463.2	4078.6	4078.6
1971	1326.6	943.2	3013.2	3021.6	61.8	71.4	129.5	517.1	4531.1	4553.3
1976	1420.1	1056.4	3234.1	3242.4	96.0	122.2	129.5	546.4	4879.7	4967.3
Headship Ratios										
1961	.1031	.1036	.8815	.0388	.3962	.4934	.5497	.6089	.6338	.1214
1966	.1077	.1057	.9007	.0407	.4668	.5659	.5739	.6315	.6441	.1287
1971	.1303	.1230	.9137	.0418	.5263	.6323	.6250	.6645	.6708	.1386
1976	.1745	.1491	.9268	.0448	.6112	.6343	.6338	.6853	.6939	.1519

1. Married includes permanently separated.

2. Households and populations are given in thousands.

3. Populations given are for persons aged 15 years and above.

SOURCE : See footnotes 1 and 2 on page 4 for the sources of data used in Tables 1 to 4.

TABLE 2 : AVERAGE ANNUAL PERCENTAGE CHANGES¹ IN HOUSEHOLDS,
POPULATION AND HOUSEHOLD HEADSHIP RATIOS FOR AUSTRALIAN
MALES AND FEMALES BY MARITAL STATUS,
1961 TO 1976

	Never Married		Married		Divorced		Widowed		All	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Households										
1961-1966	3.4	3.5	2.3	2.8	5.5	6.2	1.9	3.3	2.4	3.4
1966-1971	5.2	4.1	2.8	3.1	10.2	9.3	2.9	3.3	3.0	3.8
1971-1976	7.5	6.3	1.7	2.9	12.6	11.4	0.3	1.7	2.2	3.7
1961-1976	5.4	4.6	2.3	2.9	9.4	9.0	1.7	2.8	2.5	3.6
Population										
1961-1966	2.5	3.1	1.9	1.8	2.1	3.4	1.0	2.5	2.0	2.2
1966-1971	1.3	1.0	2.5	2.6	7.6	6.9	1.2	2.2	2.1	2.2
1971-1976	1.4	2.3	1.4	1.4	9.2	11.3	-0.01	1.1	1.5	1.8
1961-1976	1.7	2.1	1.9	1.9	6.3	7.2	0.7	2.0	1.9	2.1
Headship Ratios										
1961-1966	0.9	0.4	0.4	1.0	3.3	2.8	0.9	0.7	0.3	1.2
1966-1971	3.9	3.1	0.3	0.5	2.4	2.2	1.7	1.0	0.8	1.5
1971-1976	6.0	3.9	0.3	1.4	3.0	0.1	0.3	0.6	0.7	1.9
1961-1976	3.6	2.5	0.3	1.0	2.9	1.7	1.0	0.8	0.6	1.5

1. Average annual percentage changes were calculated as follows: $r = \left[\frac{\left[\frac{h_{n_1}}{h_{n_0}} \right]^{\frac{1}{n_1 - n_0}} - 1.0 \right] \times 100.0$,
where n_0 initial year and n_1 is the final year.

TABLE 3 : HOUSEHOLDS, POPULATION AND HOUSEHOLD HEADSHIP RATIOS
FOR AUSTRALIAN MALES AND FEMALES BY AGE,
1961, 1966, 1971 AND 1976

	15-19		20-24		25-34		35-44		45-54		55-59		60-64		65+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Households ¹																
1961	4.1	2.2	78.7	8.2	479.6	22.0	601.9	45.9	529.1	75.0	198.9	44.7	155.9	54.6	288.9	184.1
1966	7.6	3.9	116.7	15.4	522.5	33.7	666.0	58.2	577.7	86.2	237.5	53.0	182.3	57.6	316.8	217.0
1971	10.8	6.5	194.5	28.4	675.6	53.4	680.4	66.0	646.1	98.9	266.1	61.2	211.9	68.9	354.3	247.6
1976	18.1	14.3	217.4	47.3	835.7	87.3	701.2	76.7	690.2	104.8	275.5	63.3	238.7	77.5	409.0	283.5
Population ¹																
1961	416.0	397.1	361.7	336.5	728.6	665.3	739.2	723.0	628.9	596.7	238.1	225.2	190.8	210.0	384.1	510.2
1966	532.1	511.7	436.5	416.6	740.0	693.7	794.0	744.1	666.8	652.5	276.1	266.8	215.6	219.5	412.5	573.8
1971	566.7	541.8	558.3	538.9	893.3	841.7	788.5	739.3	732.2	712.2	301.5	303.6	243.8	257.9	446.9	618.0
1976	621.9	597.0	558.8	553.9	1052.3	1024.2	789.5	751.5	770.6	734.8	308.7	313.9	271.6	292.3	506.3	699.8
Headship Ratios																
1961	.0099	.0054	.2177	.0243	.6582	.0330	.8143	.0635	.8413	.1257	.8354	.1986	.8168	.2603	.7521	.3609
1966	.0141	.0077	.2673	.0370	.7060	.0486	.8388	.0782	.8663	.1320	.8602	.1988	.8455	.2622	.7321	.3911
1971	.0191	.0120	.3484	.0527	.7563	.0634	.8629	.0893	.8823	.1389	.8827	.2017	.8692	.2673	.7807	.4217
1976	.0291	.0239	.3891	.0853	.7941	.0852	.8881	.1021	.8956	.1426	.8924	.2017	.8791	.2651	.8373	.5503

1. Households and populations are given in thousands.

TABLE 4 : AVERAGE ANNUAL PERCENTAGE CHANGES¹ IN HOUSEHOLDS,
POPULATION AND HOUSEHOLD HEADSHIP RATIOS FOR AUSTRALIAN
MALES AND FEMALES BY AGE, 1961 TO 1976

	15-19		20-24		25-34		35-44		45-54		55-59		60-64		65+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Households																
1961-1966	13.0	12.7	8.2	13.5	1.7	8.9	2.0	4.8	1.8	2.8	3.6	3.5	3.2	1.0	1.9	3.3
1966-1971	7.4	10.7	10.8	13.0	5.3	9.6	0.4	2.6	2.3	2.8	2.3	2.9	3.1	3.7	2.3	2.7
1971-1976	10.8	17.0	2.3	10.7	4.4	10.3	0.6	3.1	1.3	1.2	0.7	0.7	2.4	2.4	2.9	2.8
1961-1976	10.4	13.4	7.0	12.4	3.8	9.6	1.0	3.5	1.8	2.3	2.2	2.4	2.9	2.4	2.3	2.9
Population																
1961-1966	5.2	5.2	3.8	4.4	0.3	0.8	1.4	0.6	1.2	1.8	3.0	3.5	2.5	0.9	1.4	2.4
1966-1971	1.1	1.2	5.1	5.3	3.8	3.9	-0.1	-0.1	1.9	1.8	1.8	2.6	2.5	3.3	1.6	1.5
1971-1976	1.9	2.0	0.0	0.6	3.3	4.0	0.0	0.3	1.0	0.6	0.5	0.7	2.2	2.5	2.5	2.5
1961-1976	2.7	2.8	2.9	3.4	2.5	2.9	0.4	0.3	1.4	1.4	1.8	2.2	2.4	2.2	1.9	2.1
Headship Ratios																
1961-1966	7.4	7.2	4.2	8.8	1.4	8.0	0.6	4.2	0.6	1.0	0.6	0.0	0.7	0.2	-0.5	1.6
1966-1971	6.2	9.4	5.4	7.3	1.4	5.5	0.6	2.7	0.4	1.0	0.5	0.3	0.6	0.4	1.3	1.5
1971-1976	8.8	14.7	2.2	10.1	1.0	6.1	0.6	2.7	0.3	0.5	0.2	0.0	0.2	-0.2	1.4	5.5
1961-1976	7.5	10.4	4.0	8.7	1.3	6.5	0.6	3.0	0.4	0.9	0.4	0.1	0.5	0.1	0.7	2.9

1. Average annual percentage changes were calculated using the formula given in the footnote to Table 2.

we present the numbers of households, the population and the headship ratios for each demographic group, and in Tables 2 and 4 we present the intercensal growth rates for households, population and headship ratios for each group.

(i) The Overall Picture

In the fifteen years from 1961 to 1976, the number of Australian households grew at an average rate of 2.7% per year. However, the Australian population grew at an average rate of only about 2.0% per year over the same period. This suggests an average annual growth rate of around 0.7% in the total household headship ratio for the Australian community.¹ Hence, although the growth in the number of households arose in part from population growth, a significant contribution came from increasing headship ratios. As shown in Table 2, the growth rate in the number of male-headed households over the period 1961 to 1976 was 2.5% per year, being composed of a 1.9% per year growth rate in the male population and a 0.6% per year growth rate in their household headship ratio. The growth rate of 3.6% per year in the number of households headed by females was substantially higher than that for male-headed households. More importantly, the composition of that growth rate differed, with the growth rate of the female population, at 2.1% per year, being similar to that for the male population, but with the growth of the female headship ratio, at 1.5% per year, exceeding that for males. As a result of these differential growth rates for male- and female-headed households, which arose almost entirely from the higher rate of growth

1. By simply adding together the rate of growth of the population and the household headship ratio, we are neglecting a contribution from the product of the two growth rates. In most cases this is negligible.

in female headship ratios, women became increasingly important as heads of households: in 1961, women headed 16% of all households, whereas in 1976, women headed over 18% of households.

In the remainder of this section, we analyse changes in the number of households and their distribution across demographic groups, and then consider how the changes in this distribution have arisen from differential growth rates between these demographic groups. Finally we analyse the growth rate in the number of households in terms of the growth and composition of the population on the one hand, and the changes in the household headship ratios within each demographic group on the other.

(ii) The Changing Demography of Households

As the data in Tables 1 and 3 indicate, the tendency to assume the status of household head differs with marital status and with age. There have also been substantial changes over time in the numbers of households headed by the different demographic groups. Over the period 1961 to 1976, the number of households headed by persons of every marital status and by persons of every age group increased. However, as shown in Tables 2 and 4, rates of growth differed between these demographic groups. This has led to substantial changes in the demographic composition of the total stock of households.

As could be expected, by far the largest proportion of households are headed by married males; however, this proportion has declined steadily over the period from 77.1% of all households in 1961 to 72.4% in 1976. This decline has been due to the relatively slower rate of growth in the number of households headed by married males of 2.3% per year, compared to 2.7% per year for all households. The next most

important sex/marital status group is widowed females. The number of households with heads in this group grew at a rate of 2.8% per year, but the proportion of all households with such heads increased from 8.9% in 1961 to 9.4% in 1971 and then decreased to 9.1% in 1976. These declines in the proportions of households with the more traditional married male or widowed female heads are not a reflection of declines in the number of households headed by the traditional groups themselves, but rather a reflection of the above average growth in the number of households headed by the less traditional sex/marital status groups. The proportion of households headed by never married and divorced persons of both sexes has increased substantially from 8.3% in 1961 to 13.1% in 1976. The most important contributions to this increase were from households headed by divorced males and females, which grew, over the period, at average annual rates of 9.4% and 9.0% respectively. Households headed by never married males and females also grew at above average rates of 5.4% and 4.6% per year respectively. These differential growth rates between marital status groups have led to substantial changes in the marital status composition of heads of households.

If we consider the age composition of heads of households, we observe that the majority of households are headed by persons in the prime age groups, 25-54 years. However, young people heading their own households have become increasingly numerous. As shown in Table 3, in 1961, 15-19 and 20-24 year olds headed 0.2% and 3.1% respectively of households, whereas in 1976 the same age groups headed 0.8% and 6.4% respectively of households. In achieving these increases, households headed by such persons have grown at above average rates of 11.5% and 7.7% per year respectively. This increase in the proportions of households headed by young persons had been at the expense of those

headed by prime-aged persons, whilst the proportion of households headed by older persons (above 55 years) had remained virtually stationary over the period. Households headed by young women showed far greater average annual rates of increase (13.4% for 15-19 year olds and 12.4% for 20-24 year olds) than those headed by young men (10.4% and 7.0% for the same age groups). However, the high rate of increase in young female-headed households does not imply a particularly large increase in the number of households because women have historically headed very few households, except at older ages.

(iii) The Composition of these Changes in Households

As was pointed out above, changes in the numbers of households can be visualized as consisting of two components: (a) the joint contribution from the growth in the population and the change in its distribution between demographic groups, and (b) the component due to changes in headship ratios within demographic groups. Over the period 1961 to 1976, the population has grown for all marital states and all age groups; there have occurred, however, differentials between rates of growth which help to explain some of the differential changes in the numbers of households headed by different demographic groups. The most dramatic example was the substantially higher than average growth rate for the population of divorced persons. This led to increases in the proportion of the population who were divorced and compensating, but necessarily smaller, falls in the proportions of the population who were married or widowed. Hence, part, but not all, of the above average increase in the number of households headed by divorced persons can be explained by the increase in the population of those persons. Across the age distribution, there was a lower than average growth in the population of prime aged persons, in particular those aged between the mid 30's and mid 50's. This partly explains the decline in the proportion of households headed by prime aged persons.

The most interesting feature of changes in the number of households headed by persons of different ages was the increasing importance of young persons. However, the growth in the population of young persons could explain only one-quarter to one-third of the growth in the number of households headed by young persons. So, whilst changes in the growth rates of, and the age and marital status composition of, the population are important in determining the changes in the number of households, they can provide only part of the explanation for these changes. Of more interest for our modelling exercise are the changes which have occurred in the headship ratios for each demographic group.

Household headship ratios have increased for all marital states and almost all age groups over the period. The average annual rate of increase was greatest for never married males (3.6%) and females (2.5%) and for divorced males (2.9%) and females (1.7%).¹ The lowest rate of increase occurred for married males (0.3%) and widowed females (0.8%). For the increases in headship ratios over the age distribution, we see that the annual average rate of growth in headship ratios was fastest for the younger age groups - - 7.4% (10.4%) for 15-19 year old males (females) and 4.0% (8.7%) for 20-24 year old males (females) - - and tended to decrease with age, up until the 60-64 year age group and beyond, where headship ratios had increased by an annual average rate of approximately 0.5%. Also for all age groups except 55-59 and 60-64, the average annual rate of growth of female headship exceeded that for males.

1. It may appear inconsistent that, in Table 2 from which these figures are taken, the average annual rate of increase in headship ratios for all females exceeds that for all males and yet for each marital status, with the exception of the numerically small group, married females, the female growth rate is less than the male growth rate. These results are not, however, inconsistent given that the lowest rate of increase for males has occurred in the numerically largest group, the marrieds, and the higher rates have occurred in the smaller groups, whilst the increases for females have been experienced more consistently across all the groups, including the numerically large widowed group.

(iv) The Important Features

As the above analysis has shown, whilst growth in the population and changes in its distribution between marital status groups and ages have led to substantial increases in the number of Australian households, changes in household headship ratios for each demographic group have also been extremely important. The respecified econometric model, described below in Section 5, must explain the substantial growth in headship ratios for all persons and, in particular, for women. Such growth suggests that there has been an increased preference for, or ability to sustain, separate (as opposed to shared) living arrangements or an increase in the available dwelling stock which enabled previously unmet demand for separate housing to be fulfilled or a combination of both these factors. Various explanations have been put forward for the above average growth in female headship ratios, including increasing job opportunities, higher earnings, and changing social values.¹ The econometric model must also explain the relatively low growth in headship ratios for the more traditional households headed by married males and females; it may be possible that household headship for these groups is tending towards its upper limit. In contrast, the high growth rates in household headship of divorced and never married persons must also be explained by the model. Over the age distribution we have observed relatively higher growth rates in the headship ratios for the young and the old. It appears that the young, despite (or, perhaps, because of) their historically low headship ratios, have responded to their increased affluence, employment opportunities and social independence and to the increased availability of suitable small-unit housing, by forming separate households. Older persons appear

1. O.B. Di Iulio, op. cit., p.7.

to be retaining independent headship status to a much later age. This is probably the result of the increased affluence of older persons, due to improved social security provisions, plus improvements in health at older ages. It is the challenge of the econometric model to incorporate all the above factors into its explanation of household headship over the period.

3. POST MORTEM ON AN EARLIER ECONOMETRIC MODEL OF HOUSEHOLD HEADSHIP

In this section, we discuss the IMPACT Project's original econometric model of household headship,¹ the rationale behind its specification, and the lessons which can be learnt from its failure. This discussion should help to identify those features which should be present in its respecification.

(i) The Reduced Form

The number of households formed will be determined by the interaction of factors affecting the demand for household formation and the supply of housing. Hence a model of household headship ratios should attempt to incorporate interactions between the demand for household formation (over and above increases expected as a direct result of population growth) and the supply of housing, possibly via a reduced form specification. It was the intention that the earlier model should be of the reduced form; however, as data at a sufficiently disaggregated level regarding the supply of housing were sparse, the model made limited use of supply variables. Consequently, the model was not a fully reduced form, but predominantly reflected characteristics of the demand for headship. This could cause the model to over-predict headship ratios when there are housing supply constraints. However, it has been suggested that, in the long run, the rate of household formation will be demand determined, with no supply constraints.² The earlier model could, therefore, be seen as a long run model of household headship. For some purposes, it may be preferable to

1. The specification and estimation of the original model and an analysis of its in-sample performance are more fully documented in P.J. Williams and R.C. Brooks, op. cit. .

2. A.R. Hall and M.R. Hill, "Housing Demand in Australia," The Economic Record, Vol. 36, No.76, December 1960, p.550.

search out supply data to enable the estimation of a short-run reduced form model of household headship. This represents a possible direction for future research, but it has not been attempted in the current respecification, which is intended to explain only changes in household formation when there are no bottlenecks in the supply of housing.

(ii) The Specification of the Original Model

In the specification of the original model, the headship ratio, h_{int} , for the i^{th} sex/marital status group of people in the age group with mid-point n at time t , was estimated using a partial adjustment technique, where the headship ratio for each age/sex/marital status group depended upon

- (i) the level of desired headship, h_{int}^* , which that group would wish to achieve in the absence of any constraints on their behaving in a similar manner to people who were in the same age/sex/marital status group in the past;
- (ii) the level of headship which has been accepted by the general community for that group in the past, $h_{in(t-1)}$;
- (iii) the gap between the past headship level and desired headship; and
- (iv) the speed of adjustment, W_1 .

The adjustment parameter, W_1 , was determined by an iterative technique, and the value chosen suggested that, over a Census period of five years, adjustment from past headship levels towards desired headship is almost complete. However, the model was insensitive to changes in W_1 and, as only two time transitions were available for its estimation, the value of W_1 was poorly determined. Despite the availability of a further time transition for the estimation of the respecified model, it is unlikely that the estimation of dynamic parameters such as W_1 could

be improved substantially using a sample whose time series dimension is so short. Given this, it was decided to dispense with the limited dynamics offered by the partial adjustment framework. In the new model, adjustments are assumed to work themselves out fully by the end of the five year response periods bounded by the Census dates.

In the original model, the level of desired headship was estimated as a logistic function of its demographic and socio-economic determinants. The logistic function ensured that estimated headship ratios were bounded from below by zero and could not exceed reasonable upper limits. This is a particularly useful feature for any model of headship ratios which is intended for use in projections, for it ensures that, even in very long run projections, headships cannot exceed reasonably expected levels. The demographic and socio-economic variables used in the model were chosen according to their expected ability to explain headship, but this choice was severely constrained by the poor availability of disaggregated data series. A pragmatic approach to the construction of data series and the inclusion of explanatory variables of necessity has persisted in the respecification of the econometric model.

(iii) The Demographic Characteristics of Household Headship

As shown in the descriptive analysis of the previous section, demographic factors - age, sex and marital status - are extremely important indicators of the likelihood that any given individual will be a household head, irrespective of his socio-economic characteristics. Demographic factors were accounted for in the model by estimating separate equations for each sex and marital status group and by including two life-cycle variables in the specification of the estimated equations. Analysis of headship ratio data shows that, for all sex/marital status groups, the propensity to be a household head increases with age up to a point, after

which the propensity declines, and the life-cycle variables were specified to track these effects. The respecified model retains the feature of estimating separate equations for each sex/marital status group but incorporates life-cycle effects in a different manner.

(iv) The Socio-economic Determinants of Household Headship

The relationships between headship ratios and their socio-economic determinants are complex. If the supply of housing does not provide a constraint, we can postulate that the individual's decision to become, or remain, a household head will be made after balancing the costs of setting up, or living in, a separate household against the benefits he will receive, given the constraint of his ability to pay. In theory we could formulate a model of household headship based on the maximization of net benefits from setting up or living in a separate household subject to the ability of the individual to pay. Lack of data precludes a full analysis of this nature, but, if we assume that the benefits of separate housing remain fixed over time, household headship decisions will be closely related to changes in the ability to afford, and the costs of setting up and maintaining, a separate household.

The individual's perception of his ability to afford a separate household will be closely related to his current and past levels of real income and his expectations regarding the certainty of that income in the future. Unfortunately, data relating to expected income levels and their distribution between age, sex and marital status groups are sparse. It is, however, possible to proxy for these data. Permanent disposable income per capita reflects general economic conditions and unemployment rates reflect the relative

certainty with which these conditions impinge on particular groups. Although age, sex and marital status specific unemployment rates were readily available, only an economy-wide measure of permanent disposable income was available. Such general variables may not be able to fully capture changes in the ability of a particular age/sex/marital status group to afford separate housing, but they may be sufficient for those sex/marital status groups, such as married and previously married males, whose income levels have tended to move in line with economy-wide trends. For other sex/marital status groups, such as females of all marital states and young males, whose relative income positions could have been expected to change substantially over the period, it may be preferable to proxy for changes in income using the labour force participation rates for each age/sex/marital status group. Hence, in the specification of the original model, age, sex and marital status specific labour force participation rates were included in the equations for never married males and for females of all marital states, and permanent disposable income per capita and age, sex and marital status specific unemployment rates were included in the equations for never married females and for males of all marital states. In estimation, these proxy variables performed adequately as explanators of household headship, despite the simplicity of our postulated relationships between income, unemployment and labour force participation. Unfortunately, such simplicity led to substantial inaccuracy in projection. The consequences of this will be discussed more fully later in this section.

Another important economic determinant of household headship, which was mentioned above, is the cost of setting up and maintaining a separate household. This will depend, among other things, upon

rental and housing prices, costs of removal and maintenance costs, and can be expected to bear a negative relationship to headship. The lack of suitable data led to the inclusion of only one cost variable, namely, a housing price index. This index can be expected to capture the effects of changes in the cost of housing relative to other consumer prices and was used as the deflator for income (and all other monetary variables). This variable appeared to perform adequately in the original econometric model, and was therefore also included in the respecified model.

Since the original model was essentially a reduced form, the supply of housing was perceived as an important determinant of household headship, especially for groups such as young persons requiring small-unit dwellings, previously married females requiring cheap, and often welfare-sponsored, housing and young marrieds who may double-up with parents in periods when housing market conditions are tight. Data availability restricted us to the use of only one supply variable, the availability of welfare housing, which was moderately successful in helping to explain the headship of previously married females. Due to the lack of readily available supply information, we have chosen, in the respecification, not to estimate the reduced form but to concentrate on estimating the demand for household headship.

Over time there has also been a variety of changes in social attitudes which have affected demand for headship, and their effects may not be explainable in terms of the types of variables considered above. The changing social attitudes towards women and their independence and towards the nuclear family are two examples. For the purposes of econometric modelling, such effects could, at best, only be proxied by the use of other variables. Attempts in this direction did not prove

successful, so variables representing changing social attitudes were not included in the original nor in the respecified econometric model.

(v) Estimation and Projection with the Original Model

The model described above was estimated using data from the 1961, 1966 and 1971 Censuses and performed adequately over this period; in general the signs on parameters accorded with a priori expectations, the fits of the equations (as measured by their co-efficients of determination) were good and the model tracked the in-sample movements in household headship ratios adequately. However, when simulations to 1976 were performed, the model was unable to capture those changes in headship ratios which had occurred. In Table 5, the actual and projected headship ratios for 1976 are presented.

The table indicates that the projected headship ratios did not closely match actual headship ratios in 1976. For never married males and females, the projected values underestimated headship at younger ages, overestimated headship for the middle ages (40's to 50's) and underestimated headship at older ages. This pattern of inaccuracy over the age distribution had also been noted within the sample period, but it worsened in projection. The most inaccurate projection was made for married males, where the econometric model projected household headship ratios for males of all ages to be extremely low (below 0.5). For married females, the projected values exceeded actual headship ratios for all ages up to the 70's, and, for all previously married women, projected headship ratios always exceeded the actual values. Similar, although less severe, overestimation occurred for previously married men.

These projections were most unsatisfactory. The poorest approximations to actual values occurred in the numerically largest

TABLE 5 : COMPARISON OF ACTUAL AND PROJECTED¹ HOUSEHOLD HEADSHIP RATIOS, AUSTRALIA, 1976

Age Group	Never Married		Married		Permanently Separated		Divorced		Widowed	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
15-19	.0223	.0246	.6815	.0059	.1648	.2447	.2182	.2632	.1967	.3274
Estimated	.0120	.0077	.0000	.0114	.2880	.2815	.1922	.2301	.1352	.8723
20-24	.1631	.1585	.8634	.0115	.4194	.4059	.4138	.3376	.3052	.4612
Estimated	.0701	.0669	.0000	.0198	.4906	.5646	.4683	.5495	.3719	.9157
25-39	.3128	.2752	.9170	.0153	.5572	.5298	.5614	.4606	.4752	.6350
Estimated	.1721	.1440	.0026	.0195	.5761	.6482	.5392	.6308	.6463	.9298
30-34	.3655	.3166	.9457	.0189	.6212	.6042	.6231	.5872	.6372	.7439
Estimated	.2760	.2268	.0139	.0224	.6264	.7036	.5957	.6988	.7153	.9403
35-39	.3877	.3296	.9541	.0215	.6574	.6705	.6323	.6689	.6906	.8012
Estimated	.3531	.3083	.0158	.0261	.6517	.7371	.6275	.7444	.7910	.9429
40-44	.4181	.3373	.9611	.0230	.6744	.6988	.6318	.7030	.7214	.8378
Estimated	.4133	.3852	.0183	.0289	.6709	.7626	.6525	.7733	.8146	.9441
45-49	.4586	.3685	.9603	.0235	.6612	.6974	.6261	.6965	.7855	.8341
Estimated	.4805	.4380	.0413	.0307	.6790	.7715	.6672	.7860	.8330	.9438
50-54	.4943	.4230	.9578	.0219	.6483	.6858	.6464	.7214	.7507	.8322
Estimated	.5098	.4772	.0217	.0313	.6822	.7737	.6750	.7916	.8361	.9418
55-59	.5260	.4705	.9513	.0213	.6317	.6676	.6319	.7220	.7308	.8010
Estimated	.5400	.4930	.0051	.0313	.6816	.7682	.6787	.7915	.8310	.9396
60-64	.5502	.5099	.9387	.0220	.6108	.6450	.5953	.7054	.7191	.7619
Estimated	.5507	.5166	.0002	.0308	.6774	.7539	.6764	.7802	.8252	.9374
65-69	.5369	.5536	.9196	.0260	.5748	.6105	.6068	.6921	.6843	.7431
Estimated	.5263	.4952	.0092	.0315	.6702	.7342	.6673	.7719	.8199	.9360
70-74	.5194	.5637	.9151	.0317	.5781	.5898	.5703	.6718	.6437	.7192
Estimated	.5432	.4857	.0266	.0335	.6519	.7074	.6547	.7606	.7951	.9337
75-79	.4663	.5200	.9066	.0525	.5194	.5422	.5095	.6148	.5813	.6457
Estimated	.5435	.2977	.0012	.0363	.6304	.6728	.6335	.7478	.7543	.9298
80+	.3960	.4050	.8508	.0818	.4315	.4372	.4977	.5030	.4819	.4590
Estimated	.4805	.2339	.0000	.0387	.5171	.6118	.6133	.7288	.6530	.9151

1. The projected headship ratios given here were obtained using the IMPACT Project's original econometric model of household headship, as documented in P.J. Williams and R.C. Brooks, *op. cit.*

groups - married males and widowed females - and the underestimation and overestimation which occurred for other groups appeared to be systematic across all ages.

(vi) The Poor Performance of the Original Model

The poor performance of the econometric model in estimation can be related to the economic explanators of headship behaviour and the simplistic manner in which they were incorporated into the model.

Firstly, as discussed above, it is unlikely that general variables, such as per capita income and expenditure on welfare housing, will be able to explain adequately the changes in household headship for specific groups, since important distributional effects will not be captured. For instance, the econometric model was unable to explain the substantial increases over the early 1970's in the household headship of young persons. Over this period there were substantial shifts in wage relativities which favoured young persons and we could expect that their incomes increased above the rates of increase experienced by other demographic groups. Because it failed to take account of the particular level of income of young people and the shifts in that income which occurred over the period, the model underestimated the headship of young persons. The difficulty in removing such specification errors arises in finding accurate measures of income for the large number of demographic groups under consideration. Data are sparse and often of poor quality. Hence, it is not obvious that the resources which would be necessary to derive such data disaggregated by demographic groups would lead to substantially more accurate headship estimates. Despite these pessimistic observations, in respecifying the econometric model substantial effort has been expended in constructing series of disaggregated income data. These will be discussed in Sections 4 and 5.

Secondly, the original econometric model did not allow for the tendency of potential demand for independent household status to be highest amongst those groups whose incomes historically have been insufficient to support such independent status. We could postulate that, for each demographic group, there exists a threshold income below which income changes have little effect on headship, but above which even small increases in income can lead to substantial increases in headship. This specification could be extremely useful in explaining the behaviour of some of the less traditional headship groups, such as young people. An attempt to incorporate this postulate has been made in the respecification of the model.

Thirdly, in the original econometric model we attempted to proxy for changes in the ability to afford separate housing and the certainty associated with this ability, using general income variables and labour force participation and unemployment rates. Despite the disaggregation by age, sex and marital status of the labour force variables, these proxies did not perform adequately. By way of example, the ability of the model to capture the increases in household headship for young Australians in the 1970's can be explained partly by the use of the general income variable which, as discussed above, did not identify the positive influences on teenage headship from above-average increases in teenage wage rates and unemployment benefits, and partly by the simplistic use of disaggregated labour force participation and unemployment rates which did not recognise the combined effect of declining labour force participation, increasing unemployment rates and increasing durations of unemployment on teenage incomes. In Australia since the mid-1970's, the increasing unemployment rate has been accompanied by increases in the duration of unemployment. Hence, the unemployment rate alone overestimates the increase in the number of persons directly affected by unemployment.

On the other hand, it underestimates the deleterious effects of unemployment on those who do experience it, because those who are experiencing unemployment will be bearing, individually, an increasing proportion of the loss in national income resulting from unemployment, whilst the income of those not experiencing unemployment will be relatively unaffected by the increasing unemployment rate. Hence, those teenagers who were in the labour force and who were not unemployed in the 1970's were increasingly able to afford separate housing, whilst their unemployed peers became less and less able to do so. Thus the ability of individuals within a demographic group to afford separate housing will depend upon the composition of that group according to labour force status - - employed, unemployed and not in the labour force - - and the incomes which accrue to each of these labour force states. If it is possible to distinguish between these labour force categories, it will be possible to compute a more comprehensive and accurate estimate of income for each demographic group. It will also be possible to relate the headship behaviour of a given demographic group to changes in the probability that individuals in that group will be employed, unemployed or not in the labour force, to changes in the periods for which they can be expected to experience these labour force states, and to variations in the income accruing to each of the labour force states. In the respecification of the econometric model, efforts have been made to measure the level of average per capita income for each labour force status group, and to determine the probability that an individual of any given demographic group will be in receipt of income from each of these sources.

The specification of the econometric model of household headship attempts to incorporate the features discussed above. After a short discussion in Section 4 of the available data, the respecified model is detailed in Section 5.

4. DATA

There is no limit to the theoretical complexities with which an econometric model describing Australian household behaviour could be specified, but all such complexities are limited by data availability. In order to take account of the demographic characteristics of household headship, it is necessary to obtain household headship data disaggregated by age, sex and marital status. As discussed in Section 1, such data are available from the 1961, 1966, 1971 and 1976 Censuses and from two surveys held in 1978 and 1980. The Census data are available disaggregated by ten sex/marital status groups -- never married males and females, married males and females, permanently separated males and females, divorced males and females and widowed males and females -- and fourteen quinquennial age groups, from 15-19 to 80 and over. The survey data, however, are available disaggregated by only four sex/marital status groups -- not married males and females and married males and females -- and by only six decennial age groups from 15-24 to 65 and over.

Due to lack of disaggregation, in particular by marital status, of the survey data, we have declined to use these data in the estimation of the model. They can, however, be used to test the out-of-sample performance of the econometric model. The Census data were not used at the fullest possible level of disaggregation by either age or sex/marital status group. Since the aim in modelling household headship ratios is to enable projections of the number of households in Australia, our projections of household headship ratios must be compatible with those projections of the population which are derived from the population projection facility of the IMPACT Project's demographic core.¹ This facility

1. See Dennis Sams. op. cit., and Dennis Sams and Pam Williams, op. cit..

provides projections of the population disaggregated by eight legally defined sex/marital status groups; it therefore does not distinguish between permanently separated and married persons. Unfortunately, in terms of their headship behaviour, married and permanently separated persons differ markedly, especially for women, and it is likely that the determinants of their headship will also differ. Hence, there is the possibility that some misspecification could arise when attempting to select explanators for the headship behaviour of the combined group of married and permanently separated persons. The aggregation of married and permanently separated persons also disallows direct comparisons between projected headship ratios and the survey figures for 1978 and 1980 since the latter combine permanently separated persons with not married, rather than married, persons. However, by using approximations to the proportions of persons in each sex/marital status group, comparisons between the survey data and projections of the econometric model can be made. In defence of the aggregation of married and permanently separated persons, we point out that the concept of permanently separated is not particularly clear, and it is not obvious that the criteria by which persons declare themselves as permanently separated are consistent between persons or over time. Until improvements are made to the data relating to non-legal marital states, such as permanently separated and de facto married, we are committed to using the legally defined marital states and to accepting the difficulties this causes.

The disaggregation across the age distribution that is provided by the Census is also not fully utilised. As the explanators of household headship include age-specific information on incomes and labour force behaviour, it was felt that little could be gained by disaggregating the age distribution of headship ratios beyond the disaggregation which was generally available for these variables. The eight age groups used still enable us to capture the life-cycle characteristics of headship behaviour.

Thus, the data on the dependent variable to be estimated were headship ratios for eight sex/marital status groups -- never married males and females, married¹ males and females, divorced males and females and widowed males and females -- and eight age groups -- 15-19, 20-24, 25-34, 35-44, 45-54, 55-59, 60-64 and 65 and over -- at four Census dates -- 1961, 1966, 1971 and 1976. Unfortunately, due to a lack of data concerning the labour force variables (which will be discussed later), data from the 1961 Census could not be used. As only three time series points were available, it was necessary, as in the previous model, to use cross-sectional information on the age distribution of headship ratios. Reliance upon cross-sectional data in estimation leads to some difficulty in the interpretation of the results of the model, since the response of headship to changes in its explanatory variables over the cross-section may not be equivalent to its response over time. Unfortunately, this difficulty cannot be avoided.

The most attractive means of using this cross-sectional information over the age distribution is to capture the life-cycle influences by specifying the response coefficients of headship ratios with respect to their explanatory variables to be age dependent. The life-cycle variables used were the mid-point of the age group², n , and its square, n^2 , where the eight age groups were as given above.

The respecification of the econometric model attempts to relate an individual's probability of heading his own household to his long-run,

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1. As discussed above, married includes permanently separated.
 2. To enhance reporting of the parameter estimates, the life-cycle variables were scaled by the first age, 15 years, and could be denoted more appropriately as $\left(\frac{n}{15}\right)$ and $\left(\frac{n}{15}\right)^2$.

or permanent (as opposed to transitory), supernumerary income, where supernumerary income is that part of income which exceeds the income necessary for subsistence. Since an individual's income will be closely related to his labour force status - employed, unemployed or not in the labour force - the model attempts to relate household headship for each demographic group to the per capita income accruing to each labour force status, the probability that an individual within a given demographic group will attain each labour force status, and the expected duration in that status. The model therefore requires data, for each demographic group, on income accruing to each labour force status, on the labour force participation and unemployment rates, and on the durations of labour force participation and unemployment. Ideally, the disaggregations of these data should correspond to those available for the household headship data. Also, since calculations of permanent variables require data for several preceding years as well as for the current year, to be able to use all four Census points of headship data, it would be necessary to collect and/or construct data series for each financial year from 1956/57 to 1975/76. It would also be desirable to extend the data beyond the sample period to enable out-of-sample projections to be compared with actual data. Due to the poor availability of labour force data prior to 1964, it was possible to construct the relevant labour force series only from 1961/62 on. It has not been possible, therefore, to use the information regarding household headship ratios as at the 1961 Census.

Income data are sparse, and must be constructed using information from various publications¹. The Australian National Accounts²

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1. Further details regarding the construction of these income series are given in Dennis Sams, "Income Data Requirements for the IMPACT Project's Household Headship Model", IMPACT Research Memorandum BACHUROO Module, Melbourne, July 1981.
 2. Australian Bureau of Statistics, Australian National Accounts : National Income and Expenditure, Cat. No. 5204.0, various issues.

provide, for each financial year, data on total household disposable income from various sources, not necessarily in the disaggregations required for this study. The publication, Commonwealth Government Finance¹ (or, as previously titled, Public Authority Finance), provides more disaggregated information regarding government cash benefits to persons, such as unemployment benefits and pensions. Information regarding the disaggregation of income according to demographic groups is available from various issues of Income Distribution, Australia² and from Social Indicators³. We require total household disposable income to be divided into five categories:

- (i) earned income, which is constructed from the Australian National Accounts as the sum of wages, salaries and supplements plus the income of unincorporated enterprises less income tax payable;
- (ii) unemployment benefit income, which is derived from Commonwealth Government Finance;
- (iii) not-in-the-labour force income (where this income consists of transfers paid to persons as a result of their not-in-the labour force status and which would cease if these persons entered the labour force), which is derived from Commonwealth Government Finance as the sum of age and invalid pensions, widows pensions, supporting mothers pensions, sickness and special benefits, war and service and other pensions, third party insurance transfers and unfunded retirement benefits;

1. Australian Bureau of Statistics, Commonwealth Government Finance, Australia, Cat. No. 5502.0, various issues.

2. Australian Bureau of Statistics, Income Distribution, Australia, Cat. No. 6502.0, various issues.

3. Australian Bureau of Statistics, Social Indicators, Australia, Cat. No. 4101.0, various issues.

- (iv) unearned income (where this income is derived from sources totally unrelated to labour force status and does not represent the principal source of income for those receiving it), which is derived from the Australian National Accounts and Commonwealth Government Finance as the sum of education and health benefits, child endowment, imputed income from dwellings, and cash benefits from State and local governments less consumer debt interest and other direct taxes and fees; and
- (v) unearned income, - principal source (where this is the principal source of income for those receiving it), which is derived from the Australian National Accounts as the sum of interest and dividends plus net transfers from overseas.

The division of aggregate household disposable income into the above five categories is not ideal; in some cases it has been difficult to assign a particular type of income to the correct category --for instance, income from third party insurance transfers and unfunded retirement benefits may not necessarily cease if the recipients join the labour force -- and in other cases more than one category may apply -- for instance, income tax payable should have been deducted from more than just the earned income category. Lack of alternative data precludes further refinements.

The five income categories discussed above were not available disaggregated according to the demographic groups required for the headship model. This disaggregation was made using information from various issues of Income Distribution, Australia, which was, unfortunately, not available for all years of the sample period, plus data on unemployment benefit payments from Social Indicators. The information required to make these disaggregations was not complete;

in fact, whilst a disaggregation into the required eight age groupings could be made, it was only possible to disaggregate by sex and not by marital status. Hence, the income data available for the estimation of the headship model consist of a time series of financial year real per capita incomes from 1961/62 to 1975/76 disaggregated by source, by sex and by eight age groups.

This income is not, however, supernumerary income, so the level of subsistence income must be deducted. To simplify the data requirements, it has been assumed that the level of real subsistence income per capita does not vary between demographic or labour force status groups, but only with time. Within the class of demand systems models based on the Klein-Rubin utility function, we can define the Frisch parameter, ω , as equal to the negative of the ratio of total expenditure to supernumerary expenditure.¹ Hence,

$$-\omega = \frac{Y_t - s_t}{(Y_t - s_t - \Gamma_t)},$$

where Y_t is real disposable household income per capita, s_t are real savings per capita and Γ_t is real subsistence income (or expenditure) per capita. Thus,

$$\Gamma_t = (Y_t - s_t) \left[1 + \frac{1}{\omega} \right].$$

Williams² has developed a general relationship between the Frisch parameter and real household income per capita which, when converted

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1. The seminal paper on the Frisch parameter is R. Frisch, "A Complete Scheme for Computing all Direct and Cross-Demand Elasticities in a Model with many Sectors", Econometrica, Vol.27, 1959, pp.177-196.
 2. Constantino Lluich, Alan A. Powell and Ross A. Williams, Patterns in Household Demand and Saving (New York: Oxford University Press, 1977), p. 76ff.

to 1966/67 Australian dollars, becomes

$$- \omega_t = 2.4834 Y_t^{-0.36} .$$

It follows that real per capita subsistence income is given by

$$r_t = (Y_t - s_t) \left[1 + \frac{1}{-2.4834 Y_t^{-0.36}} \right] .$$

The level of real per capita supernumerary income for each sex and age group is thus given by the level of real per capita income for that group less the level of real per capita subsistence income for the economy as a whole, as given in the above equations.

Since we require the income data to be permanent, rather than transitory, we make a weighted moving average over the data for each Census year and the four financial years preceding it to arrive at the real per capita supernumerary incomes to be used in the estimation of the model.¹

We also require an index of the cost of setting up, or maintaining, a separate household which can be used as a deflator for the incomes which have been calculated above. This index was calculated as a weighted average of the "housing" and "household equipment and

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1. The weights for the current Census period t , and the previous 4 financial years are given the values set out below:

t	0.24030
$t-1$	0.23256
$t-2$	0.21706
$t-3$	0.18605
$t-4$	0.12403

The sequence is defined so that

$$\left[\omega_{t-j} - \omega_{t-(j+1)} \right] = \left(2^j / \sum_{j=0}^4 2^j \right) \omega_t ; j=0, \dots, 3,$$

and

$$\sum_{j=0}^4 \omega_{t-j} = 1.0 .$$

operation" components of the Consumer Price Index¹ (CPI). The real income variables were converted back to nominal terms using the CPI and then deflated by an index of housing prices, namely a weighted average of the "housing" and "household equipment and operation" components of the CPI. The income variables are therefore expressed in terms of constant housing prices.

The construction of the labour force series to be used in the estimation of the econometric model has been fully documented elsewhere², but a short discussion will be given here. The major sources of data on the labour force participation and unemployment of the Australian population are: the Workforce Survey³, which provides quarterly information at a highly aggregated level for years prior to 1964; the Labour Force Survey⁴, which has been conducted quarterly since 1964 and monthly since February 1978; and the Labour Force Experience Survey⁵, which has been conducted intermittently since 1969, with data being available for 1968, 1972, 1974, 1975, 1976, 1978 and 1979. These surveys have varied over time in the nature of the data provided and their level of disaggregation. Ideally the labour force data required for the estimation of the household headship model are, for a "typical week" in each financial year from 1961/62 to 1975/76, labour force participation

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1. Australian Bureau of Statistics, Consumer Price Index, Cat. No. 6401.0, various issues.
 2. Pamela Williams, "Labour Force Data Requirements for the IMPACT Project's Household Headship Model", IMPACT Research Memorandum, BACHUROO Module, Melbourne, July. 1981.
 3. Australian Bureau of Statistics, Labour Report, various issues.
 4. Australian Bureau of Statistics, Labour Force, Cat.No. 6203.0, various issues.
 5. Australian Bureau of Statistics, Labour Force Experience, Cat. No. 6206.0, various issues.

and unemployment rates disaggregated by demographic groups (where these groups are the same as those available for household headship ratios), and average durations (as a fraction of the year) of labour force participation and unemployment disaggregated by demographic groups.

These data series were collected and partly constructed from information given in the three surveys, supplemented by some Census information. The Australian Bureau of Statistics has made revisions to labour force data prior to 1978 to incorporate improved population estimates and to ensure comparability with more recent survey data. Where possible, revised figures, have been used. To enable the use of these revised figures, which are available for only the August quarters, we have assumed that the August revised survey figures represent a "typical" survey week, and therefore reflect employment conditions over the year as a whole. The series were all constructed on a calendar year basis and were averaged to give financial year series.

As discussed above, the major source of data on labour force participation and unemployment rates was the Labour Force Survey. However, the only source of suitable labour force data prior to 1964 was the Workforce Survey, which was of limited use since it did not cover the entire labour force and provided highly aggregated data. Prior to 1964, we used labour force participation rates and unemployment rates, disaggregated only by sex, from the Workforce Survey. They were disaggregated further using the age and marital status distributions suggested by the 1964 Labour Force Survey data. In general, the Labour Force Survey provides information, from 1964, on labour force participation rates for males and females, married and not married, for the

eight age groups¹ required in our analysis. However, the data on unemployment rates provided by this survey are generally only available for males and females, while the only marital status disaggregation available is into married and not married for females from 1972. Moreover the Labour Force Survey disaggregates unemployment rates by age only to the level of six groups,² where the first five groups correspond to the required age groupings and the sixth age grouping is for persons aged 55 and over. It was decided to use labour force data disaggregated by the required eight age groupings, which implied the need to construct series of unemployment rates for persons aged 55 and over. This was achieved using proportions calculated from Census data. For the disaggregation across marital states, the lack of data is more severe, and it was decided to use labour force data for males only (undisaggregated by marital status) and for females disaggregated into married and not married. If the labour force behaviour of males and not married females did not vary greatly across the individual marital states, this lack of disaggregation would not substantially distort our results. Census data indicate that this is not in fact true; for example, never married males have lower labour force participation rates and higher unemployment rates than the male average and never married females have higher labour force participation rates than the not married female average. Unfortunately, lack of data disallows improvements in this regard. Given the disaggregation into married and not married females, it

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1. Whilst the eight age groups are generally available, the groups 55-59 and 60-64 were aggregated up to the August quarter of 1966. The combined group was disaggregated using proportions suggested by the earliest available disaggregated year.
 2. Prior to 1970, the age groups 20-24 and 25-34 were combined into the group 20-34, and the age groups 35-44, 45-54 and 55 and over were combined into the group 35 and over. As for the labour force data, combined groups were disaggregated using proportions suggested by the earliest available disaggregated year.

was necessary to construct individual data series of the unemployment rates of these two groups. Female unemployment rates are disaggregated by age and into married and not married from 1972, so the data prior to this was calculated using the age distributions of married and not married females suggested by the 1972 data.

Whilst the Labour Force Survey provides some aggregated information on the duration of unemployment, it provides no data on the duration of labour force participation. Such data can, however, be constructed from the Workforce Experience Survey using data series of numbers of persons in the labour force or unemployed at some time during the year preceding the survey. We propose that the average duration of labour force participation (unemployment) as a proportion of the year is equal to the number of persons in the labour force (unemployed) in a typical week during the year divided by the number of persons in the labour force (unemployed) at some time during the year. We therefore require series of numbers of males and married and other females who experience, at some time during the year, labour force participation or unemployment, disaggregated by eight age groups, for each year from 1961 to 1976. As this information was available only for some years in the sample period and for only a limited disaggregation, it was necessary to construct a large part of the required series. The labour force participation experience data was available in the required disaggregations, but the unemployment experience data was available only for six age groups (the same as for unemployment rates) and was not disaggregated into married and other females. The age groupings were extended, and the split of females into married and other was achieved, using the same methods described for the unemployment rates. It was then necessary to interpolate and extrapolate backwards in time to construct annual series of these

data. To do this, we specified a functional relationship over time between the known series of labour force and unemployment rate data and the partially unknown series of labour force experience and unemployment experience data.¹ Smooth relationships between average durations of labour force participation and labour force participation rates, and between average durations of unemployment and unemployment rates, were fitted to the few data points available and used to interpolate all other required data points.

1. The exact form of these relationships is given in Pamela Williams, op. cit.

5. THE RESPECIFICATION OF THE ECONOMETRIC MODEL

The respecified model of household headship attempts to explain household formation under conditions in which such formation is demand determined and not limited by constraints on the supply of housing. Since the demand for household formation of an individual is closely related to his or her demographic and socio-economic characteristics, we have attempted to incorporate these factors as fully as possible into the respecified econometric model.

(i) The Dependent Variable

We define h_{int} as the headship ratio for the i^{th} sex/marital status group of people in age group with mid-point n at time t .¹

The use of headship ratios disaggregated into demographic groups follows from Section 2, where it was shown that headship ratios exhibit certain characteristics according to the age, sex and marital status of the group under consideration, and that these characteristics persist over time.

1. There are eight sex/marital status groups, denoted by i :

- (1) never married males,
- (2) never married females,
- (3) married (including permanently separated) males,
- (4) married (including permanently separated) females,
- (5) divorced males,
- (6) divorced females,
- (7) widowed males, and
- (8) widowed females;

and there are eight age groups, denoted by n :

- | | |
|------------|------------------|
| (1) 15-19, | (5) 45-54, |
| (2) 20-24, | (6) 55-59, |
| (3) 25-34, | (7) 60-64, and |
| (4) 35-44, | (8) 65 and over. |

We postulate that the household headship ratio for any given demographic group is logistically related to its socio-economic determinants, as follows:

$$(1) \quad h_{int} = S_{in} \left\{ 1 + \exp [f_{in} (Z_{int})] \right\}^{-1} .$$

The logistic relationship specified in (1) has a lower asymptotic limit of zero and an upper asymptotic limit of S_{in} . Now, if $0 < S_{in} < 1$, it follows that $0 < h_{int} < 1$, thus ensuring that headship ratios do not exceed their interpretable range. The value of the upper limits to headship ratios are not estimated as part of the model, but are judgementally determined from an examination of the data.

$f_{in}(Z_{int})$ is a linear function of age/sex/marital status specific demographic and socio-economic variables, Z_{int} , which are expected to affect headship ratios.

In order to estimate equation (1), we require a linear transformation. Subtracting both sides of (1) from S_{in} gives:

$$\begin{aligned} S_{in} - h_{int} &= S_{in} \left[1 - \left\{ 1 + \exp [f_{in}(Z_{int})] \right\}^{-1} \right] , \\ &= S_{in} \exp [f_{in}(Z_{int})] \left\{ 1 + \exp [f_{in}(Z_{int})] \right\}^{-1} , \\ &= h_{int} \exp [f_{in}(Z_{int})] . \end{aligned}$$

Therefore,

$$\frac{S_{in} - h_{int}}{h_{int}} = \exp [f_{in}(Z_{int})] ,$$

and

$$\log \left\{ \frac{S_{in} - h_{int}}{h_{int}} \right\} = f_{in}(Z_{int}) .$$

Let

$$(2) \quad H_{int} = \log \left\{ \frac{(S_{in} - h_{int})}{h_{int}} \right\} ,$$

then

$$(3) \quad H_{int} = f_{in}(Z_{int}), \quad (i=1, \dots, 8; n=1, \dots, 8; t=1, 2, 3) .$$

In estimation, we treat (3) as a system of equations which is estimated from pooled time series and cross-sectional information. Hence, the model has been estimated for eight sex/marital status groups (i), with data points generated by cross-sectional variations in age (n) and time series variation in Census dates (t). Because of the very limited time series data which would be available to determine the age-specific upper limits, S_{in} , for headship ratios, we have assumed that the upper limit for headship ratios is invariant with age; that is,

$$S_{in} = S_i .$$

The externally fixed values of S_i which are used in estimation are given in Table 6.

TABLE 6: THE UPPER LIMITS FOR HEADSHIP RATIOS

S_1 (never married males)	0.65
S_2 (never married females)	0.65
S_3 (married males)	0.97
S_4 (married females)	0.10
S_5 (divorced males)	0.80
S_6 (divorced females)	0.85
S_7 (widowed males)	0.85
S_8 (widowed females)	0.90

Whilst it is reasonable to assume that the upper limit for headship ratios is invariant with age, it is not reasonable to make a similar assumption for the functional relationship between headship ratios and their demographic and economic determinants. We assume that it is possible to specify some age dependency in the response of household headship to changes in its socio-economic determinants, such that the life-cycle determinants of headship are taken into account, but where it is not necessary to estimate a separate equation for each age group. Hence, we estimate a relationship of the following form:

$$(4) \quad H_{int} = f_i(n, Z_{int}) \quad , \quad \text{for } i = 1, \dots, 8 ; \quad t = 1, 2, 3.$$

From these estimated values of H_{int} , via equation (2), we can derive the implicit estimate of h_{int} , the headship ratio for the (i,n)th age/sex/marital status group in period t.

(ii) The Explanatory Variables

Selection of the demographic and socio-economic variables to be used as explanators of headship follows from the discussion given in Section 3 and that given in Williams and Brooks.¹ If the supply of housing does not provide a constraint, and the benefits from setting up or retaining a separate household remain fixed over time, an individual's decision to head a separate household will be closely related to changes in his ability to afford, and the costs of setting up and maintaining, a separate household. His ability to afford a separate household will, in turn, be closely related to his current and past levels of real supernumerary income, which is the income over and above that required for his subsistence, and the perceived uncertainty surrounding his receipt of such income, which will be related to his expectations regarding future employment, unemployment and labour force participation.

1. P.J. Williams and R. C. Brooks, op. cit., p. 4ff.

Hence, for each demographic group, we can identify two elements which will affect the average ability of the group to afford a separate household and, therefore, the level of household headship for that group:

- (i) the level of permanent real per capita supernumerary income¹, which will vary according to changes in the levels of the various sources of that income -- wages and salaries, unemployment benefits, other government transfers and unearned income; and
- (ii) the probability that an individual within that demographic group will be in receipt of such incomes, which will vary according to
 - (a) the labour force status of that individual -- the predominant source of income for employed persons is wages and salaries, for unemployed persons is unemployment benefits and for persons not in the labour force is unearned income and government transfers, whilst unearned income is received by persons of all labour force states, and
 - (b) the likely duration for which that individual will be in each labour force state -- the duration of labour force participation, employment and unemployment.

It is the relationship between household headship and the economic variables discussed above which will be highlighted in this specification.

1. Note that all incomes are given in terms of constant housing, as opposed to constant consumer, prices.

We postulate that household headship (as transformed to allow for estimation) for each demographic group will be dependent upon the utility, or satisfaction, level enjoyed by an economic agent representative of that demographic group. The expected utility index of the representative agent will be constructed in such a way as to yield plausible group behaviour with respect to household formation, given average supernumerary income and the distribution of that income among persons of different labour force status within the group. An appropriate form for such a utility index is the Klein-Rubin utility function¹, which is given by

$$(5) \quad U(Y) = \ln(Y - \Gamma), \quad Y > \Gamma,$$

where U is utility, Y is real income and Γ is the real income needed to support subsistence (all three on a per capita basis).

As we have discussed above, an individual's supernumerary income may derive from several sources depending upon his labour force status. Although data limitations have led us to assume that utility is independent of the source of income, it is clearly not independent (see (5)) of the amounts of income, which will vary over time, t , between demographic groups, (i,n) , and, for given i,n and t , according to labour force status, j . We therefore identify three labour force status groups, as follows:

- (1) persons who are in the labour force for at least some of the time but who never experience unemployment ($j = 1$),
- (2) persons who are in the labour force for at least some of the time and who are unemployed at some time ($j = 2$), and

1. The seminal article is L.R. Klein and H. Rubin, "A Constant-Utility Index of the Cost of Living", Review of Economic Studies, Vol.15, 1947-48, pp. 84-87.

(3) persons who are never in the labour force ($j = 3$).

These groupings are exhaustive of the population and identify those whose income will be directly affected by changing employment, unemployment and labour force participation.

The expected utility index for the agent representative of the (i,n) th demographic group at time t is defined to be the probability weighted sum of the utilities accruing to individual agents of the (i,n) th sex/marital status/age group belonging to each of the labour force states ($j = 1,2,3$) at time t . Thus the expected utility of the (i,n) th representative agent at time t is written as

$$(6) \quad \xi_{int} = \sum_{j=1}^3 w_{intj} \ln (Y_{intj} - \Gamma_{intj}) ,$$

where $(Y_{intj} - \Gamma_{intj})$ is real supernumerary income for the sub-group (i,n,j) at time t , and w_{intj} is the probability that a randomly selected member of the (i,n) th sex/marital status/age group will be of the j^{th} labour force status in year t^1 . The w_{intj} are estimated by population shares.

Data limitations restrict the use of equation (6) and it has been necessary to assume that

$$\Gamma_{intj} = \Gamma_t , \text{ for all } i,n,j;$$

1. The use of the expected utility criterion mirrors one possible treatment of risk in the theory of an individual agent; see M. Friedman and L.J. Savage, "The Utility Analysis of Choices Involving Risk", Journal of Political Economy, Vol.56, No.4, August 1948, pp.279-304. The analogy holds because what is formally accommodation of risk for an individual agent becomes allowance for income distributional effects in the case of a representative agent constructed to be consistent with group behaviour.

that is, the level of subsistence income is assumed not to vary between demographic or labour force status groups, but only with time. Equation (6) therefore becomes

$$(7) \quad \xi_{int} = \sum_{j=1}^3 w_{intj} [\ln(Y_{intj} - \Gamma_t)] .$$

ξ_{int} , from here on referred to as expected utility of income, is the economic explainer of transformed headship in the model, and we can specify equation (4) as follows:

$$(8) \quad H_{int} = \alpha_{in} + \epsilon_{in} \xi_{int} .$$

This formulation, however, implies that separate coefficients are necessary for each of the 64 sex/marital status/age groups and that separate equations would be specified for each of these age groups. As discussed above, the data do not allow for the estimation of this large number of parameters and it will be necessary to restrict the coefficients in some way which will still allow for the demographic characteristics of headship to be captured. We postulate that the response of individuals, in terms of their headship decision, to economic stimuli will vary with age, such that younger persons will be more likely, and older persons less likely, to change their living arrangements in response to changes in their economic situation. This is because, when compared to older persons, younger persons are more mobile, have a wider range of acceptable alternatives with respect to accommodation and are less likely to have wealth that could act as a buffer under adverse economic conditions. We specify

$$(9) \quad \epsilon_{in} = \beta_i + \gamma_i n + \delta_i n^2 .$$

This formulation should impose age dependency on the response of transformed headship to changes in its economic determinants.

The final form of the equations to be estimated is as follows:

$$(10) \quad H_{int} = \alpha_{in} + (\beta_i + \gamma_i n + \delta_i n^2) \xi_{int},$$

where

$$(11) \quad H_{int} = \log \left(\frac{S_i - h_{int}}{h_{int}} \right),$$

and

$$(12) \quad \xi_{int} = \sum_{j=1}^3 w_{intj} \ln(Y_{intj} - \Gamma_t),$$

It is possible to interpret this model in terms which clearly indicate the micro-level behaviour which is implied by the model.¹ This alternative interpretation has been presented for interested readers in Appendix 1.

(iii) Generation of the Income Data

In order to estimate the system of equations, (10) - (12), it is necessary to separate the population into the three labour force status categories and to identify the income accruing to each of these groups. To accord with data availability, we express these requirements in terms of labour force participation and unemployment rates, durations of labour force participation and unemployment, and incomes according

1. We are grateful to Alan Powell for this interpretation.

to their source. Quite apart from data availability, if the equations of the model can be expressed in terms of rates and durations of labour force participation and unemployment, and in terms of incomes according to source, it will be possible to determine directly the relationship between household headship and these variables and the response of household headship to changes in these variables.

Let the number of persons in the n^{th} age and i^{th} sex/marital status group in period t be x_{int} . x_{int} can be separated into three components corresponding to the three labour force status categories described above:

- (i) x_{int1} , the number who are in the labour force for at least some part of period t and who are never unemployed during that period;
- (ii) x_{int2} , the number who are in the labour force for at least some part of period t , but who are unemployed at some time during that period; and
- (iii) x_{int3} , the number who are not in the labour force at any time during period t .

We also define x_{intk} to be the number of persons of the n^{th} age and i^{th} sex/marital status group who are employed ($k = 1$), unemployed ($k = 2$), and not in the labour force ($k = 3$), in the "typical" survey week, which should reflect labour force and unemployment conditions over the year as a whole. These three components are exhaustive of the population in the typical week, so it follows that

$$(13) \quad \sum_{k=1}^3 x_{intk} = \sum_{j=1}^3 x_{intj} \stackrel{\text{def}}{=} x_{int} ,$$

We can also define the total number in the labour force in the "typical" week as

$$(14) \quad L_{int} = X_{int1} + X_{int2} \quad ,$$

By dividing the population in this manner, it is possible to determine simple expressions for labour force participation and unemployment rates and for the average duration of participation in the labour force and of unemployment. The labour force participation rate in a typical week in period t is given by

$$(15) \quad \ell_{int} = \frac{L_{int}}{X_{int}} \quad ,$$

and the corresponding unemployment rate is given by

$$(16) \quad u_{int} = \frac{X_{int2}}{L_{int}} \quad .$$

The average duration in the labour force as a fraction of a year, in period t , is given by the ratio of those persons who are in the labour force during the typical week to those persons who, at some time during period t , were in the labour force; that is,

$$(17) \quad \lambda_{int} = \frac{L_{int}}{\Lambda_{int}} \quad ,$$

where, analogously to equation (14),

$$(18) \quad \Lambda_{int} = \mathcal{X}_{int1} + \mathcal{X}_{int2} \quad ,$$

is the number of persons who are in the labour force at any time during period t . The average duration of unemployment (among those who do

experience unemployment in period t) as a fraction of a year is

$$(19) \quad \mu_{int} = \frac{X_{int2}}{\mathcal{X}_{int2}} .$$

It is possible to express the number of people in each of our three labour force status categories, \mathcal{X}_{intj} , in terms of the variables discussed above.

Firstly,

$$\begin{aligned} \mathcal{X}_{int1} &= \Lambda_{int} - \mathcal{X}_{int2} \quad \text{from (18)} \\ &= \frac{L_{int}}{\lambda_{int}} - \frac{X_{int2}}{\mu_{int}} \quad \text{from (17) and (19)} \\ &= L_{int} \left[\frac{1}{\lambda_{int}} - \frac{u_{int}}{\mu_{int}} \right] \quad \text{from (16)} \\ (20) \quad &= X_{int} \left[\frac{\ell_{int}}{\lambda_{int}} - \frac{\ell_{int} u_{int}}{\mu_{int}} \right] \quad \text{from (15)} . \end{aligned}$$

Secondly,

$$\begin{aligned} \mathcal{X}_{int2} &= \frac{X_{int2}}{\mu_{int}} \quad \text{from (19)} \\ &= \frac{L_{int} u_{int}}{\mu_{int}} \quad \text{from (16)} \\ (21) \quad &= X_{int} \left[\frac{\ell_{int} u_{int}}{\mu_{int}} \right] \quad \text{from (15)} . \end{aligned}$$

Thirdly,

$$\begin{aligned} \mathcal{X}_{int3} &= X_{int} - \Lambda_{int} \quad \text{from (13) and (18)} \\ &= X_{int} - \frac{L_{int}}{\lambda_{int}} \quad \text{from (17)} \\ (22) \quad &= X_{int} \left[1 - \frac{\ell_{int}}{\lambda_{int}} \right] \quad \text{from (15)} . \end{aligned}$$

Now, the variable in which we are interested, from equation (10), is the expected utility of income, ξ_{int} , which is, from equation (12),

$$\xi_{int} = \sum_{j=1}^3 w_{intj} \ln (Y_{intj} - \Gamma_t) \quad .$$

As defined previously, the w_{intj} are the shares of the population in the j^{th} labour force status category. From equation (13),

$$(23) \quad w_{intj} = \frac{X_{intj}}{X_{int}} \quad (j = 1, 2, 3) \quad .$$

Substituting into equation (12), using equations (20), (21) and (22), we have

$$(24) \quad \begin{aligned} \xi_{int} = & \left[\frac{\ell_{int}}{\lambda_{int}} - \frac{\ell_{int} u_{int}}{u_{int}} \right] \ln (Y_{int1} - \Gamma_t) \\ & + \left[\frac{\ell_{int} u_{int}}{u_{int}} \right] \ln (Y_{int2} - \Gamma_t) \\ & + \left[1 - \frac{\ell_{int}}{\lambda_{int}} \right] \ln (Y_{int3} - \Gamma_t) \quad . \end{aligned}$$

We wish to express the incomes, Y_{intj} , which accrue to individuals in the j^{th} labour force status in terms of incomes, I_{intk} , according to the source, k , of that income. We define I_{intk} , for each age and sex/marital status group to be:

- (i) firstly ($k=1$), the income which would be earned by a person in full-time employment for the whole year -- wages, salaries and supplements;

- (ii) secondly (k=2), the income which would be received by a person who is unemployed for the whole year (and which would cease if that person was to become employed) -- unemployment benefit payments;
- (iii) thirdly (k=3), the income which would be received by a person by virtue of his not being in the labour force (and which would cease if that person entered the labour force) -- sickness and invalid pensions, supporting mothers and widows pensions and the like;
- (iv) fourthly (k=4), per capita unearned income, from sources totally unrelated to labour force status, which does not represent the principal source of income for those receiving it -- education and health benefits, child endowment and the like; and
- (v) fifthly (k=5), per capita unearned income, which is the principal source of income for those receiving it -- interest and dividends and the like.

Given these definitions, it follows that the per capita income accruing to persons who are in the labour force at least some part of period t and who are never unemployed during that period, Y_{int1} , will be given by

$$(25) \quad Y_{int1} = \lambda_{int} I_{int1} + (1 - \lambda_{int}) I_{int3} + I_{int4} .$$

Hence, the per capita income of these persons is the sum of their income from employment (which is dependent on the average length of

duration of non-participation in the labour force, $(1 - \lambda_{int})$, and the per capita income which would be received by a person by virtue of his not being in the labour force, I_{int3} , and from sources totally unrelated to labour force status (which is dependent on per capita income derived from sources outside the labour force, I_{int4}).

Similarly, the per capita income accruing to persons who are in the labour force for at least some part of period t but who are unemployed for some part of that period, Y_{int2} , will be given by

$$(26) \quad Y_{int2} = \lambda_{int} \left[\mu_{int} I_{int2} + (1 - \mu_{int}) I_{int1} \right] \\ + (1 - \lambda_{int}) I_{int3} + I_{int4} .$$

Hence, the per capita income of these persons is the sum of their income from labour force sources (which is dependent on the average duration of their participation in the labour force, λ_{int} ; the duration of their unemployment, μ_{int} , and the per capita full-year unemployment benefit income, I_{int2} ; and the average duration of their employment, $(1 - \mu_{int})$, and the per capita full year employment income, I_{int1}), from sources related to non-labour force participation (which is dependent on the average length of duration of non-participation in the labour force, $(1 - \lambda_{int})$, and the per capita income which would be received by a person by virtue of his not being in the labour force, I_{int3}), and from sources totally unrelated to labour force status (which is dependent on per capita income derived from sources outside the labour force, I_{int4}).

Finally, the per capita income accruing to persons who are never in the labour force during period t , Y_{int3} , will be given by

$$(27) \quad Y_{int3} = I_{int3} + I_{int4} + I_{int5} ,$$

being the sum of per capita income from sources related to non-participation in the labour force (such as sickness benefits, and the like), I_{int3} , and per capita incomes from sources unrelated to the labour force, where these incomes are received by everyone, I_{int4} , or as the principal source of income, I_{int5} .

Substituting (25), (26) and (27) into equation (24) gives

$$(28) \quad \xi_{int} = \left[\frac{\ell_{int}}{\lambda_{int}} - \frac{\ell_{int} u_{int}}{\mu_{int}} \right] \ln \left[\begin{array}{l} \lambda_{int} I_{int1} + (1 - \lambda_{int}) I_{int3} \\ + I_{int4} - \Gamma_t \end{array} \right]$$

$$= \left[\frac{\ell_{int} u_{int}}{\mu_{int}} \right] \ln \left[\begin{array}{l} \lambda_{int} \left\{ \mu_{int} I_{int2} + (1 - \mu_{int}) I_{int1} \right\} \\ + (1 - \lambda_{int}) I_{int3} + I_{int4} - \Gamma_t \end{array} \right]$$

$$+ \left[1 - \frac{\ell_{int}}{\lambda_{int}} \right] \ln \left[I_{int3} + I_{int4} + I_{int5} - \Gamma_t \right] .$$

The results of the estimation of this model are given in the following section, along with an analysis of how the model suggests household headship will respond to changes in incomes (according to their sources), labour force participation and its duration, and unemployment and its duration.

6. ESTIMATION RESULTS

The econometric model specified in Section 5 was estimated separately for eight sex/marital status groups using ordinary least squares (OLS) on an equation by equation basis.¹ The results of the estimation of the coefficients of the constant terms and of ξ_{int} in equation (10) are presented in Table 7.

(i) The Parameter Estimates

In general, the results are encouraging. The fit of the equations, as measured by the coefficient of determination (adjusted for degrees of freedom), is good for all equations estimated. We had expected that the signs on the parameters of the expected utility of income for each sex/marital status/age group would be negative, since headship could be expected to vary directly with changes in income. This was true for all sex/marital status groups and all age groups, with the exceptions of the older (55-59, 60-64 and 65 and over) age groups for married women. Whilst this implies, counter-intuitively, that the headship of older married women will fall with increases in their expected utility of income, we are not particularly concerned since, firstly, most of the offending coefficients are not significantly different from zero at the 95% level and, secondly, the small numbers of married women who are

1. For the original model, an attempt was made to estimate the equations as a system of seemingly unrelated regressions using the full information maximum likelihood (FIML) technique. This was not successful due to the presence of minor specification errors. Hence, the ordinary least squares estimation technique was used instead of FIML because of the superior robustness of the former. The same approach has been adopted in the estimation of the respecified model. See P.J. Williams and R.C. Brooks, op. cit., pp.23-26, for a fuller discussion.

TABLE 7 : OLS PARAMETER ESTIMATES FOR THE ECONOMETRIC MODEL OF HOUSEHOLD HEADSHIP¹

Age Group	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65+	ϵ_{i8}	ϵ_{i8}^2							
Sex/Marital Status Group ²	α_{i1}	α_{i2}	α_{i3}	α_{i4}	α_{i5}	α_{i6}	α_{i7}	α_{i8}	ϵ_{i8}	R^2							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
NMM	8.169 (16.32)	-2.019 (15.57)	13.940 (13.63)	-2.437 (14.62)	16.488 (14.62)	-2.856 (14.12)	17.077 (11.45)	-3.028 (11.50)	15.077 (10.26)	-2.762 (10.71)	11.614 (9.95)	-2.273 (10.88)	8.567 (9.02)	-1.809 (10.36)	3.128 (3.27)	-0.908 (4.30)	.993
NMF	4.254 (23.67)	-0.794 (5.79)	5.131 (3.92)	-0.792 (3.92)	3.880 (4.13)	-0.762 (3.36)	2.794 (2.88)	-0.673 (2.56)	1.396 (1.85)	-0.527 (2.18)	.101 (0.24)	-0.381 (2.14)	-0.377 (1.09)	-0.266 (2.25)	-0.959 (3.68)	-0.067 (0.73)	.960
MM	1.306 (4.77)	-0.854 (10.60)	5.191 (13.97)	-1.367 (13.97)	8.077 (13.09)	-1.907 (17.24)	9.158 (11.22)	-2.206 (15.32)	8.067 (10.04)	-2.024 (14.35)	5.512 (8.63)	-1.572 (13.75)	3.088 (5.95)	-1.119 (11.71)	-1.488 (2.84)	-0.215 (1.86)	.999
MF	2.001 (52.90)	-0.667 (7.26)	2.514 (14.10)	-0.526 (7.85)	1.289 (12.62)	-0.344 (7.64)	.504 (4.84)	-0.157 (3.87)	.102 (1.12)	-0.051 (0.78)	.098 (1.74)	.023 (0.75)	.068 (1.07)	.039 (1.79)	-0.272 (4.24)	.034 (1.52)	.990
DM	6.890 (11.74)	-2.488 (14.70)	15.435 (14.00)	-2.936 (14.00)	18.389 (13.91)	-3.361 (14.17)	18.925 (10.82)	-3.470 (11.25)	16.512 (9.58)	-3.061 (10.13)	12.533 (9.16)	-2.412 (9.84)	8.991 (8.08)	-1.816 (8.86)	2.371 (2.11)	-0.678 (2.74)	.973
DF	2.496 (13.42)	-1.270 (5.39)	5.847 (6.37)	-1.191 (5.70)	4.028 (4.15)	-1.060 (4.52)	1.980 (1.98)	-0.863 (3.17)	.611 (0.78)	-0.638 (2.55)	-0.313 (0.71)	-0.453 (2.45)	-0.343 (0.95)	-0.321 (2.62)	-0.722 (2.68)	-0.110 (1.16)	.924
WM	4.470 (2.72)	-1.390 (1.77)	9.356 (3.18)	-1.698 (2.89)	10.742 (2.90)	-2.001 (3.01)	10.511 (2.15)	-2.111 (2.44)	8.801 (1.82)	-1.887 (2.23)	6.655 (1.74)	-1.500 (2.18)	4.658 (1.49)	-1.136 (1.98)	1.290 (0.41)	-0.434 (0.63)	.887
WF	1.767 (13.39)	-0.893 (5.34)	3.751 (5.76)	-0.833 (5.61)	1.790 (2.60)	-0.735 (4.41)	-0.211 (0.30)	-0.591 (3.06)	-0.885 (1.60)	-0.431 (2.43)	-1.071 (3.40)	-0.300 (2.29)	-0.894 (3.50)	-0.208 (2.40)	-0.561 (2.93)	-0.063 (0.94)	.975

1. Columns (1) to (16) contain estimated parameters (and t-ratios) for the constant terms (whose parameters are denoted by α_{in}) and for the expected utilities of income (whose parameters are denoted by $\epsilon_{in} = (\beta_i + \gamma_i n + \delta_i n^2)$). Column (17) shows the coefficient of determination adjusted for degrees of freedom.

2. The sex/marital status groups are defined in the footnote on page 40.

household heads often assume that position under atypical circumstances. Married female headship is most likely to occur when the couple are temporarily or permanently separated, when the wife takes a dominant role in the household or when the husband has been institutionalized for a long period (for example, imprisoned or hospitalized). In few of these cases is it possible to see a direct link between the decision to head the household and income. It is, therefore, not surprising that our model implies some inconsistencies in married female headship behaviour. In most cases, for the whole model, the parameters estimated were significant at the 95% level, although insignificant parameters were more likely to appear at the older ages, especially for married females and widowed males. These results suggest that headship for the older age groups may well be determined partly by factors other than income. For instance, older persons may be less responsive, in terms of their headship decisions, to changes in their income because they are likely to have accumulated wealth which can act as a buffer in times of declining income, and they are likely to have settled living arrangements, which they would be reluctant to change. It was hoped that the age-dependency incorporated into the specification of the model would be sufficient to account for these factors, but it appears to have been unable fully to do so. Overall, the model has successfully captured the variation in headship across our eight age groups, eight marital states and the three census years. In the following section, we analyse the performance of the model for each of these groups.

(ii) The In-Sample Tracking of the Model

In terms of in-sample tracking, the econometric model has been successful in approximating headship behaviour over the period 1966 to 1976. In Table 8, the actual and estimated numbers of

TABLE 8 : ACTUAL AND ESTIMATED NUMBERS OF HOUSEHOLDS
AND HOUSEHOLD HEADSHIP RATIOS FOR AUSTRALIAN
MALES AND FEMALES BY MARITAL STATUS,
1966, 1971 AND 1976

		Never Married		Married ¹		Divorced		Widowed		All	
		Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
1966	Actual	134.2	95.1	2402.6	108.4	20.0	28.9	70.1	292.5	2627.0	525.0
	Estimated	138.5	110.0	2406.9	108.8	19.9	30.7	70.7	295.6	2636.0	545.2
1971	Actual	172.9	116.0	2753.3	126.2	32.5	45.2	80.9	343.6	3039.6	630.9
	Estimated	165.1	115.0	2742.6	126.6	32.4	44.4	78.9	344.2	3019.0	630.2
1976	Actual	247.8	157.5	2997.2	145.2	58.7	77.5	82.1	374.4	3385.8	754.6
	Estimated	248.8	134.7	2998.7	143.0	58.5	75.2	82.5	369.6	3388.4	722.5
Households ²											
Headship Ratios											
1966	Actual	.1077	.1057	.9007	.0407	.4668	.5659	.5739	.6315	.6441	.1287
	Estimated	.1111	.1222	.9024	.0408	.4646	.6012	.5791	.6383	.6463	.1337
1971	Actual	.1303	.1250	.9137	.0418	.5263	.6323	.6250	.6645	.6708	.1386
	Estimated	.1245	.1220	.9102	.0419	.5252	.6215	.6092	.6656	.6663	.1384
1976	Actual	.1745	.1491	.9268	.0448	.6112	.6343	.6338	.6853	.6939	.1519
	Estimated	.1752	.1275	.9272	.0441	.6090	.6150	.6373	.6765	.6944	.1454

1. Married includes permanently separated.

2. Households are given in thousands.

households and household headship ratios for each sex/marital status group are given. The table indicates that the econometric model closely estimated the total number of households and the total household headship ratio over the period, overestimating by 0.93% in 1966, underestimating by 0.56% in 1971 and underestimating by 0.71% in 1976. When the estimates for each sex are considered, we see that the model performed less adequately in explaining female headship behaviour. For males, household headship ratios and numbers of households were overestimated by 0.34% in 1966, underestimated by 0.66% in 1971 and overestimated by only 0.08% in 1976, whilst, for females, household headship ratios and numbers of households were overestimated by 3.85% in 1966, but underestimated by 0.11% in 1971 and 4.25% in 1976. It is disappointing that the model found it more difficult to estimate female headship and that it was increasingly underestimated over the sample period, since it is likely that the future growth in the number of households will be heavily concentrated amongst female heads. However, the model's performance in tracking in-sample headship behaviour is adequate, even when we consider the estimates disaggregated into the 64 age/sex/marital status groups.

The actual and estimated values of household headship ratios for each age/sex/marital status group are given in Table 9, and graphed in Figures 1 to 8.

(a) Never Married Males

For never married males, headship ratios increased over the sample period for all ages and, in particular, for the younger age groups (15-19, 20-24 and 25-34). The econometric model captured these increases but total never married male headship was overestimated

TABLE 9 : ACTUAL AND ESTIMATED VALUES OF HEADSHIP RATIOS FOR 1966, 1971 AND 1976¹

Sex/Marital Status Group ²	15-19		20-24		25-34		35-44		45-54		55-59		60-64		65+	
	Actual	Esti- mated	Actual	Esti- mated	Actual	Esti- mated	Actual	Esti- mated	Actual	Esti- mated	Actual	Esti- mated	Actual	Esti- mated	Actual	Esti- mated
NMM	1966	.0072	.0089	.0549	.0657	.1608	.1685	.2774	.2657	.5779	.3618	.4269	.4423	.4445	.4290	.4305
	1971	.0110	.0089	.0889	.0732	.2199	.2189	.3269	.3271	.4208	.4186	.4869	.4827	.5051	.4855	.4722
	1976	.0223	.0224	.1631	.1659	.3286	.3195	.4014	.4121	.4753	.4894	.5260	.5182	.5502	.5011	.5114
NMF	1966	.0074	.0091	.0604	.1003	.1350	.1916	.2086	.2468	.3217	.3499	.4157	.4410	.4551	.4621	.4724
	1971	.0119	.0091	.1001	.1008	.2120	.2121	.2693	.2698	.3623	.3620	.4399	.4486	.4894	.4928	.4939
	1976	.0246	.0261	.1585	.0989	.2879	.2164	.3330	.2922	.3964	.3723	.4705	.4414	.5099	.5115	.5058
MM	1966	.5488	.5669	.7652	.7774	.8739	.8755	.9224	.9243	.9298	.9298	.9232	.9252	.9134	.8867	.8874
	1971	.5729	.5662	.8120	.7877	.8989	.8948	.9347	.9350	.9399	.9389	.9354	.9334	.9257	.8939	.8926
	1976	.6671	.6565	.8475	.8564	.9184	.9197	.9477	.9460	.9486	.9486	.9411	.9402	.9290	.8989	.8979
MF	1966	.0102	.0119	.0196	.0189	.0315	.0321	.0434	.0445	.0482	.0486	.0489	.0469	.0490	.0575	.0566
	1971	.0127	.0119	.0236	.0240	.0362	.0365	.0472	.0466	.0496	.0489	.0461	.0466	.0442	.0511	.0542
	1976	.0130	.0119	.0298	.0302	.0414	.0404	.0497	.0488	.0494	.0492	.0453	.0464	.0450	.0558	.0528
DM	1966	.0686	.0879	.1448	.1743	.3464	.3548	.4474	.4439	.5061	.4879	.4931	.5143	.5166	.4764	.4915
	1971	.0872	.0872	.2320	.1951	.4351	.4426	.5169	.5271	.5593	.5607	.5777	.5704	.5677	.5484	.5329
	1976	.2182	.2259	.4138	.4129	.5949	.5803	.6321	.6250	.6363	.6454	.6319	.6201	.5953	.5759	.5747
DF	1966	.0361	.0647	.2224	.2846	.4139	.4582	.5642	.6160	.6220	.6616	.6181	.6694	.6017	.5686	.5774
	1971	.1165	.0647	.2960	.2862	.5283	.5010	.6765	.6468	.6842	.6746	.6671	.6783	.6409	.6220	.6234
	1976	.2632	.2697	.3376	.2799	.5243	.5096	.6851	.6733	.7086	.6852	.7220	.6699	.7054	.6587	.6483
WM	1966	.0500	.1217	.1194	.2014	.4121	.4397	.6332	.6426	.7012	.7129	.6833	.6941	.6514	.5306	.5319
	1971	.2727	.1212	.3264	.2147	.5390	.4948	.7097	.6815	.7575	.7392	.7394	.7180	.7086	.5599	.5599
	1976	.1967	.2057	.3502	.3425	.5692	.5833	.7103	.7264	.7634	.7692	.7300	.7391	.7191	.5869	.5890
WF	1966	.0993	.1313	.3363	.4177	.6621	.6770	.8093	.8126	.7794	.8056	.7280	.7646	.6915	.5738	.5764
	1971	.1724	.1313	.4553	.4191	.7169	.6999	.8321	.8223	.8126	.8106	.7627	.7693	.7275	.6048	.6061
	1976	.3274	.3291	.4612	.4138	.7008	.7044	.8239	.8306	.8329	.8147	.8010	.7649	.7619	.6300	.6251

1. The estimated values of the headships ratios were derived from the model described in Section 5 using the OLS parameter estimates given in Table 7.

2. The sex/marital status groups are defined in the footnote on page 40.

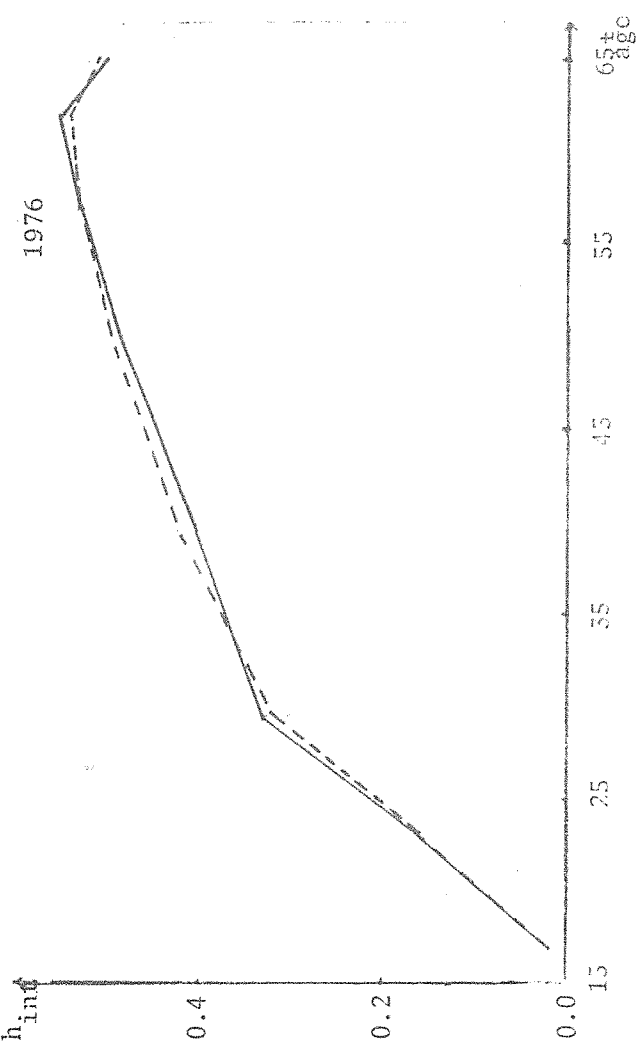
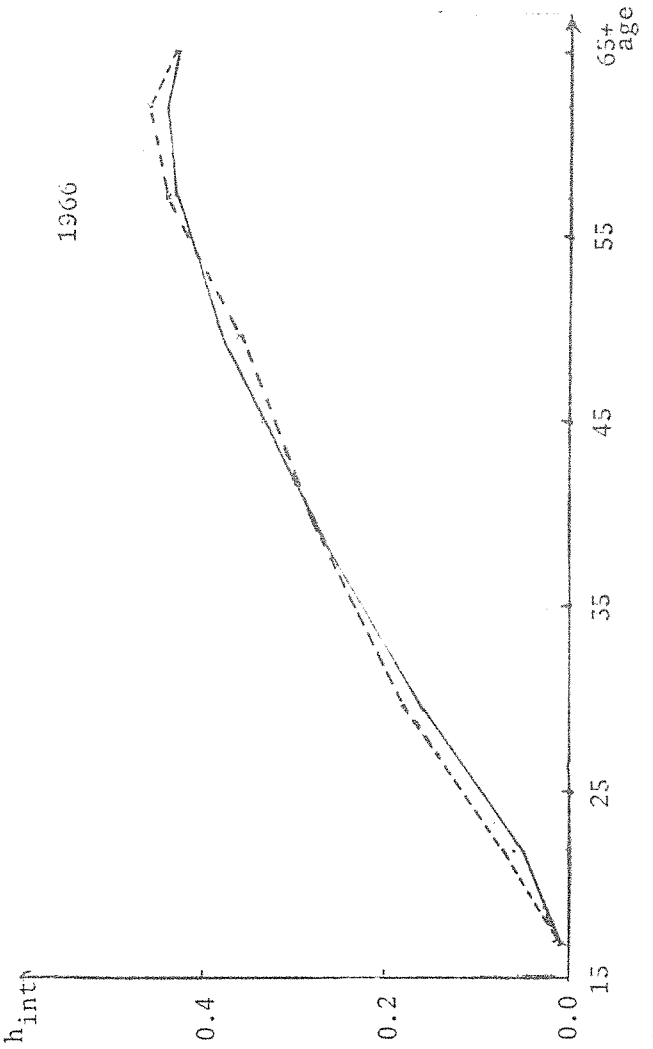
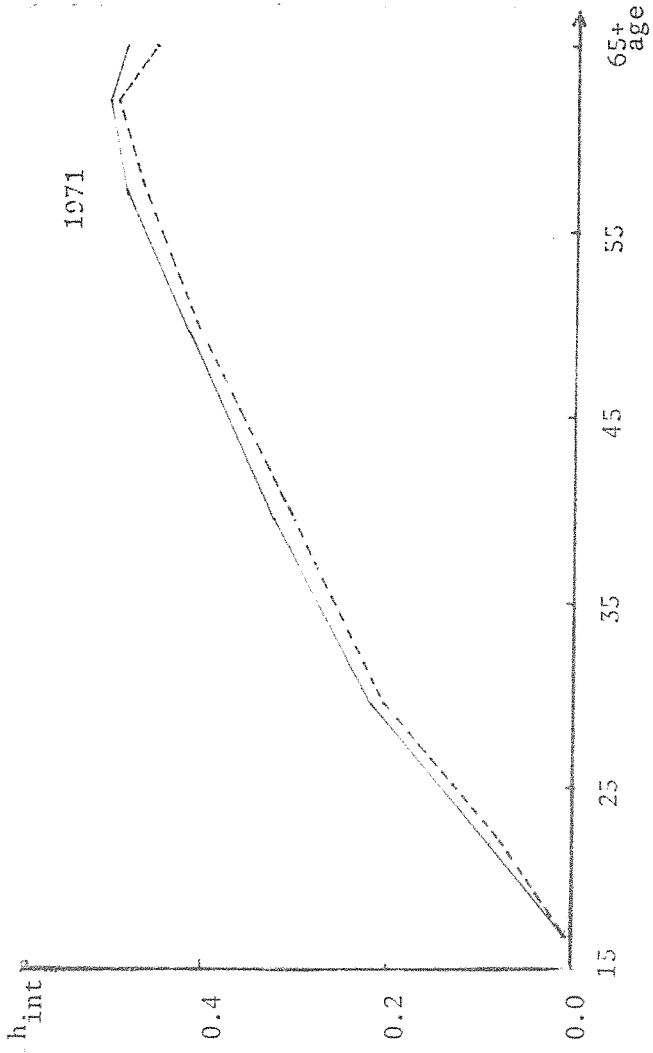


Figure 1(a)
A Comparison of Actual and Estimated
Household Headship Ratios for Never
Married Males - 1966, 1971 and 1976

1. Estimated headships are given by broken lines.

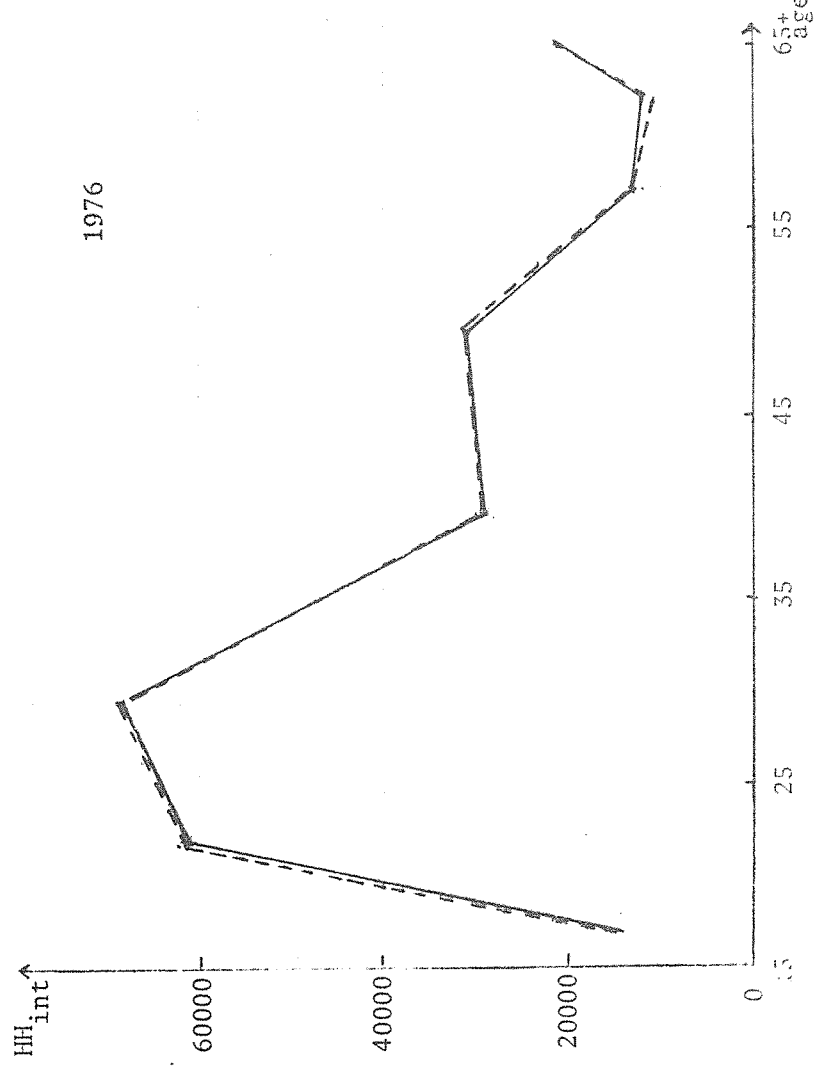
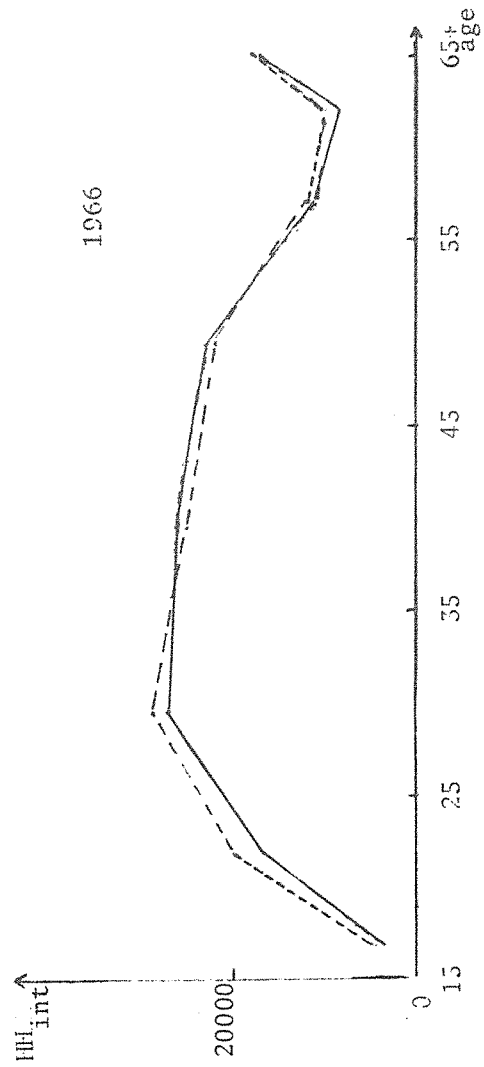
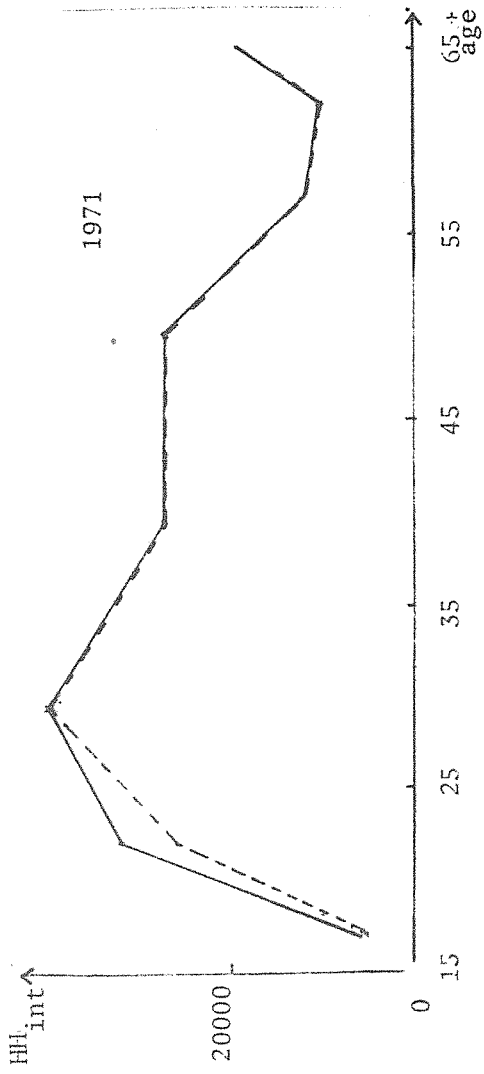


Figure 1(b)
A Comparison of Actual and Estimated
Households for Never Married Males -
1966, 1971 and 1976¹

1. Estimated households are given by broken lines.

by 3.20% in 1966, underestimated by 4.45% in 1971 and overestimated by 0.40% in 1976. The overestimation in 1966 was concentrated in the younger and older age groups, whilst in 1976 there was no consistent over or underestimation across age groups. In 1971, however, underestimation of headship ratios occurred at all ages. These results indicate that the respecification of the model has substantially improved upon the poor performance for young never married males of the previous model. Despite this, never married males still provide the worst in-sample tracking performance of all male marital states.

(b) Never Married Females

Headship ratios for never married females also increased over the period for all ages, and especially for the younger age groups. Total never married female headship was less adequately captured than its male counterpart and than any other sex/marital status group, with the model overestimating by 15.61% in 1966, and underestimating by 0.81% in 1971 and 14.49% in 1976. Whilst the underestimation in 1971 was small for most ages, the overestimation in 1966 and the underestimation in 1976 were both more severe at the younger ages. The poor performance of the model in estimating never married female headship may relate to the lack of income data fully disaggregated by marital status. Never married female headship has the income and labour force behaviour of all not married females as components of its explanator, rather than the income and labour force behaviour of only never married females. This could distort the value of the explanatory variable, since female incomes and labour force behaviour are likely to vary greatly between those who are never married and those who are previously married, for the latter are more likely to have dependent children and therefore to engage in part-time work and to be eligible for other

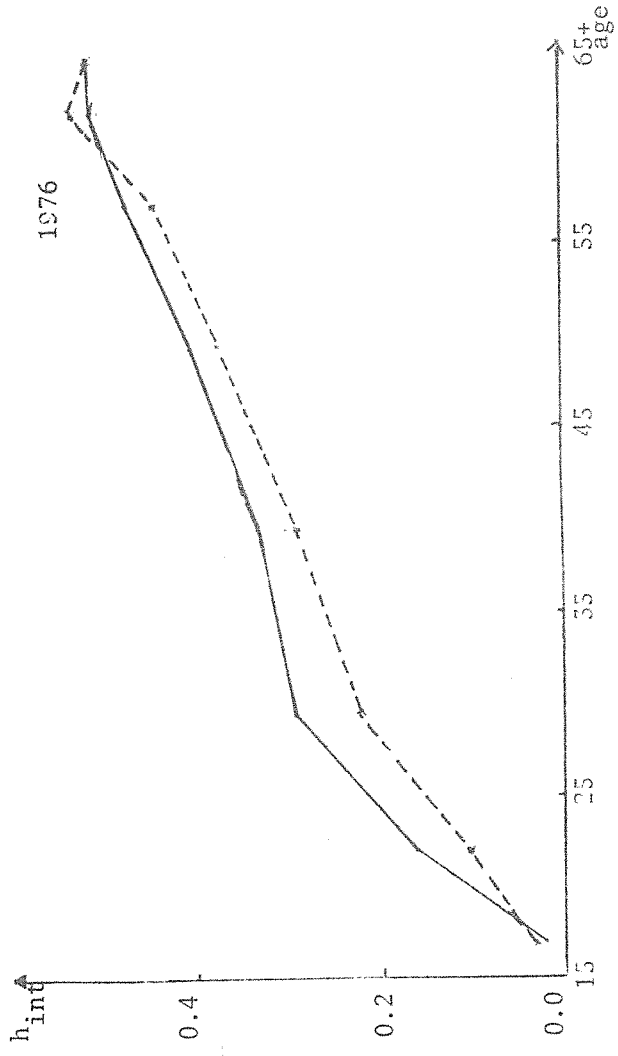
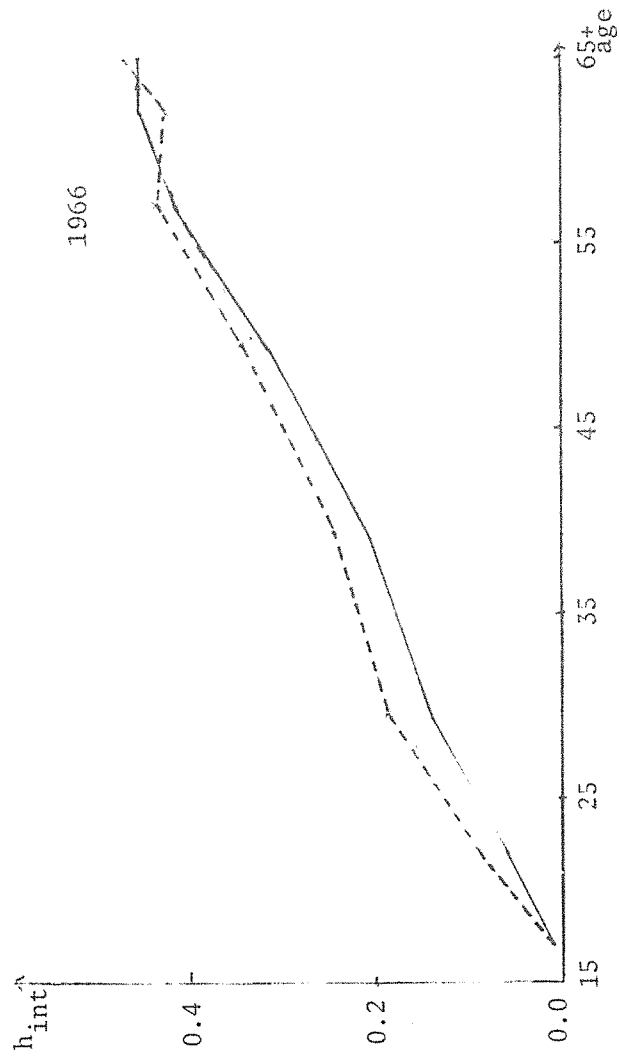
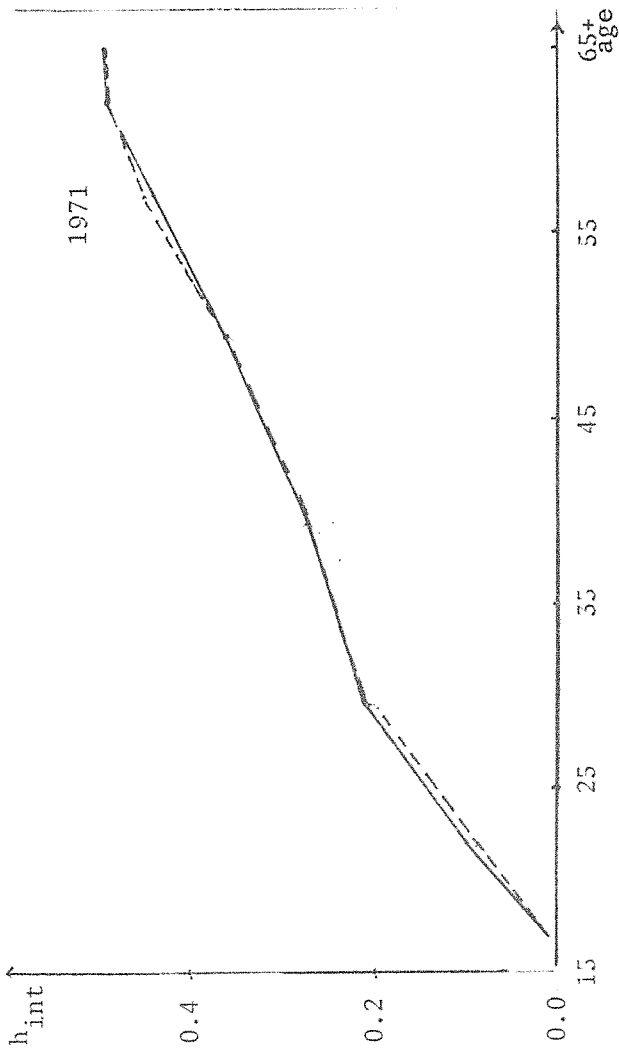


Figure 2(a)

A Comparison of Actual and Estimated Household Headship Ratios for Never Married Females - 1966, 1971 and 1976¹

1. Estimated Headships are given by broken lines.

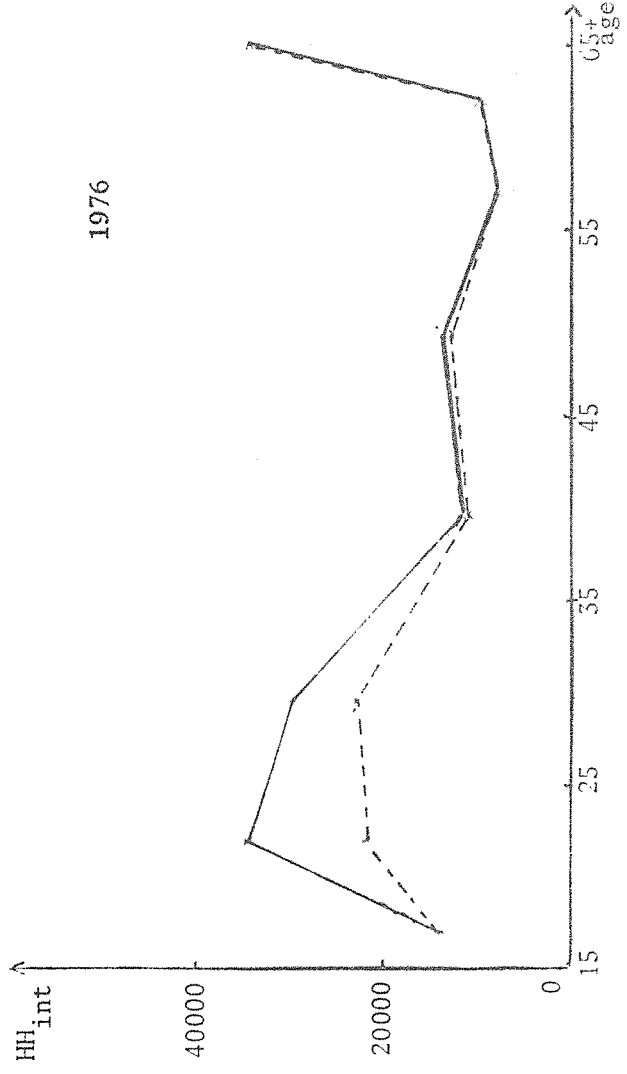
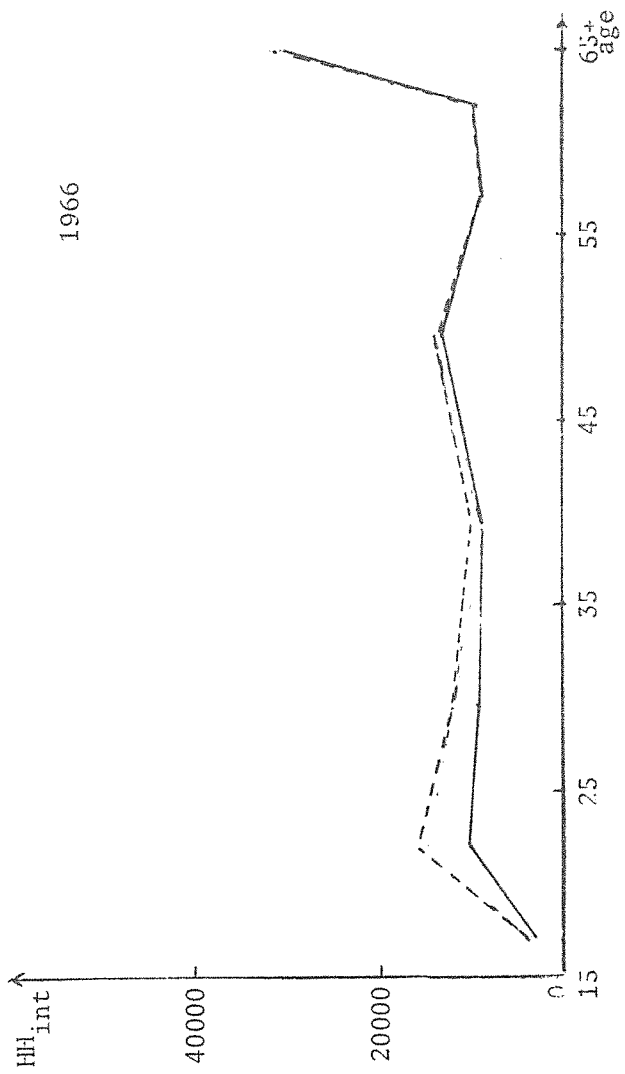
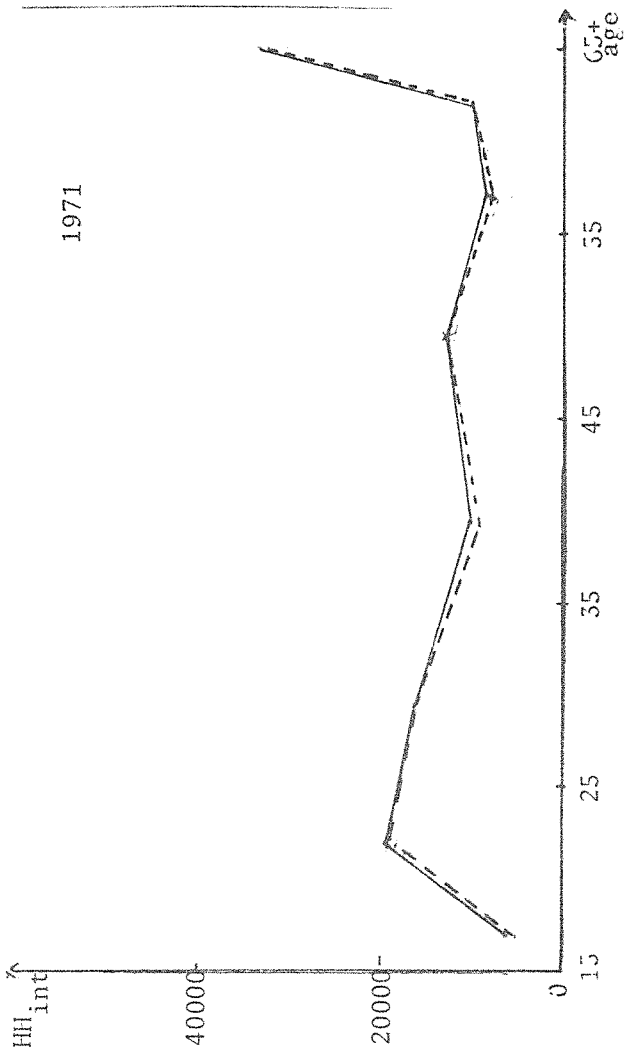


Figure 2(b)
 A Comparison of Actual and Estimated
 Households for Never Married Females -
 1966, 1971 and 1976¹

1. Estimated households are given by broken lines.

sources of income. This could also partly explain the relatively poor performance of equations for the previously married females. It is also interesting to note that the use of undisaggregated (by marital status) income and labour force data for males has not had distorting effects to the same extent. Unfortunately, improvements to the not married female headship equations may not be possible until more disaggregated data on incomes and labour force behaviour become available.

(c) Married Males

For married males, headship ratios increased over the sample period for all ages, but most dramatically at the young to middle ages. The econometric model captured these increases extremely well, with total married male headship being overestimated by only 0.19% in 1966, underestimated by 0.38% in 1971 and overestimated by 0.04% in 1976. The agreement between the estimated and actual headship ratios is generally very good for married males, although it is less close at younger ages. The married male headship equation tracked closer over the sample period than did any other sex/marital status group, which is particularly encouraging since this group traditionally provides the greatest number of household heads, and is likely to do so in the future.

(d) Married Females

Married female headship increased over the period for most age groups, with the exception of the older age groups. In general, the econometric model tracked these movements well; the model overestimated total married female headship by only 0.25% in 1966 and 0.24% in 1971 and underestimated it by 1.56% in 1976. In 1966 and 1971 there was little systematic error across ages and the agreement is

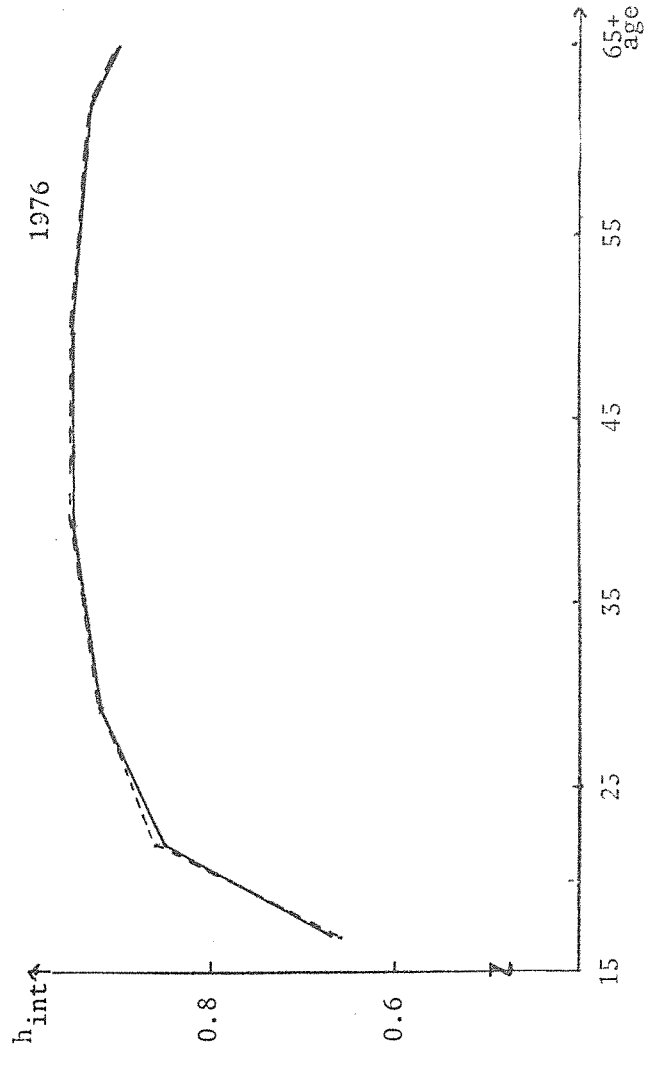
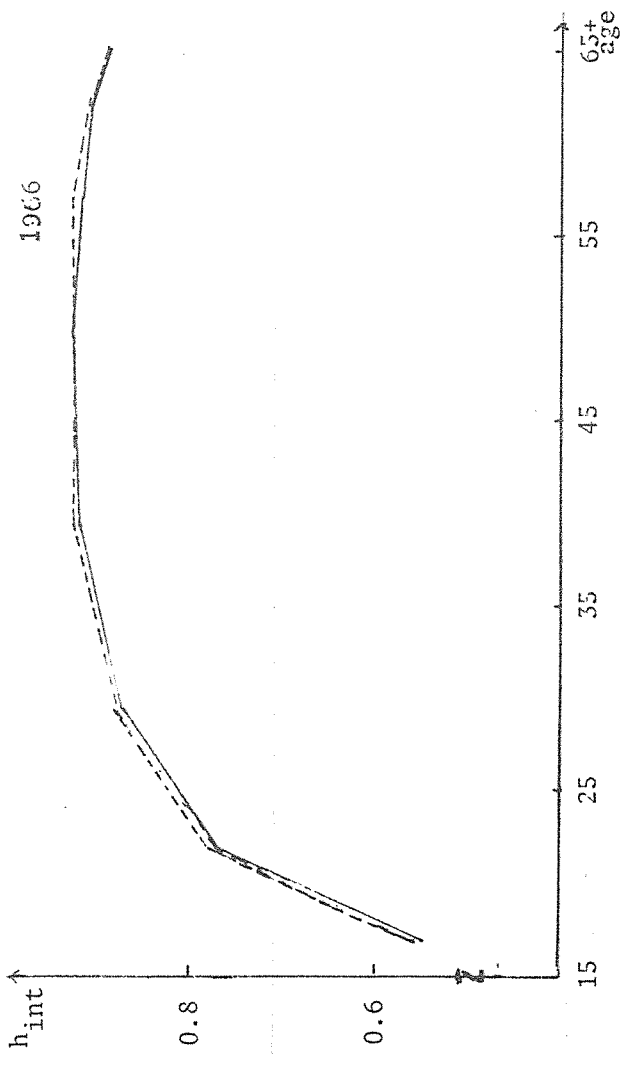
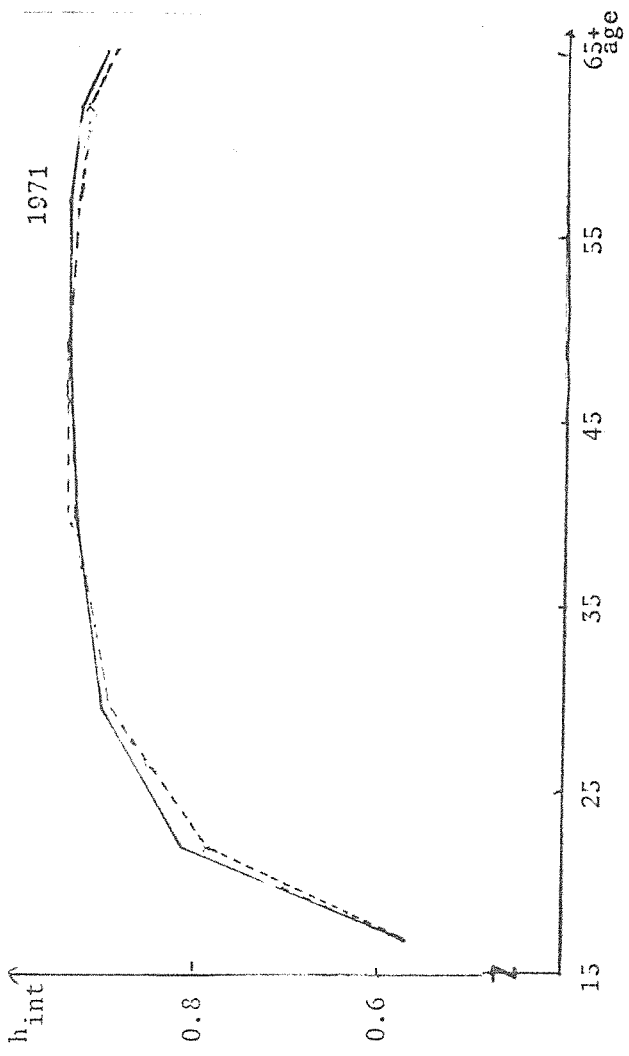


Figure 3(a)

A Comparison of Actual and Estimated Household Headship Ratios for Married Males - 1966, 1971 and 1976¹

1. Estimated headships are given by broken lines.

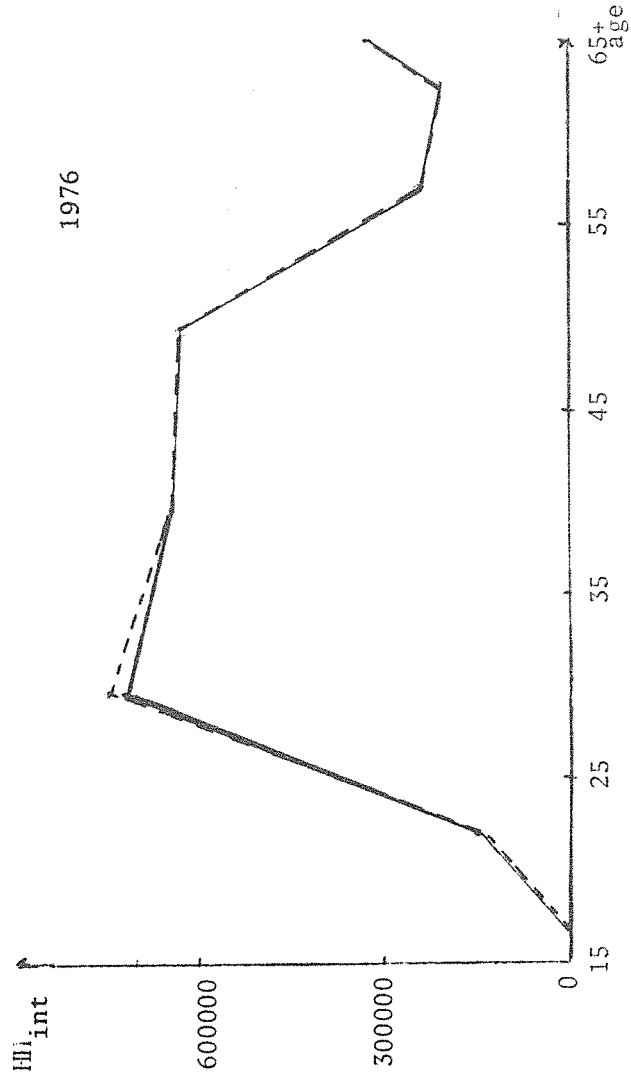
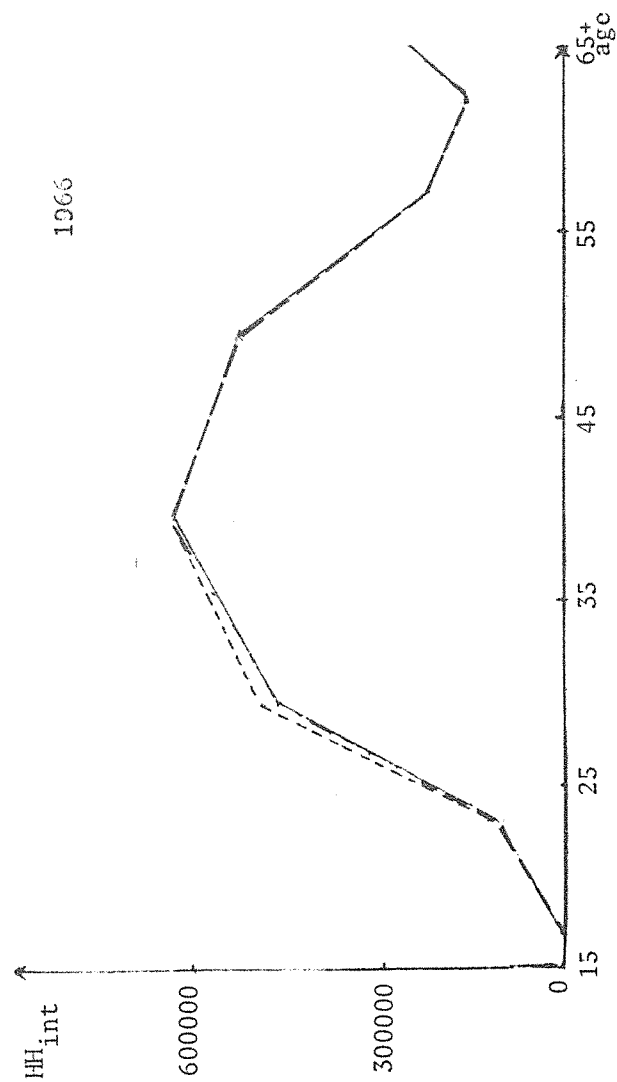
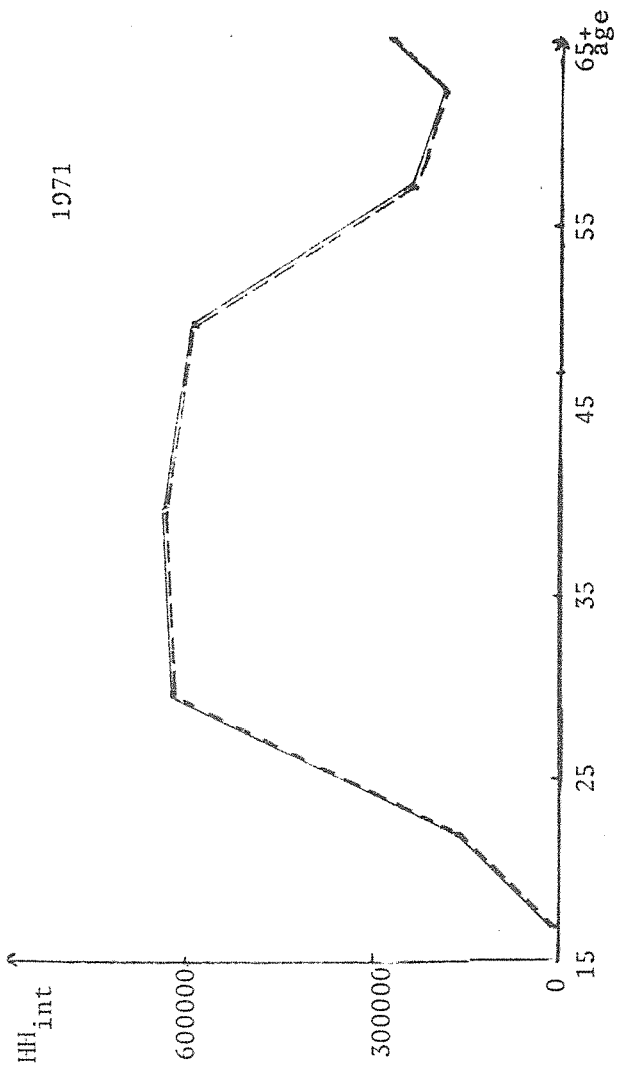


Figure 3(b)
 A Comparison of Actual and Estimated
 Households for Married Males - 1966,
 1971 and 1976¹

1. Estimated households are given by broken lines.

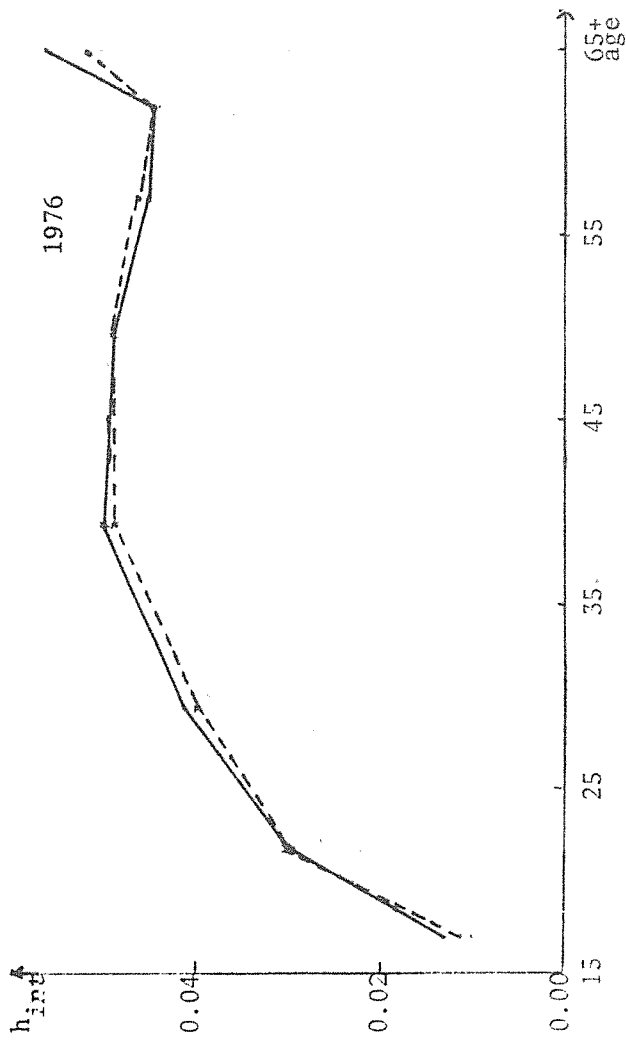
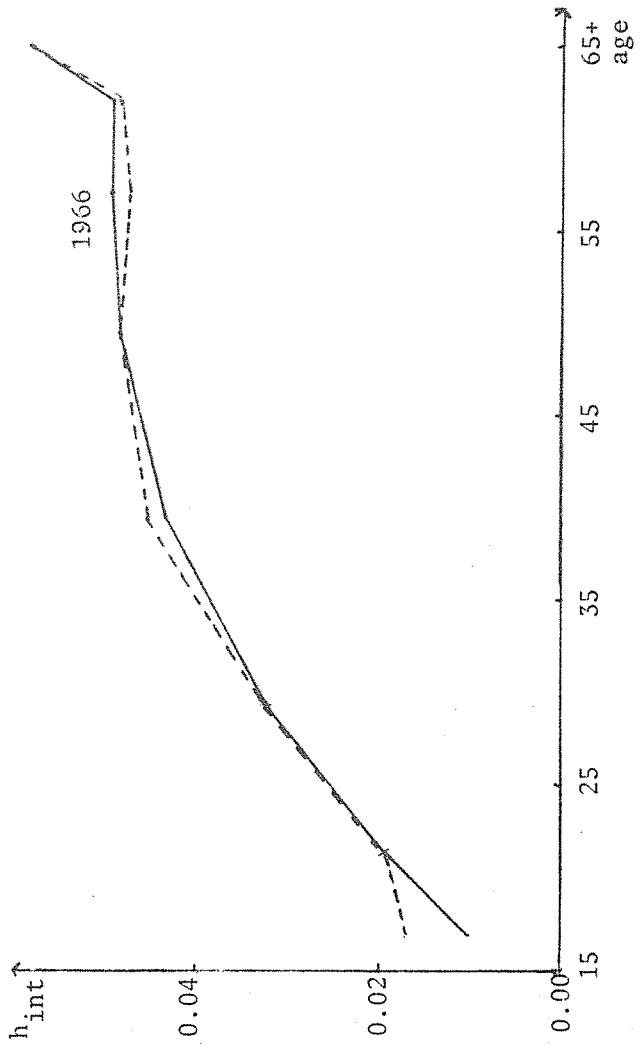
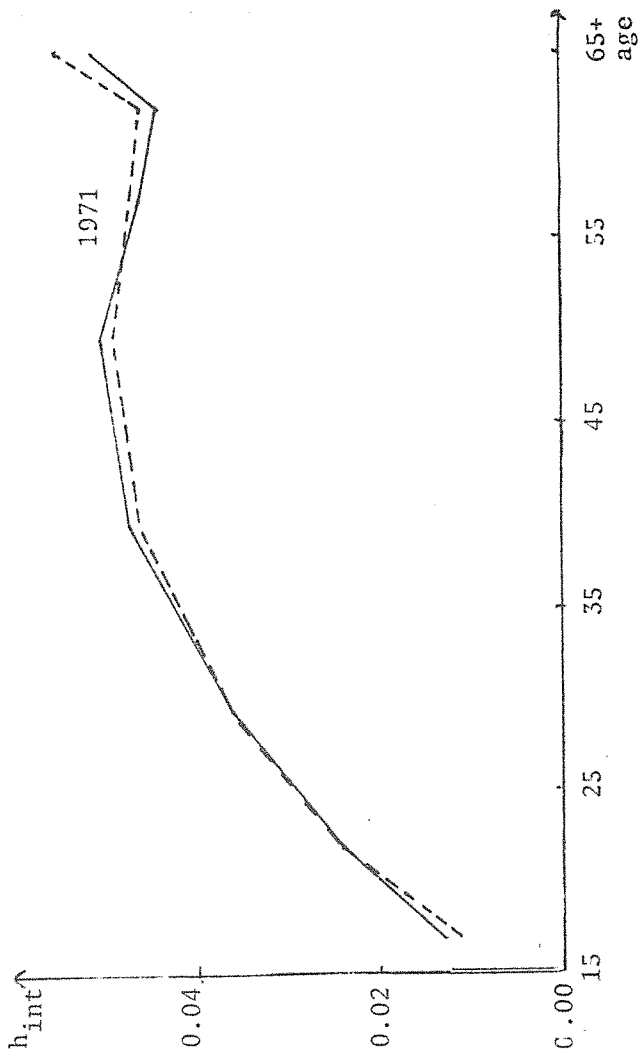


Figure 4(a)

A Comparison of Actual and Estimated Household Headship Ratios for Married Females - 1966, 1971 and 1976¹

1. Estimated headships are given by broken lines.

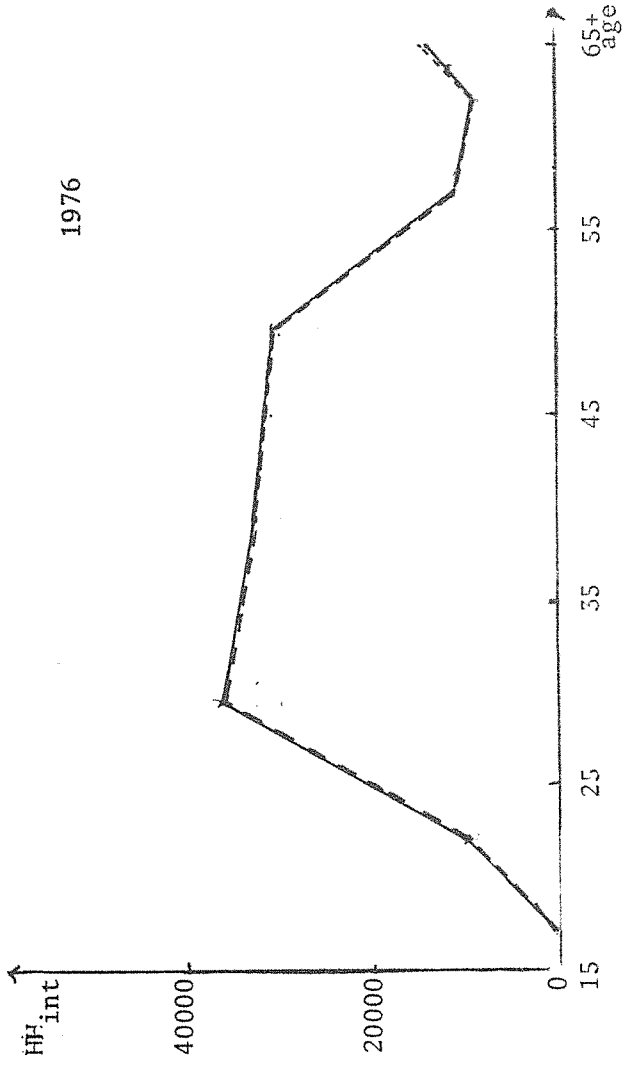
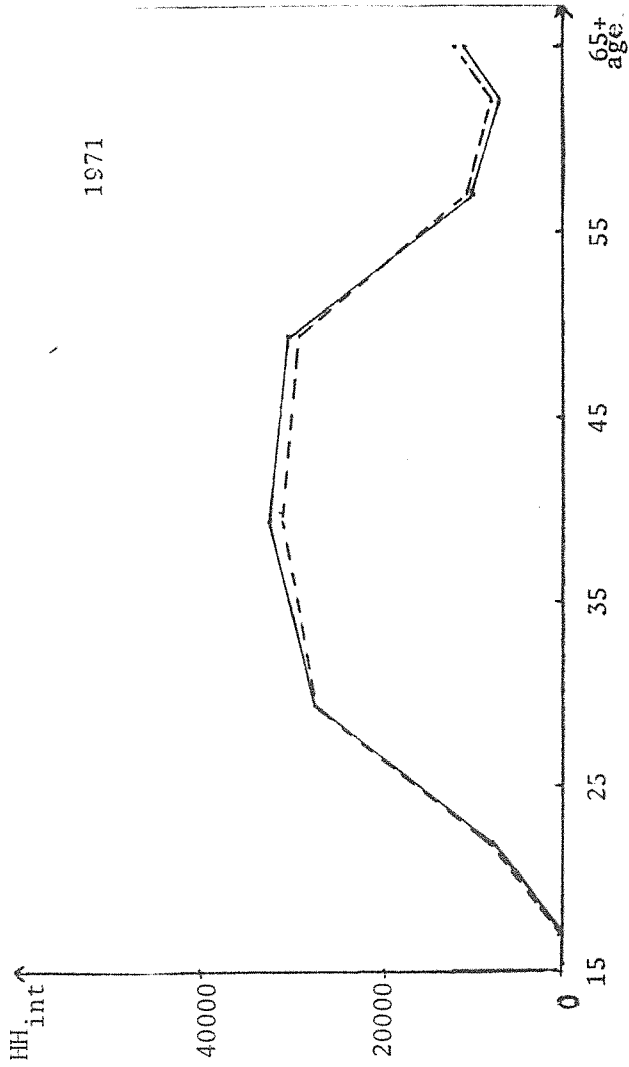
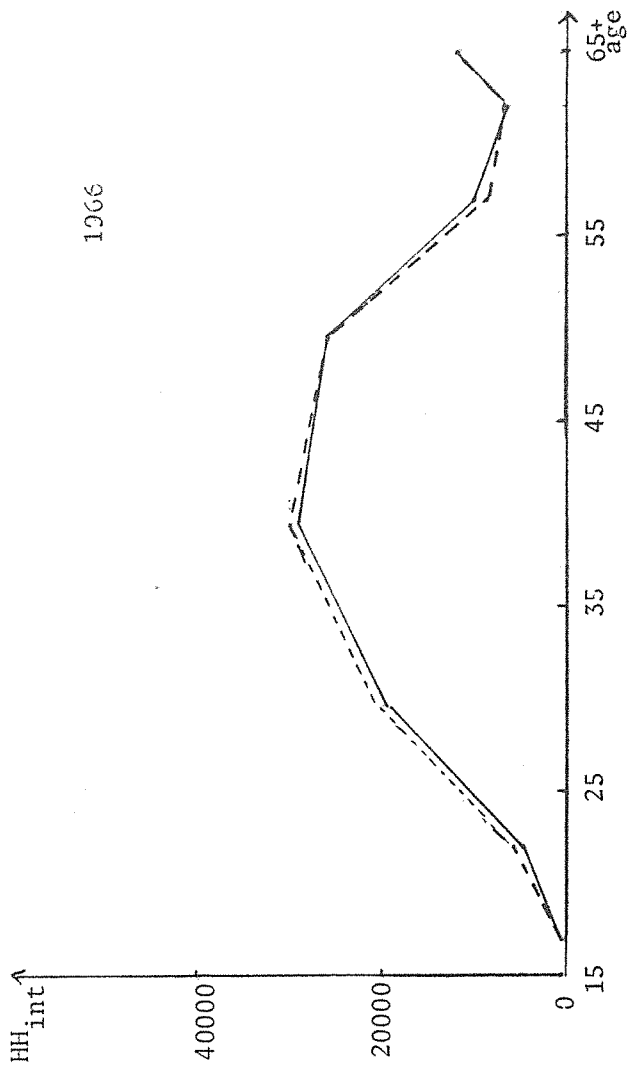


Figure 4(b)
 A Comparison of Actual and Estimated
 Households for Married Females - 1966,
 1971 and 1976¹

1. Estimated households are given by broken lines.

very close. In 1976, the underestimation was also distributed across most ages. The married female headship equation tracked extremely well, despite our pessimistic expectations and in contrast to its performance in the earlier model. In fact, this equation performed better than the other marital status groups for females.

(e) Divorced Males

Over the sample period, the headship ratios for divorced males increased at all ages and, in particular, at the younger ages. The model tracked these changes accurately; it underestimated total divorced male headship by 0.47% in 1966, by 0.21% in 1971 and by 0.36% in 1976. In all years, the underestimation showed no systematic pattern across age groups and was not concentrated in any particular age group. The econometric model has therefore performed very well in tracking the in-sample changes in divorced male headship behaviour.

(f) Divorced Females

For divorced females, household headship ratios increased for all ages over the period but, unlike most groups, the increase was greatest in the middle age groups, with the rate of increase declining between 1971 and 1976. The total headship ratio for divorced females was overestimated by 6.24% in 1966, underestimated by 1.71% in 1971 and by 3.04% in 1976. The underestimation or overestimation which occurred in each year was spread quite evenly over all the age groups. The divorced female equation was the second most inaccurate, after the never married female equation, in tracking over the sample period. It is likely that, as for never married females, these inaccuracies have derived from the use of not married female income and labour force data rather than data fully disaggregated by marital status.

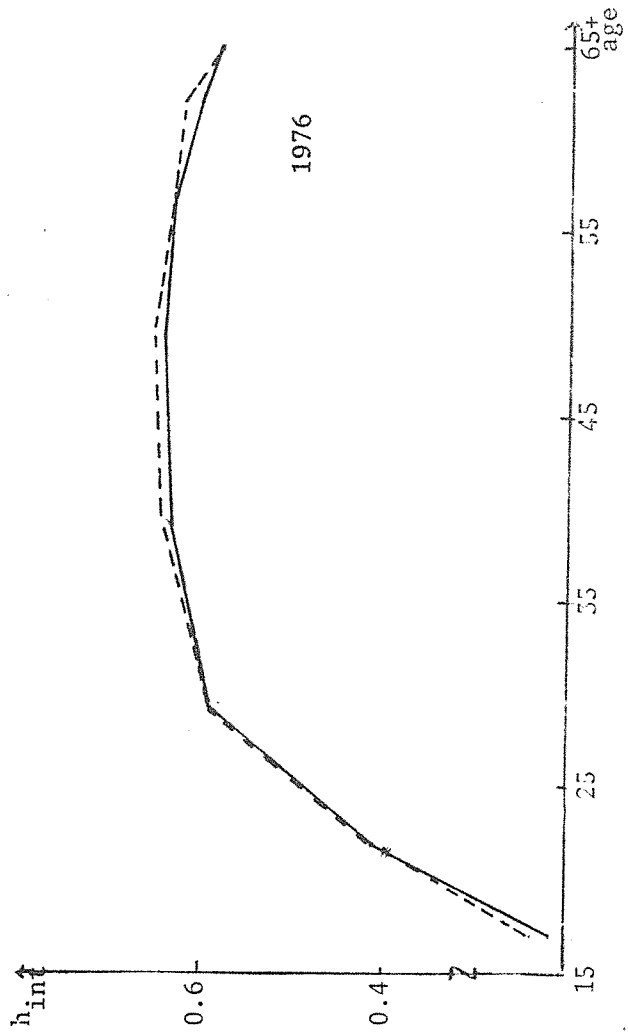
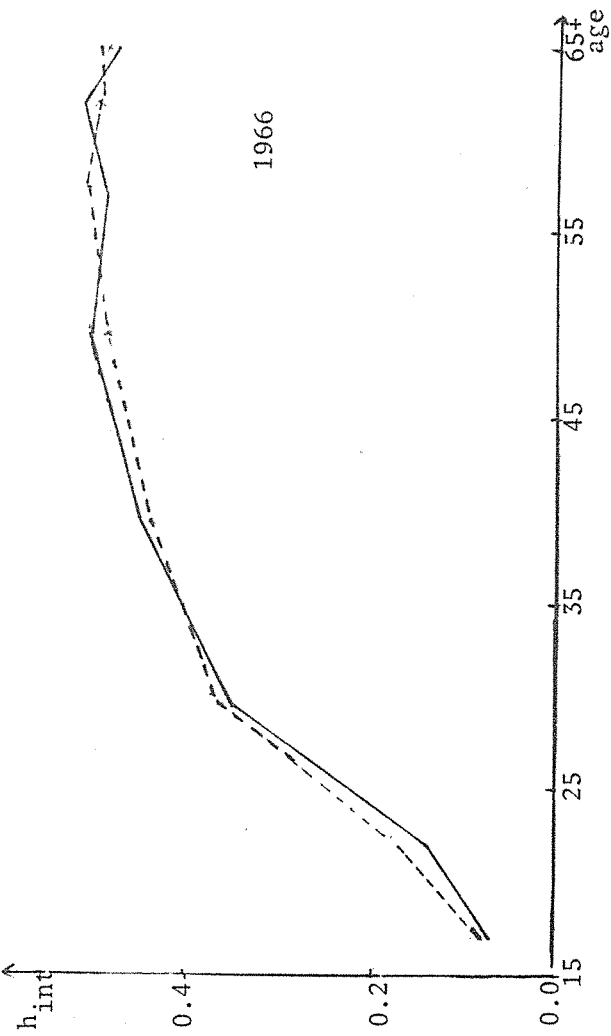
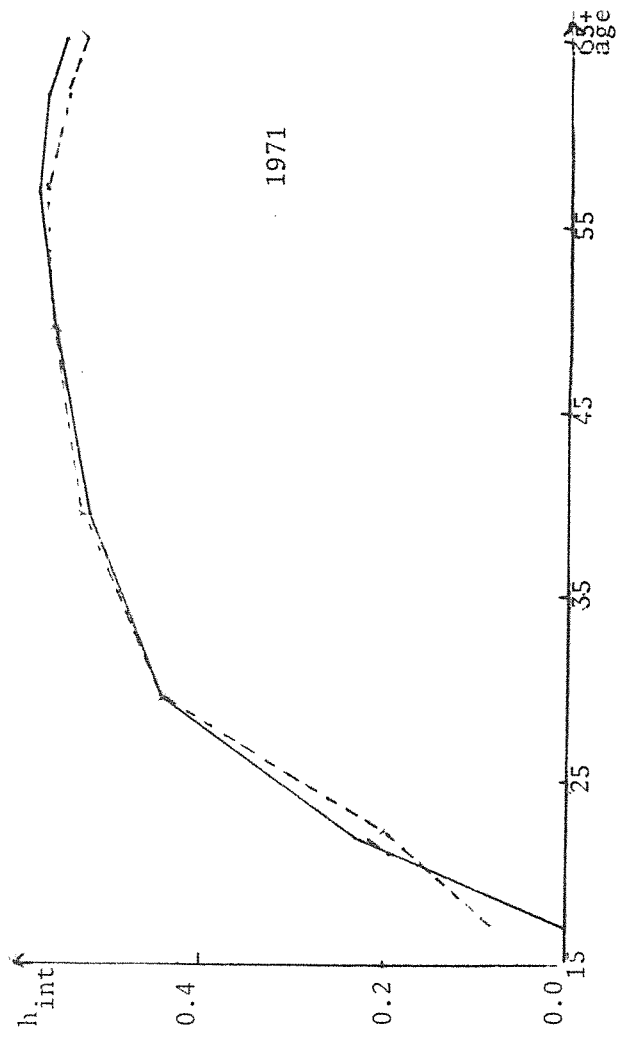


Figure 5 (a)
A Comparison of Actual and Estimated
Household Headship Ratios for Divorced
Males - 1966, 1971 and 1976

1. Estimated headships are given by broken lines.

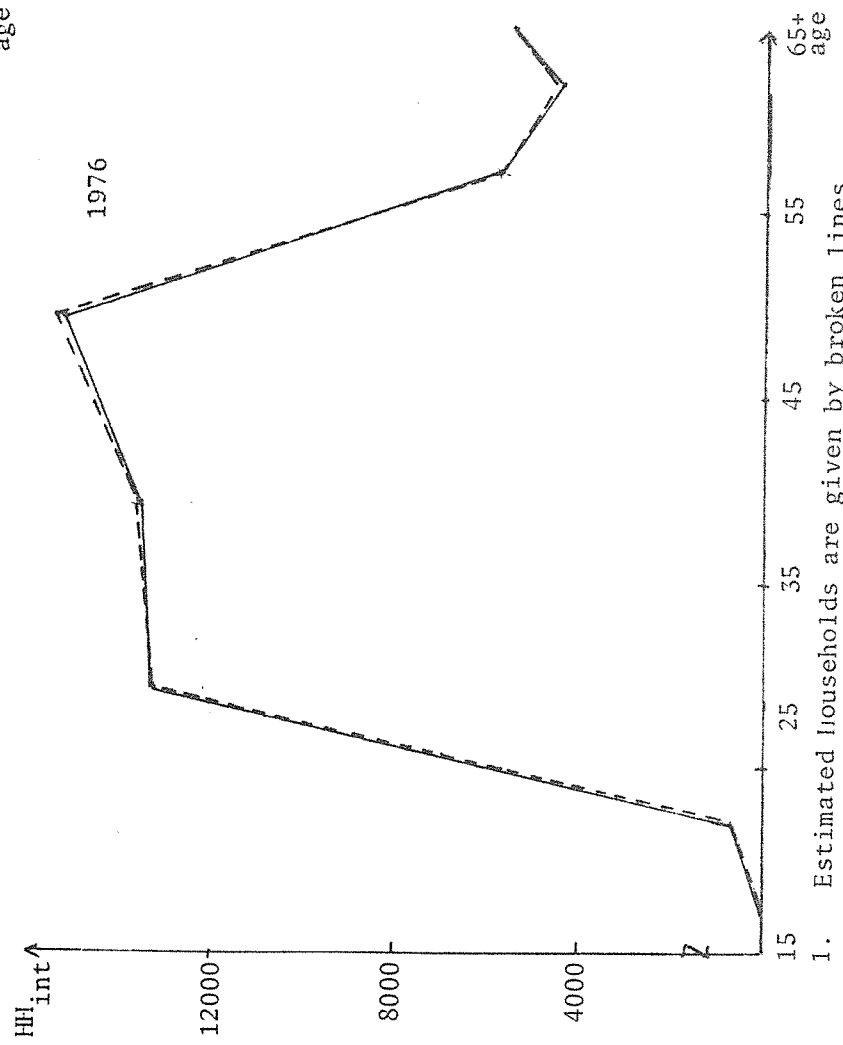
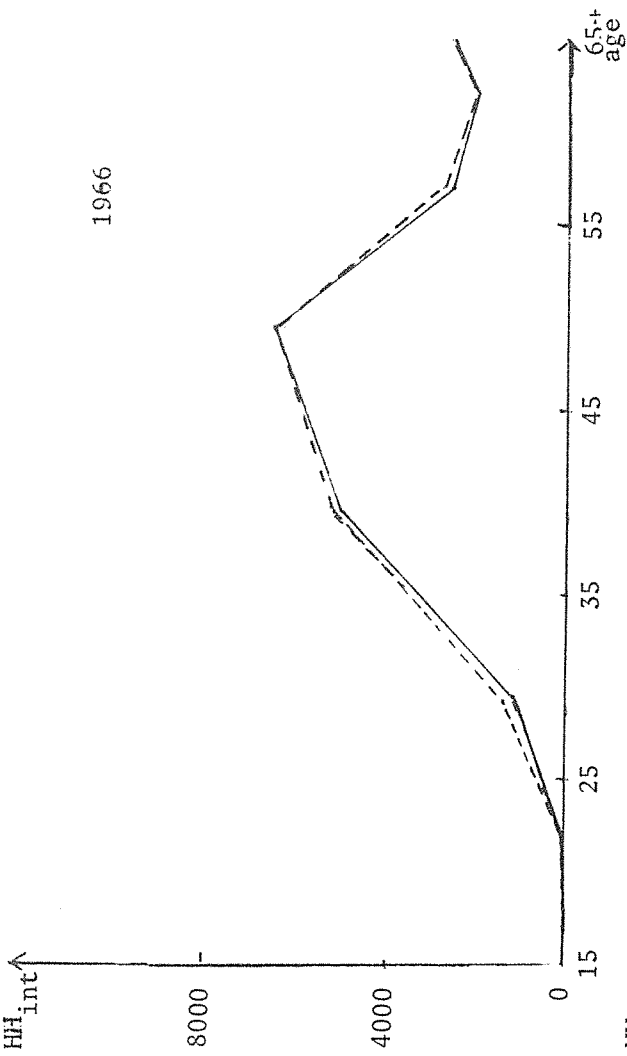
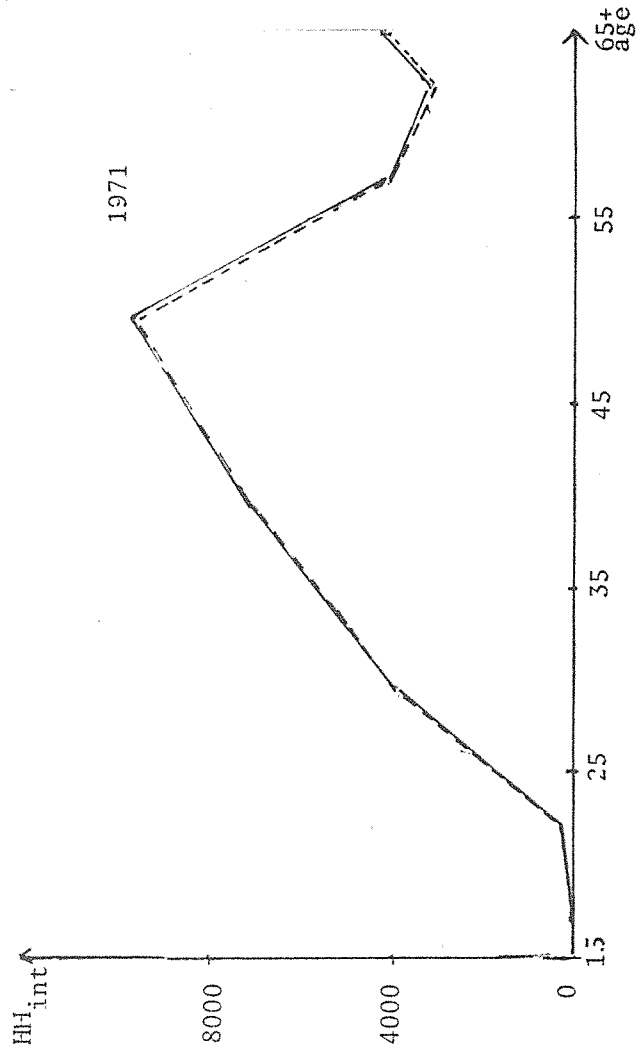


Figure 5(b)
A Comparison of Actual and Estimated
Households for Divorced Males - 1966,
1971 and 1976¹

1. Estimated households are given by broken lines.

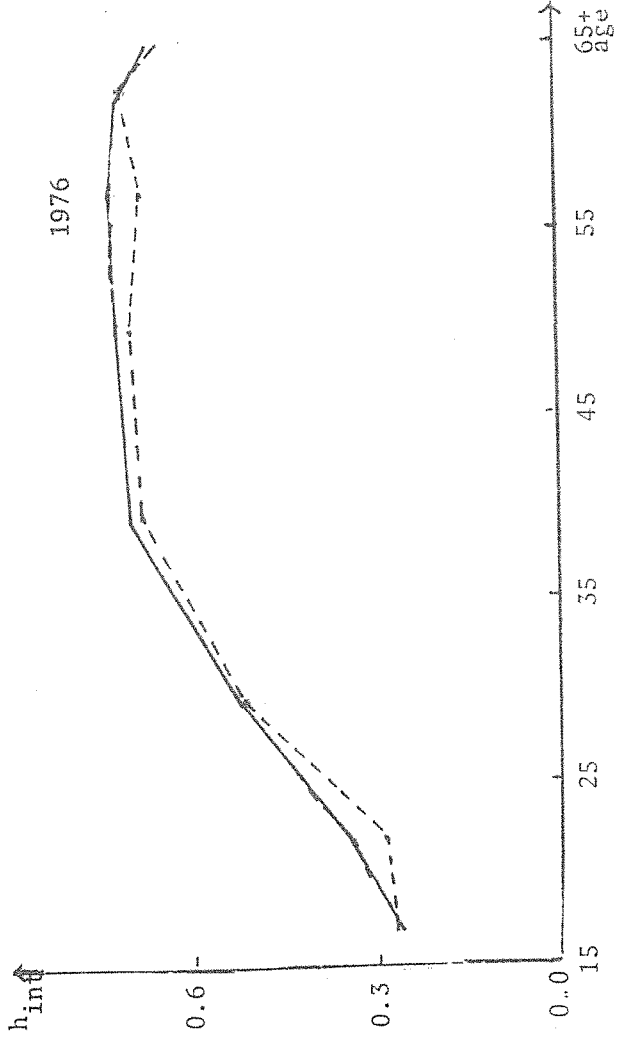
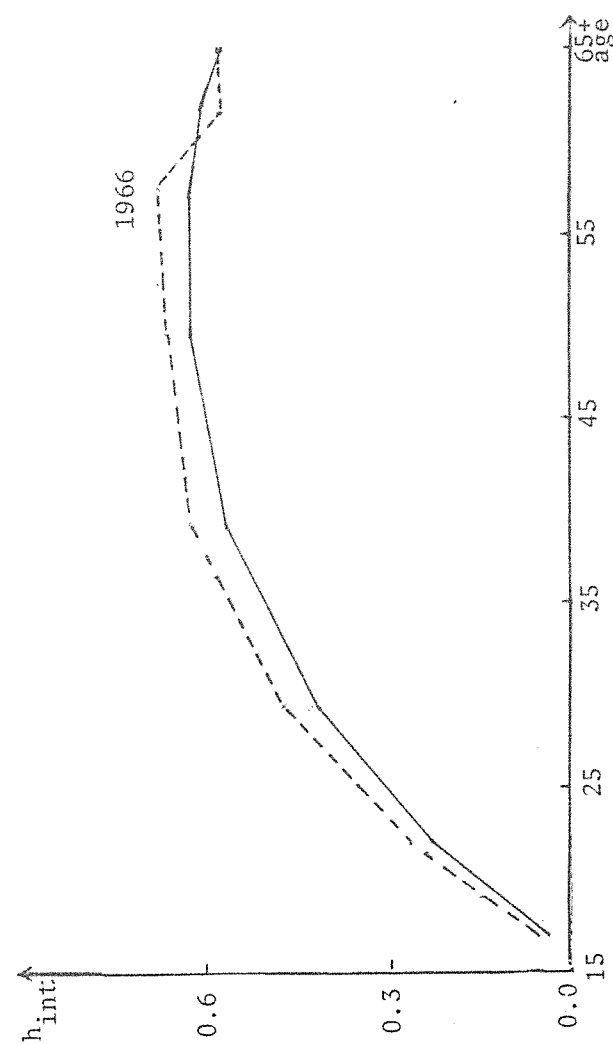
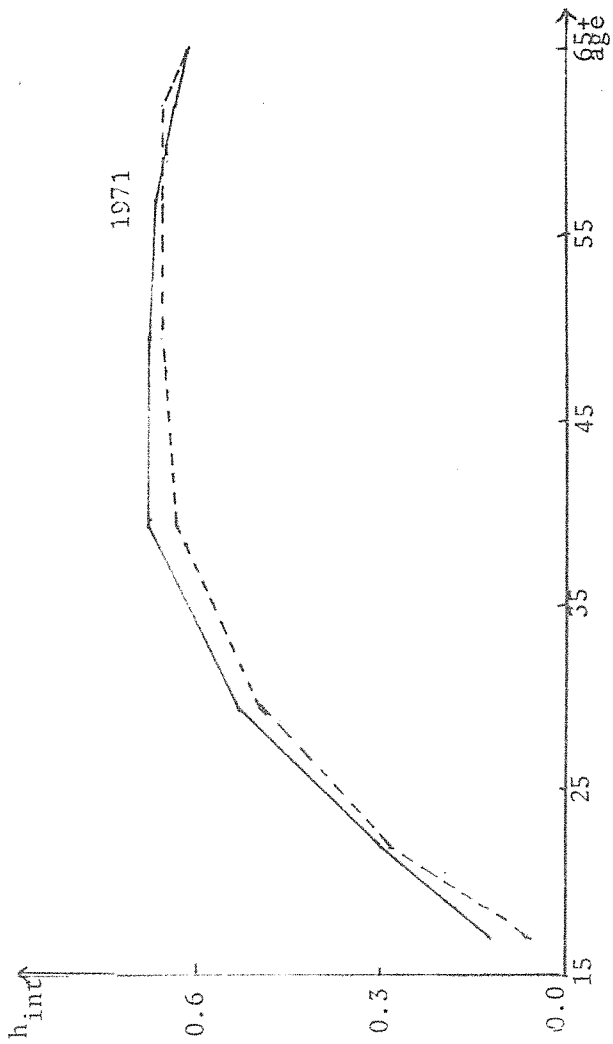


Figure 6(a)
 A Comparison of Actual and Estimated
 Household Headship Ratios for Divorced
 Females - 1966, 1971 and 1976¹

1. Estimated headships are given by broken lines.

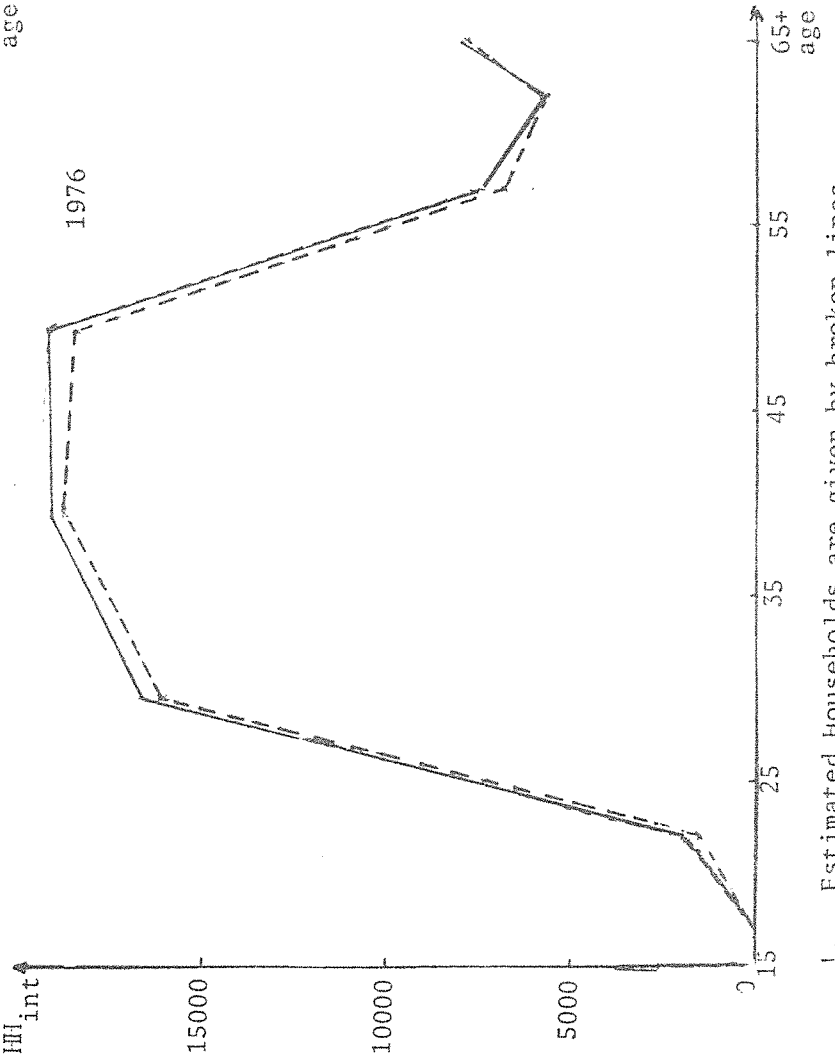
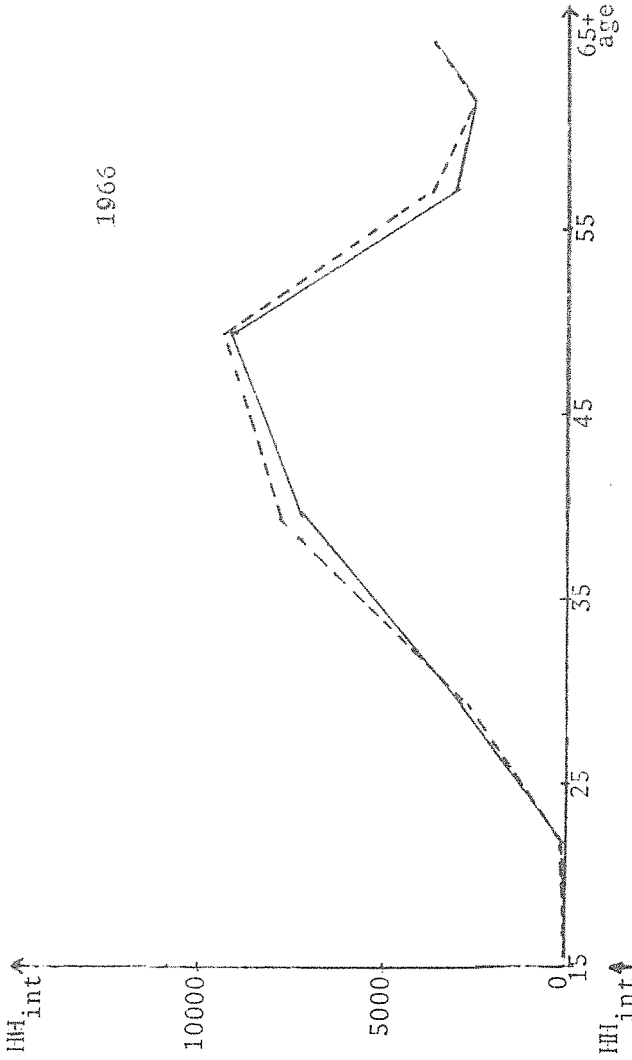
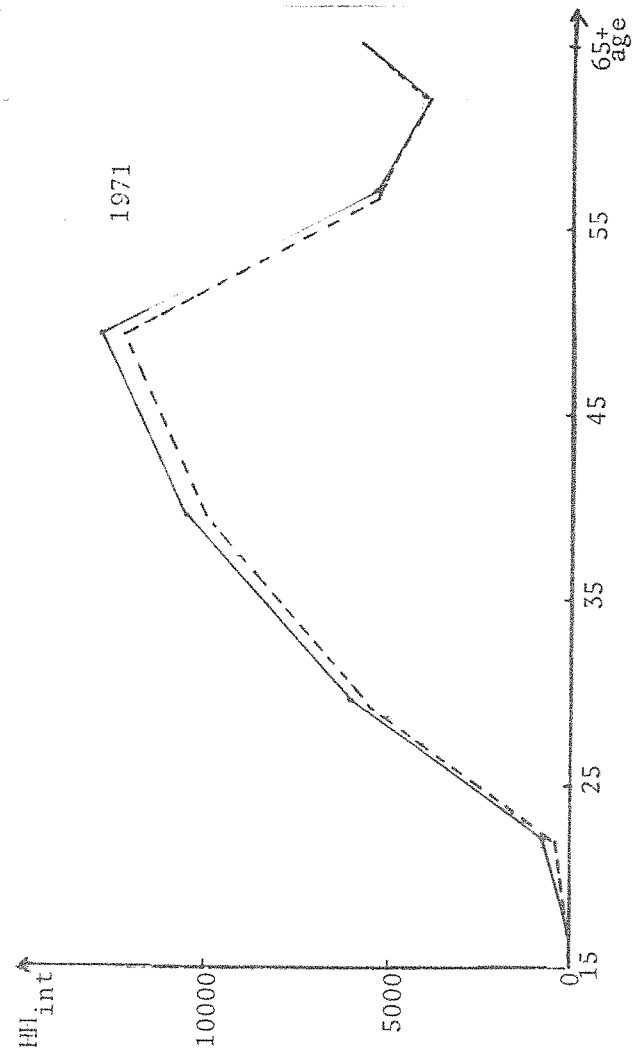


Figure 6(b)
A Comparison of Actual and Estimated
Households for Divorced Females -
1966, 1971 and 1976¹

1. Estimated Households are given by broken lines.

(g) Widowed Males

Over the sample period, widowed male headship ratios increased for most age groups, although the rate of increase lessened dramatically between 1971 and 1976, especially for the middle age groups. Total widowed male headship was overestimated by only 0.91% in 1966, underestimated by 2.53% in 1971 and overestimated by only 0.55% in 1976. In each year, the overestimation or underestimation was spread evenly across the young and middle age groups, with the older age groups being more accurately estimated. This is encouraging since the majority of widowed male households are headed by older men. The widowed male equation performed less adequately than the other male marital status groups, with the exception of never married males, and this may be related to the differences between total male and widowed male incomes and labour force behaviour. If widowed male income and labour force behaviour do not closely approximate that of all males, the explanator for widowed male headship will be misspecified and the results will be less accurate than they could have been. Lack of data precludes the removal of this specification error.

(h) Widowed Females

Widowed female headship ratios increased over the sample period, with the exception of some decline between 1971 and 1976 in the headship ratios of women in the middle age groups. Widowed female households are concentrated in the older age groups, so the extent of inaccuracy for the younger and middle age groups will have little effect on the accuracy of the headship ratios for all widowed females irrespective of age. Hence, it is crucial that headship ratios for the older age groups be closely approximated. So, despite a tendency

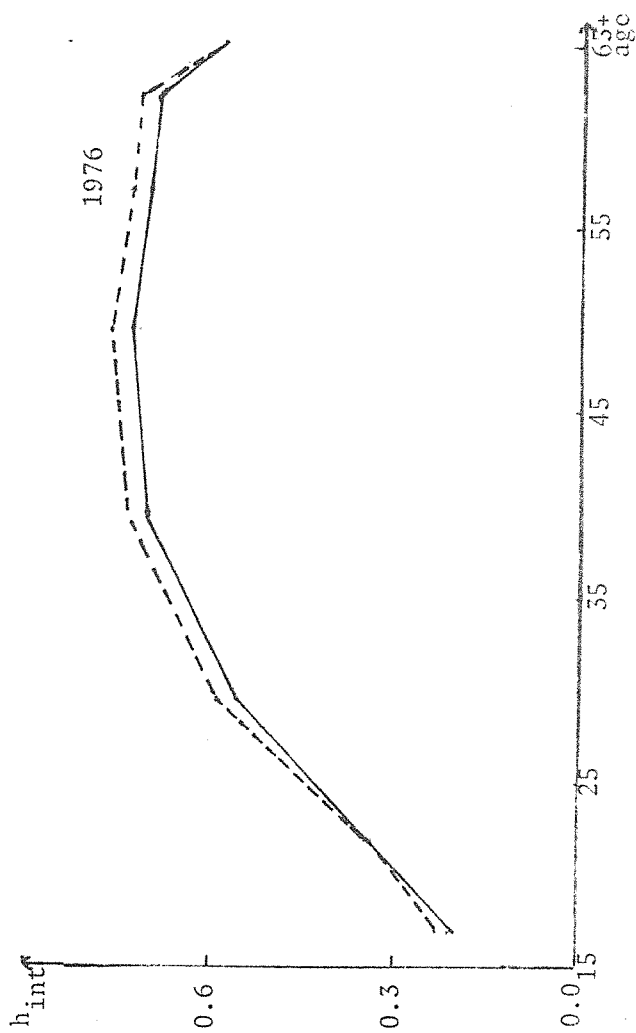
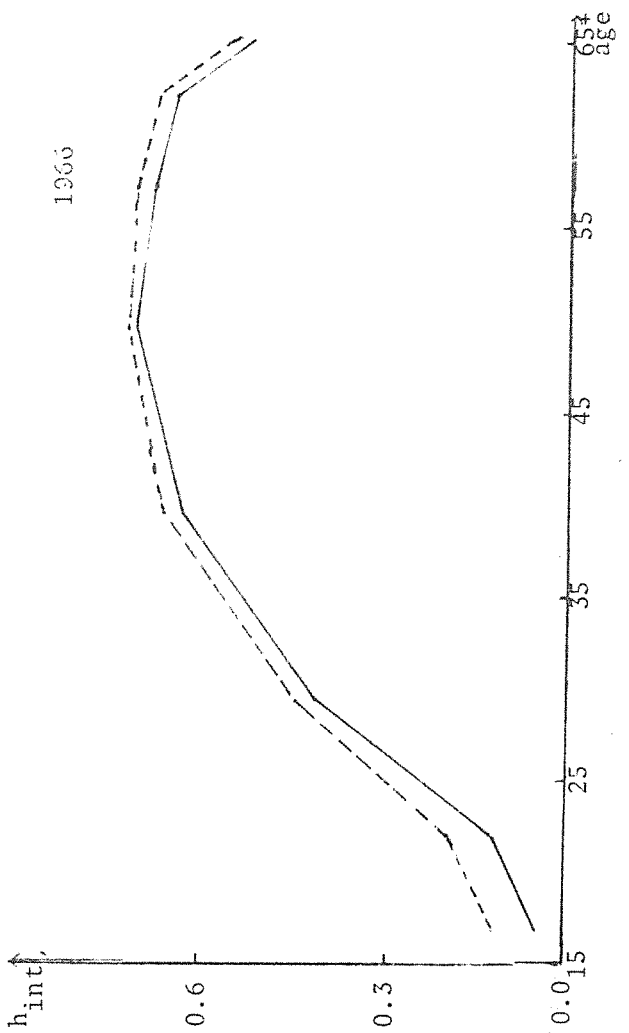
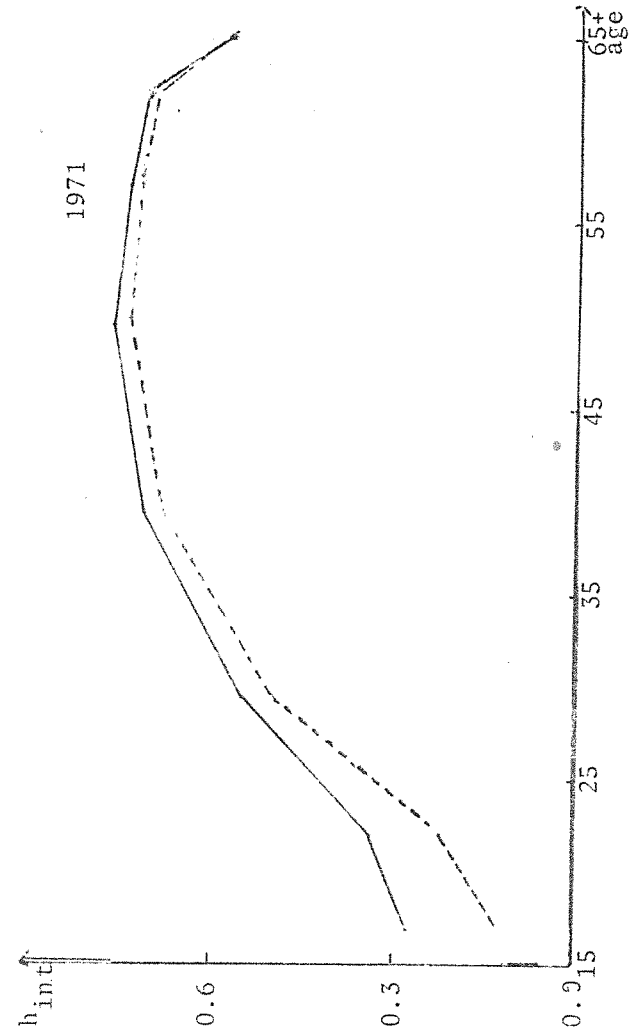
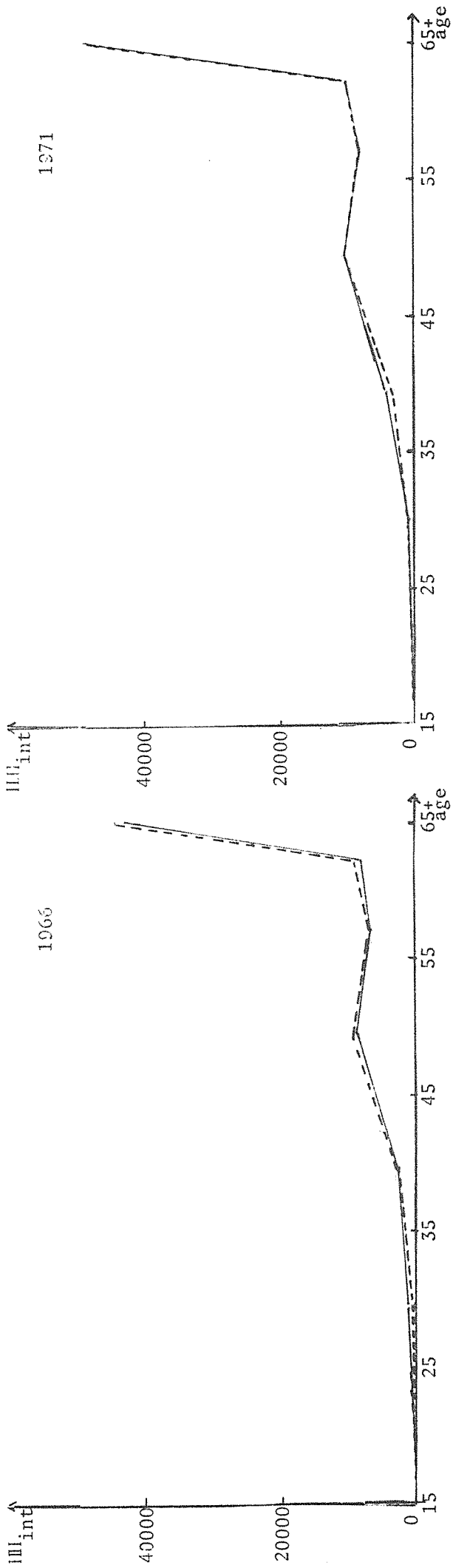
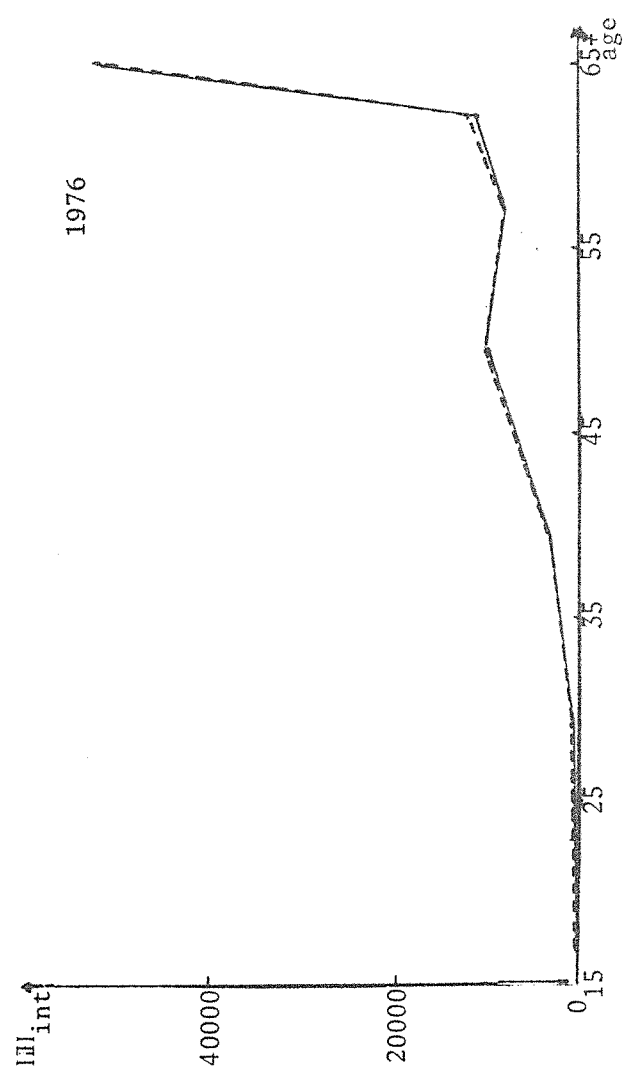


Figure 7(a)
 A Comparison of Actual and Estimated
 Household Headship Ratios for Widowed
 Males - 1966, 1971 and 1976

1. Estimated headships are given by broken lines.



1971



1976

Figure 7(b)
 A Comparison of Actual and Estimated
 Households for Widowed Males -- 1966,
 1977 and 1976¹

1. Estimated households are given by broken lines.

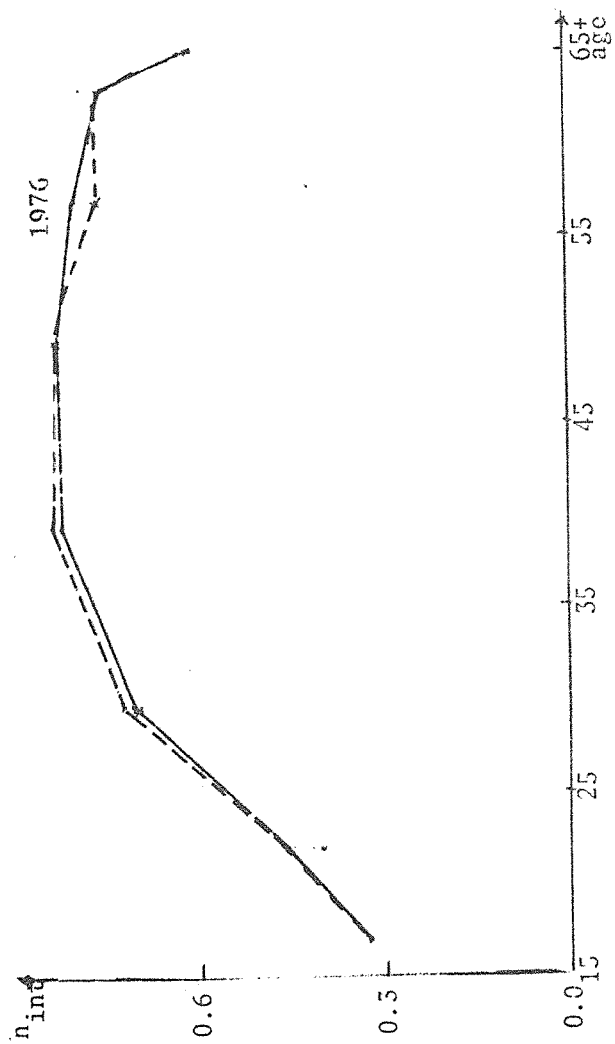
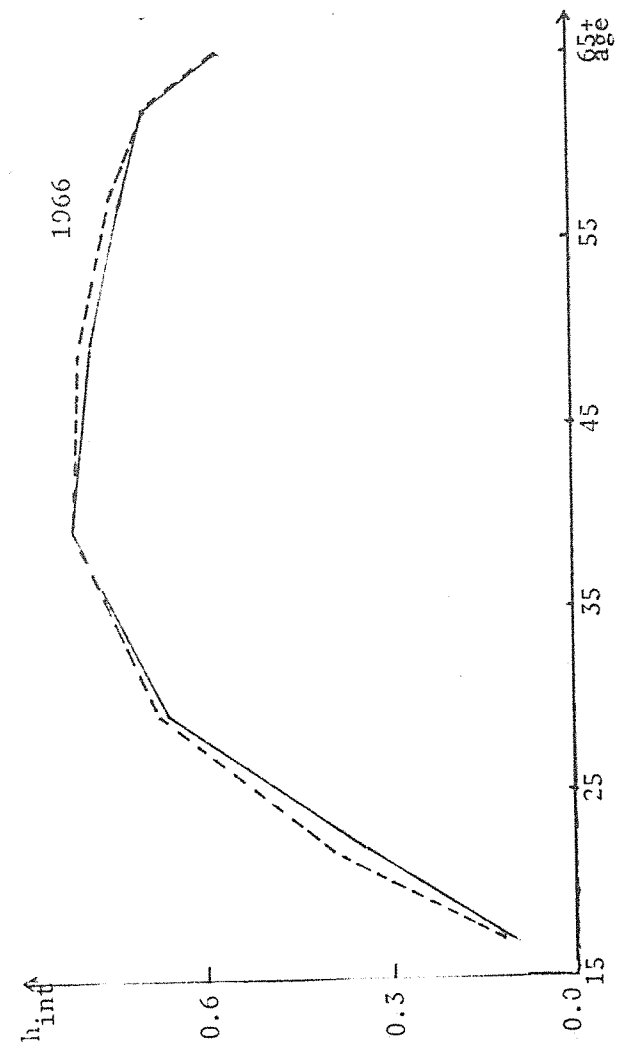
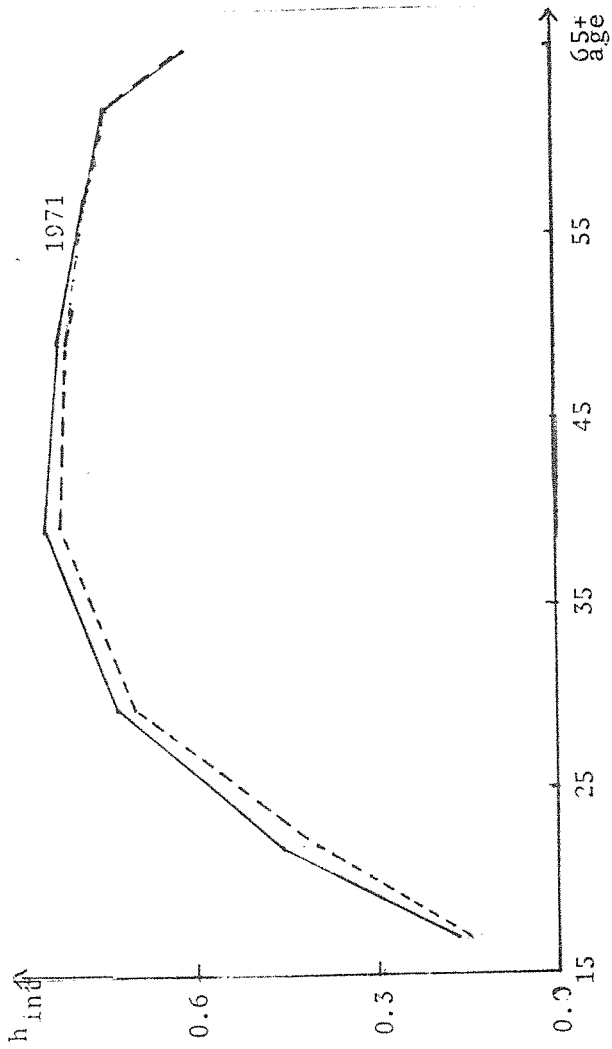


Figure 8(a)

A Comparison of Actual and Estimated Household Headship Ratios for Widowed Females - 1966, 1971 and 1976¹

1. Estimated headships are given by broken lines.

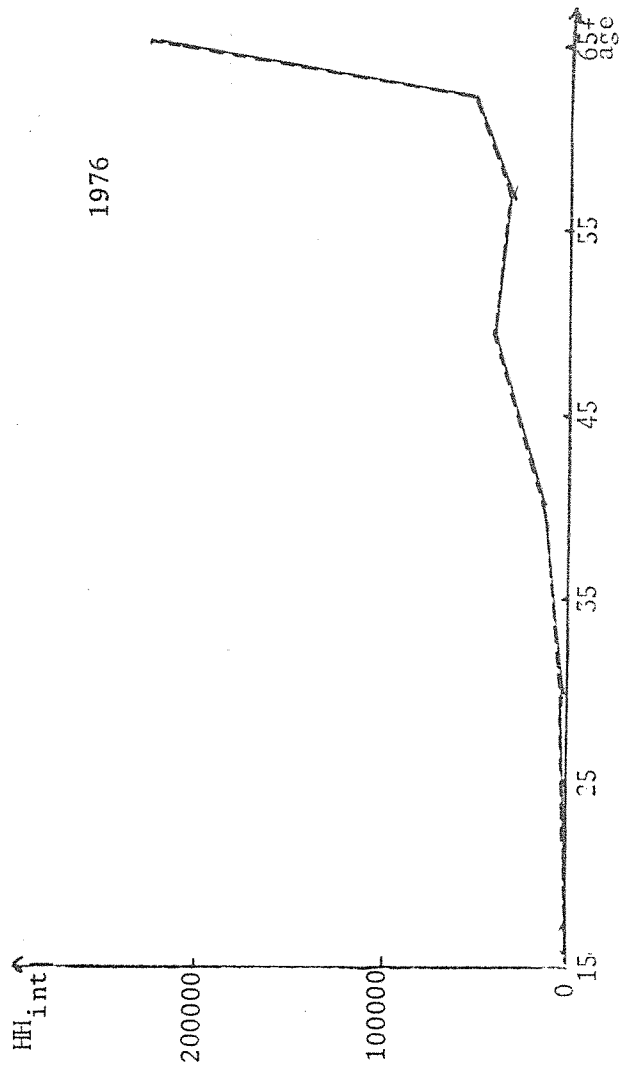
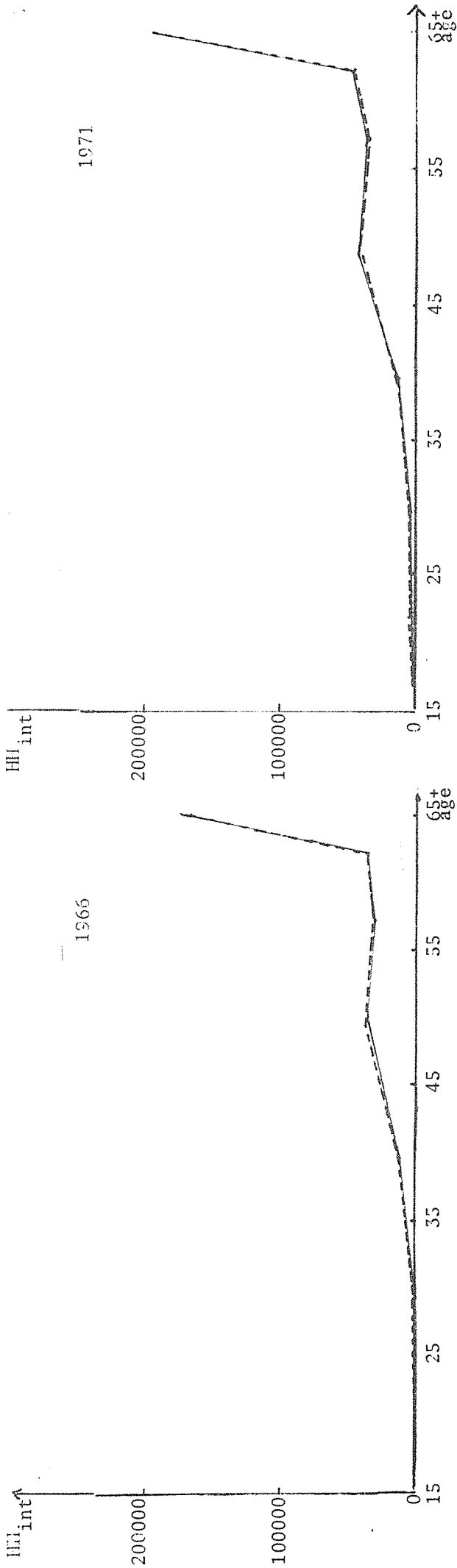


Figure 8(b)

A Comparison of Actual and Estimated Households for Widowed Females - 1966, 1971 and 1976¹

1. Estimated households are given by broken lines.

for the equation to approximate headship ratios at the youngest ages poorly, the model has tracked the changes in total widowed female headship quite well; total headship was overestimated by 1.08% in 1966, by 0.17% in 1971 and underestimated by 1.28% in 1976. The poorer accuracy at the younger and middle ages is still a cause for some concern, since it could be expected that future increases in the headship of widowed females would be likely to derive from these age groups. Headship ratios at the older ages may be moving towards their upper limit and could not be expected to continue to increase indefinitely.

In summary, an analysis of the in-sample tracking performance of the model has shown that the headship behaviour of females, especially those who are young and not married, is least likely to be projected accurately by the econometric model which has been estimated. This is disappointing, as these people could be expected to provide the greatest source of increased household headship in the future. However, the equation for the headship of married males, the largest headship group, is the most robust of the sex/marital status groups, implying that projections using the model should be quite accurate in terms of the total number of households, if not quite so accurate in terms of the distribution of those households between sex/marital status groups. In fact, over the sample period, the number of households estimated by the model was always within 1.0% of the actual number.

(iii) Elasticities of Household Headship with Respect to its Explanatory Variables

In the econometric model reported in this paper, the headship ratios for 64 demographic groups are estimated as a function of expected utility of income. However, as described in Section 5, the expected utility of income is itself a function of the available annual income from several sources plus the labour force participation rate,

the unemployment rate, the duration of labour force participation and the duration of unemployment for each demographic group. It is the purpose of this section to present the elasticities of these headship ratios with respect to each of the above explanators.¹

In the first part of this section, we discuss the elasticities with respect to expected utility of income, which are given in Table 10, and with respect to the real income of each of the three labour force categories (in the workforce and never unemployed, in the workforce and sometimes unemployed and never in the workforce) which are given in Table 11. Later in this section we discuss the elasticities with respect to income by source, given in Table 12, and by the labour force characteristics of each group, given in Table 13. In general, the model is formulated to determine headship ratios solely on the basis of a measure of the expected income of each group. Thus, in the light of the estimates reported earlier in this section, we expect that any changes in the explanators which increase the income of a demographic group will raise that group's headship ratio. However, the effect of a change in any one explainer may be complicated since it may have both positive and negative effects on income. Also, because of the way we have introduced life cycle effects into the model, we expect that the elasticities will vary smoothly across ages.

Since the model is not a linear model in the logarithms of the explanators, the elasticities will change as the levels of headship and of the explanators change. The elasticities reported in Tables 10 to 13, are calculated for the 1976 values of the explanators.

1. This elasticity is defined as the percentage change in the headship ratio for a one per cent change in the value of the explanatory variable. The details of the calculation of these elasticities is given in Appendix 2.

(a) Elasticities with Respect to Expected Utility of Income

The elasticities with respect to expected utility of income generally agree with our prior expectations and are positive for nearly all demographic groups.¹ Across the age distribution, the elasticities are at their maximum for the age groups 20-24 years for all marital states, and decline with increasing age. At ages 15-19, the elasticities are large but still less than at ages 20-24. The elasticities are lowest for those groups which traditionally have high levels of headship (married males and widowed females) and for married females, while the other not married groups for both males and females have high elasticities. For all age groups, males have higher elasticities than females of the same marital status.

The traditionally high headship groups have headship rates which are close to the saturation levels, S_i , assigned in the model. This approach to saturation, in itself, makes the headship rate unresponsive to changes in its explanators. However, the low elasticities for the traditional headship groups (and the high elasticities for the other groups) may not indicate small changes in the number of traditionally headed households (or large changes in the number of other households), since a small percentage change in the large number of traditionally headed households may cause a larger change in the number of households than a large percentage change in the smaller number of other households.

1. The elasticities which are negative are those for old, married females and arise because the coefficients, ϵ_{in} , reported earlier in this section are positive although very small. Henceforth, we shall ignore this anomaly.

TABLE 10 : ELASTICITIES OF HOUSEHOLD HEADSHIP WITH RESPECT
TO EXPECTED UTILITY OF INCOME¹, 1976

	15-19	20-24	25-54	35-44	45-54	55-59	60-64	65+
Never Married Males	4.67	9.58	8.37	6.45	4.00	2.63	1.70	0.95
Never Married Females	1.05	2.88	2.14	1.44	0.73	0.27	0.20	0.07
Married Males	0.66	0.84	0.57	0.32	0.26	0.28	0.25	0.08
Married Females	**** ²	1.17	0.54	0.23	0.04	-0.02	-0.09	-0.07
Divorced Males	4.28	7.50	5.32	4.42	3.47	3.10	2.33	0.93
Divorced Females	1.19	3.43	1.78	0.69	0.40	0.21	0.21	0.11
Widowed Males	2.52	5.35	3.62	1.79	1.05	1.11	0.97	0.65
Widowed Females	0.78	1.93	0.67	0.18	0.13	0.10	0.13	0.08

1. The elasticities are evaluated for each demographic group at the 1976 values of headship and expected utility of income.
2. When the income for a particular demographic group is below the subsistence level, the elasticity is undefined.

(b) Elasticities with Respect to Labour Force Category.

In Table 11, we present elasticities of household headship with respect to changes in the level of real permanent per capita income received by persons according to their labour force status¹ for 1976. As expected, the elasticities are positive and, again, married males, married females and widowed females have low elasticities while the other not married males and females have higher elasticities. However, the interpretation of these elasticities is more complicated than those with respect to expected utility. Firstly, the elasticities which are presented in Table 11 are for the headship of each demographic group not just for each labour force category in each demographic group. Thus for those demographic groups in which there are, say, few "sometimes unemployed" changes in the per capita real permanent income of the "sometimes unemployed" will have little effect on the headship ratio of the whole demographic group. The influence of the income of each labour category is dependent on the proportion of persons of each category in the demographic group under consideration. Secondly, some effects arise from the use of a Klein-Rubin utility function in defining the expected utility of income. If the per capita income of a labour force category is less than the subsistence level, the elasticity is undefined since we assume that, until income is greater than subsistence, no households will be formed. Once the income is above subsistence level the expected utility of that income rises rapidly for low incomes.

With the above points in mind, we can investigate Table 11

1. See Section 5(ii), page 43ff., for the definition of the three labour force states: never unemployed, sometimes unemployed and never in the workforce.

TABLE 11 : ELASTICITIES OF THE HOUSEHOLD HEADSHIP RATIO FOR EACH DEMOGRAPHIC GROUP WITH RESPECT TO INCOMES OF PERSONS OF DIFFERENT LABOUR FORCE STATES^{1,2}

Sex/ Marital Status Group ³	Incomes of Persons who are Employed but Never Unemployed							
	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65+
NMM	2.56	1.96	1.64	1.27	.78	.52	.27	.06
NMF	2.52	.75	.57	.39	.20	.08	.02	.00
MM	.36	.17	.11	.06	.05	.05	.04	.00
MF	**** ⁴	.38	.17	.07	.01	-.01	-.01	.00
DM	2.35	1.54	1.04	.87	.67	.61	.38	.06
DF	2.87	.89	.48	.19	.11	.06	.02	.00
WM	1.38	1.10	.71	.35	.20	.22	.16	.04
WF	1.88	.50	.18	.05	.04	.03	.01	.00

Incomes of Persons who are Employed but Sometimes Unemployed								
NMM	1.69	.53	.20	.10	.05	.03	.02	.00
NMF	3.22	.24	.11	.07	.03	.01	.00	.00
MM	.24	.05	.01	.00	.00	.00	.00	.00
MF	****	.10	.03	.01	.00	.00	.00	.00
DM	1.54	.41	.12	.07	.04	.03	.02	.00
DF	3.67	.29	.09	.03	.02	.00	.00	.00
WM	.91	.29	.08	.03	.01	.01	.01	.00
WF	2.39	.16	.04	.01	.01	.00	.00	.00

Incomes of Persons who are Never in the Labour Force								
NMM	****	.20	.04	.06	.04	.06	.11	.27
NMF	****	****	****	****	****	****	.12	.04
MM	****	.02	.00	.00	.00	.01	.02	.02
MF	****	****	****	****	****	****	-.06	-.05
DM	****	.16	.03	.04	.03	.07	.15	.27
DF	****	****	****	****	****	****	.12	.06
WM	****	.11	.02	.02	.01	.03	.06	.18
WF	****	****	****	****	****	****	.07	.05

- Note that the elasticities presented in this table are for the total headship of each age/sex/marital status group, not for persons of each labour force category within that demographic group.
- The elasticities are evaluated for the 1976 values of each of the above arguments, and for each of 8 sex/marital status and 8 age groups.
- The sex/marital status groups are defined in the footnote on page 40.
- Where the income for a particular labour force category is below the subsistence level, the elasticity is undefined.

further. The elasticities with respect to the income of the "never unemployed" are in agreement with our general comments above. The elasticities with respect to the income of the "sometimes unemployed" are reasonably large for the not-marrieds, other than widows, and decline with age, in keeping with the proportions of "sometimes unemployed" in each demographic group. The elasticities with respect to income of the "never employed", show predominantly an increasing trend with age, in agreement with the increasing proportion of "never employed" in the older demographic groups. However, the income for the "never employed" is often below subsistence level and many of the elasticities are zero, and, for several young ages where the income is just above subsistence, the elasticities are high.

(c) Elasticities with Respect to Income by Source

The elasticities which we have presented so far have been for the constructed variables used in the model. In this and the following subsection, we consider the elasticities of the headship ratios with respect to some more conventional variables. In Table 12, we present the elasticities with respect to the following five incomes:

- (i) the annual rate of income from full-time employment,
- (ii) the annual rate of income from the unemployment benefit,
- (iii) the annual rate of income from being not-in-the labour force,
- (iv) the annual rate of unearned income distributed to all persons, and
- (v) the annual rate of unearned income as principal income.

The elasticities are in keeping with our expectation that they should be positive. However, a few cannot be evaluated since the income in some demographic groups is below subsistence level.

TABLE 12 : ELASTICITIES OF THE HOUSEHOLD HEADSHIP RATIO FOR EACH DEMOGRAPHIC GROUP, WITH RESPECT TO INCOMES FROM DIFFERENT SOURCES^{1,2}

Sex/ Marital Status Group ³	Earned Income							
	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65+
NMM	3.33	2.24	1.73	1.29	.78	.50	.27	.05
NMF	3.88	.86	.61	.41	.20	.08	.02	.00
MM	.47	.20	.12	.06	.05	.05	.04	.00
MF	**** ⁴	.42	.18	.07	.01	-.01	-.01	.00
DM	3.05	1.75	1.10	.88	.67	.59	.37	.05
DF	4.42	1.03	.51	.20	.11	.06	.02	.00
WM	1.80	1.25	.75	.36	.20	.21	.15	.04
WF	2.88	.58	.19	.05	.04	.03	.01	.00
Unemployment Benefit Income								
NMM	.23	.03	.01	.01	.00	.00	.00	.00
NMF	.65	.02	.01	.01	.00	.00	.00	.00
MM	.03	.00	.00	.00	.00	.00	.00	.00
MF	****	.01	.00	.00	.00	.00	.00	.00
DM	.21	.02	.01	.00	.00	.00	.00	.00
DF	.74	.02	.01	.00	.00	.00	.00	.00
WM	.12	.02	.00	.00	.00	.00	.00	.00
WF	.48	.01	.00	.00	.00	.00	.00	.00
Not-in-the Labour Force Income								
NMM	.01	.08	.01	.03	.01	.01	.03	.11
NMF	.02	.00	.00	.00	.00	.00	.05	.02
MM	.00	.01	.00	.00	.00	.00	.00	.01
MF	****	.01	.01	.00	.00	.00	-.03	-.03
DM	.01	.06	.01	.02	.01	.02	.04	.11
DF	.02	.00	.00	.00	.00	.00	.05	.04
WM	.01	.04	.00	.01	.00	.01	.02	.08
WF	.02	.00	.00	.00	.00	.00	.03	.03
Unearned Income Distributed to all Persons								
NMM	.64	.19	.09	.07	.04	.03	.02	.03
NMF	1.13	.09	.06	.04	.02	.01	.02	.01
MM	.09	.02	.01	.00	.00	.00	.00	.00
MF	****	.05	.02	.01	.00	.00	-.01	-.01
DM	.58	.15	.06	.05	.03	.04	.03	.03
DF	1.28	.10	.05	.02	.01	.01	.02	.01
WM	.34	.10	.04	.02	.01	.01	.01	.02
WF	.84	.06	.02	.00	.00	.00	.01	.01
Unearned Income as Principal Income								
NMM	****	.12	.03	.02	.03	.05	.08	.14
NMF	****	****	****	****	****	****	.05	.01
MM	****	.01	.00	.00	.00	.00	.01	.01
MF	****	****	****	****	****	****	-.03	-.01
DM	****	.10	.02	.02	.03	.05	.11	.14
DF	****	****	****	****	****	****	.05	.02
WM	****	.07	.01	.01	.01	.02	.05	.09
WF	****	****	****	****	****	****	.03	.01

1, 2, 3. See footnotes 1, 2 and 3 to Table 11, p.88.

4. When the income from a particular source is below the subsistence level, the elasticity is undefined.

In interpreting these elasticities, the same considerations apply as mentioned for the earlier elasticities. The elasticities are largest for not marrieds other than widows, and lowest for marrieds. The responsiveness of the headship rate for the whole demographic group is dependent on the proportion of persons in that group who are likely to receive income from a particular source. For example, the elasticities with respect to unemployment benefit rates are highest for young people since the unemployed are a greater proportion at younger ages. Similarly, the not-in-the labour force income has a greater effect at older ages. In summary, it is changes in the rate of earned income which have most effect on headship rates, but, for certain demographic groups, unemployment benefit rates and the other incomes can have moderate effects.

(d) Elasticities with Respect to Labour Force Variables

In Table 13, the elasticities with respect to labour force participation, unemployment rates, durations of labour force participation and durations of unemployment are presented. These elasticities depend upon the effects of the particular labour force variable on the income level of the demographic groups. But again, throughout the table, it can be seen that it is the not married groups, except widows, which have the highest elasticities.

The effect of increasing labour force participation rates, when the per capita incomes from all sources¹ and the other labour force variables² are held constant, is to increase the income of all groups. Thus, we expect the positive elasticities presented in Table 13. The elasticities decline with age for most marital states but for some they peak at age 20-24.

1. That is, real per capita incomes from wages and salaries, unemployment benefit payments, government transfers and unearned sources, as defined on pp.52-53.

2. That is, unemployment rates, and durations of labour force participation and unemployment.

TABLE 13 : ELASTICITIES OF THE HOUSEHOLD HEADSHIP RATIO FOR EACH DEMOGRAPHIC GROUP WITH RESPECT TO LABOUR FORCE VARIABLES^{1,2}

Sex/ Marital Status Group ³	Labour Force Participation Rates							
	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65+
NMM	4.67	1.04	.53	1.68	.03	.10	.11	.03
NMF	1.05	2.88	2.14	1.44	.73	.27	.01	.00
MM	.66	.09	.04	.08	.00	.01	.02	.00
MF	****4	1.17	.54	.23	.04	-.02	.00	.00
DM	4.28	.81	.34	1.15	.03	.11	.14	.03
DF	1.19	3.43	1.78	.69	.40	.21	.01	.00
WM	2.52	.58	.23	.47	.01	.04	.06	.02
WF	.78	1.93	.67	.18	.13	.10	.01	.00
	Unemployment Rates							
NMM	-.15	-.07	-.03	-.02	-.01	-.01	.00	.00
NMF	-.14	-.03	-.02	-.01	.00	.00	.00	.00
MM	-.02	-.01	.00	.00	.00	.00	.00	.00
MF	****	-.01	-.01	.00	.00	.00	.00	.00
DM	-.14	-.06	-.02	-.01	-.01	-.01	-.01	.00
DF	-.16	-.04	-.01	-.01	.00	.00	.00	.00
WM	-.08	-.04	-.01	.00	.00	.00	.00	.00
WF	-.10	-.02	-.01	.00	.00	.00	.00	.00
	Labour Force Duration							
NMM	-1.43	.68	.90	-.66	.61	.32	.12	.01
NMF	3.10	-2.09	-1.60	-1.09	-.54	-.20	.00	.00
MM	-.20	.06	.06	-.03	.04	.03	.02	.00
MF	****	-.78	-.38	-.17	-.03	.02	.00	.00
DM	-1.31	.53	.57	-.45	.53	.37	.16	.01
DF	3.52	-2.48	-1.34	-.53	-.30	-.16	.00	.00
WM	-.77	.38	.39	-.18	.16	.13	.07	.01
WF	2.30	-1.40	-.50	-.13	-.10	-.07	.00	.00
	Unemployment Duration							
NMM	-.10	-.04	-.01	-.01	-.01	-.01	.00	.00
NMF	-.21	-.02	-.01	-.01	.00	.00	.00	.00
MM	-.01	.00	.00	.00	.00	.00	.00	.00
MF	****	-.01	.00	.00	.00	.00	.00	.00
DM	-.09	-.03	-.01	-.01	-.01	-.01	.00	.00
DF	-.24	-.02	-.01	.00	.00	.00	.00	.00
WM	-.05	-.02	-.01	.00	.00	.00	.00	.00
WF	-.15	-.01	.00	.00	.00	.00	.00	.00

1, 2, 3. See footnotes 1,2 and 3 to Table 11, p.88.

4. When the income for a particular demographic group is below the subsistence level, the elasticity is undefined.

The effect of increasing unemployment, ceteris paribus, and of increasing duration of unemployment, ceteris paribus, is to decrease the income of all demographic groups. Thus the elasticities are negative. They also decline in magnitude with increasing age.

The elasticities with respect to duration of labour force participation are both positive and negative. The effects of an increase in the duration of labour force participation, with the other variables held constant, are several. In particular, with labour force participation rates fixed, an increase in duration of labour force participation decreases the size of the labour force, so fewer persons in each demographic group are receiving earned income which lowers the income for each group. However, those in the workforce receive full earned income for a greater part of the year, which raises the income for the group. The signs of the elasticities are the result of these opposing effects. In general, the elasticities are negative but there are a few large positive elasticities. The other elasticities in Table 13, are also the result of opposing effects but there is generally one dominant effect, giving a uniformity of signs across demographic groups.

In summary, investigation of Table 12 and 13 reveals that the largest elasticities arise for the not marrieds, with widows having slightly lower elasticities and married males and females having the lowest elasticities with respect to any of the income or labour force variables. The elasticities are largest with respect to earned income and labour force participation rates and duration but, for selected demographic groups, the elasticities can be moderately large for unemployment benefits, not-in-the-labour-force and unearned incomes and for unemployment rates and durations.

7. SIMULATION OF THE ECONOMETRIC MODEL TO 1980 AND COMPARISONS WITH AVAILABLE SURVEY DATA

In order to test the performance of the model in projection, we have simulated the model outside of the sample period and compared its results with survey data for 1978 and 1980 which have recently become available. It was not possible to use the survey data in the estimation of the model as it was not provided in a sufficiently disaggregated form. As discussed in Section 4, the survey data is available disaggregated by only four sex/marital status groups - - not married males and females and married males and females - - and by only six decennial age groups from 15-24 to 65 and over. Also, in the survey data, permanently separated persons have been included in the not married group, whereas, in our model, permanently separated persons are classified as married. Hence, the estimated headships must be aggregated across age groups and permanently separated persons must be assigned to the not married group to enable comparisons with survey data.

To simulate the econometric model, we required labour force and income data from 1976 to 1980 in order to calculate the exogenous variables of the model. Fortunately such data were available, although some of the later income data are preliminary estimates. To aggregate the estimated headships to conform with the survey data, it was necessary to use population estimates derived from the IMPACT Project's population projection facility¹ for 1978 and 1980. The population estimates were

1. See Dennis Sams, Lynne Williams, Pamela Williams and Jim Stevenson, "A Comparison between the ABS Population Projection, 1980 to 2001, and a Compatible Projection using the IMPACT Population Projection Facility", Draft Preliminary Working Paper, Melbourne, July 1981.

used to calculate the estimated number of households in each of the eight sex/marital status and eight age groups used in the econometric model. The estimated number of households could then be simply aggregated to conform with the age groups used in the survey, and headship ratios recalculated.

Aggregation of the estimated number of households to conform with the sex/marital status groups provided by the survey was more difficult. The econometric model provides estimates of the number of households and headship ratios for married and permanently separated persons as one group, so it was necessary to remove the contribution of permanently separated persons from the model estimates for married persons and to add this contribution to the aggregate of the model estimates for not married persons. Information regarding the headship ratios and population of permanently separated persons is available only for Census years, so it was necessary to impute values for permanently separated headships and populations in 1978 and 1980. Census data suggests that household headship ratios for permanently separated persons of all ages have increased substantially since 1961. To derive estimates of the headship ratios in 1978 and 1980, we assumed that headship ratios grew from 1976 to 1980 at the same average annual rate as they had in the previous decade. The population of permanently separated persons has grown considerably since 1961, even when expressed in terms of a proportion of the combined group of married and permanently separated persons. Substantial increases occurred at the 1976 Census and this may be related to the introduction of the Family Law Act 1975. Under this Act, the only acceptable ground for divorce became separation for at least one year. It is likely that people who would previously have been enumerated as married were declaring themselves to be permanently separated. There is no clear indication that this trend will continue into the future, so we have

assumed that, for males and females, permanently separated persons, as a proportion of the combined group of married and permanently separated has remained constant since 1976. Using these estimates of permanently separated headships and populations, it was possible to adjust the estimated numbers of households to conform with the sex/marital status groups provided by the survey and to recalculate the headship ratios. The final estimates of the number of households were then calculated using the populations given by the survey (this procedure amounts to scaling the IMPACT population estimates to agree with those given by the survey).

In Figures 9 to 12, the actual and estimated headship ratios for the four sex/marital status and six age groups for the years 1966, 1971, 1976, 1978 and 1980 are depicted. As the figures show, and as could be expected from the previous section, the headship ratios over the sample period (1966, 1971 and 1976) are closely tracked by the econometric model. This also implies that our method of re-allocating permanently separated persons has been successful. Unfortunately, the out-of-sample correspondence between the survey data and the model estimates is less close. Observation of these figures suggests that there may be some discontinuity between Census and survey estimates of household headship ratios, especially for females.

In general, the model appears to be underestimating the headship ratios from the survey, especially for not married males and females and married females. The estimated headship ratios have followed the general trends experienced in the late 1960's and early 1970's, with some decline or slowing of growth in response to the less buoyant economic conditions of the late 1970's. Given the seemingly discontinuous nature of the survey data, it is difficult to assess the apparent inaccuracy of the out-of-sample performance of the econometric model. Such an assessment will have to be made when the 1981 Census becomes available.

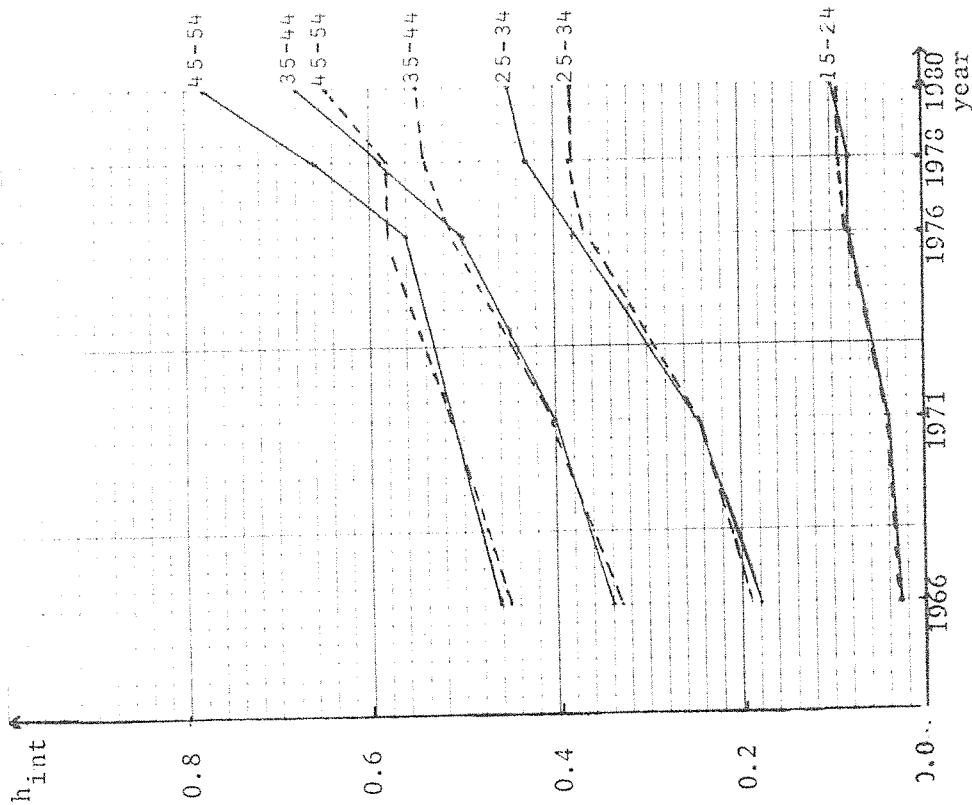
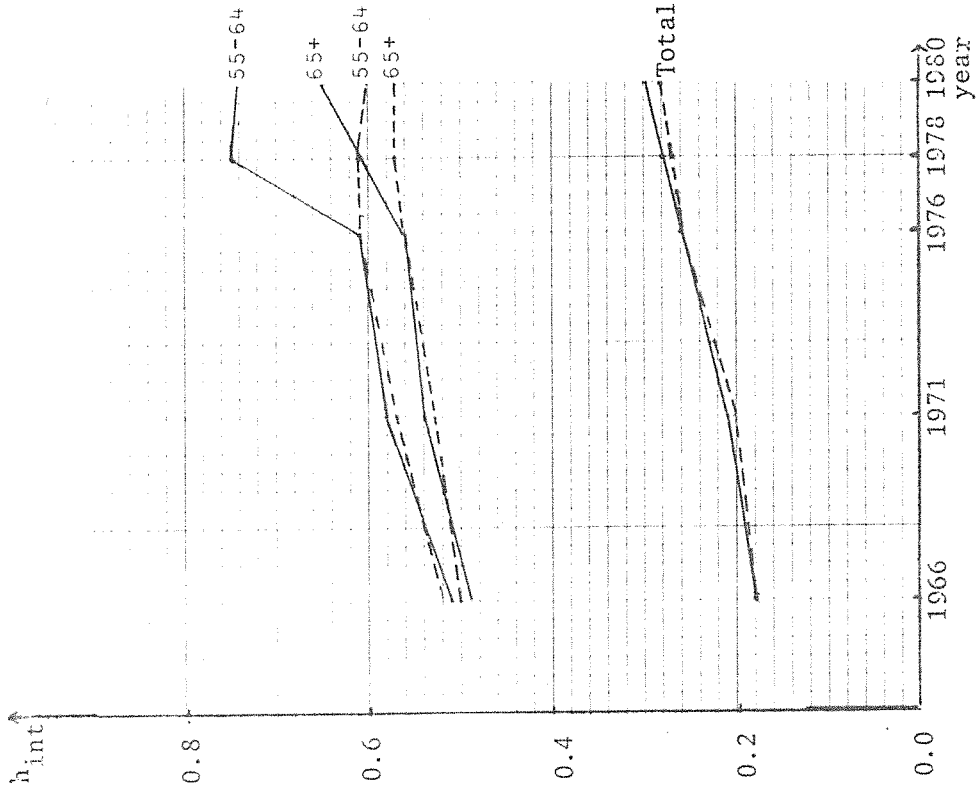


Figure 9 : Comparison of Actual and Estimated Household Headship Ratios for Not Married Males by Age; 1966, 1971, 1976, 1978 and 1980¹

1. Estimated headships are given by broken lines.

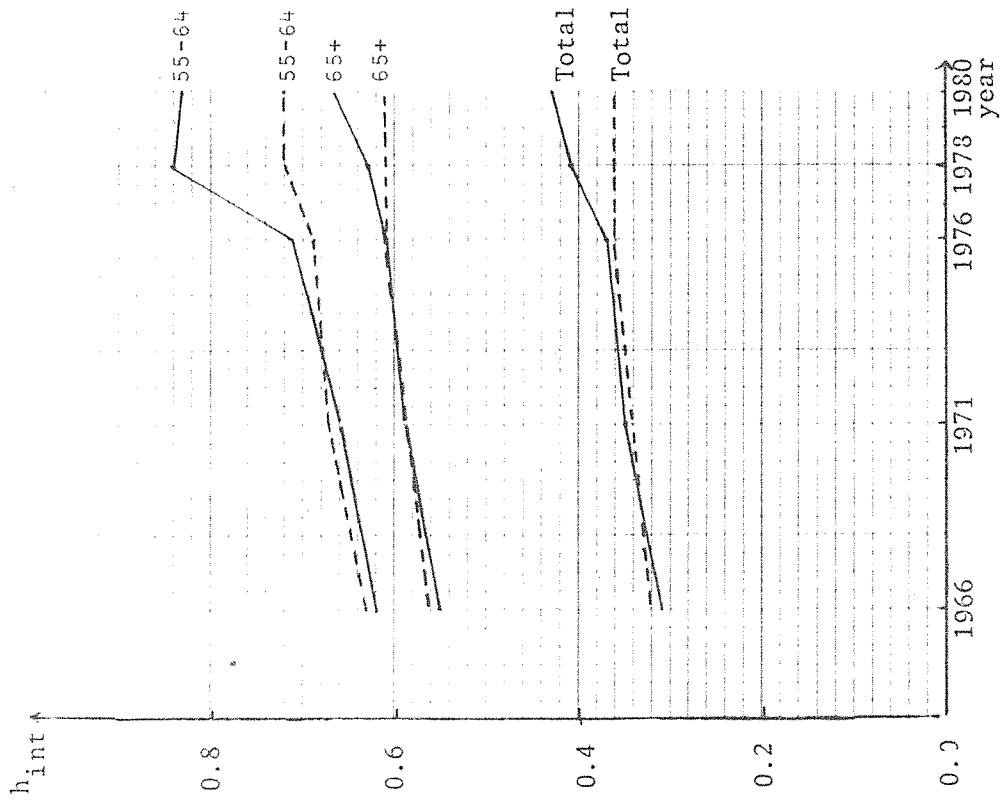
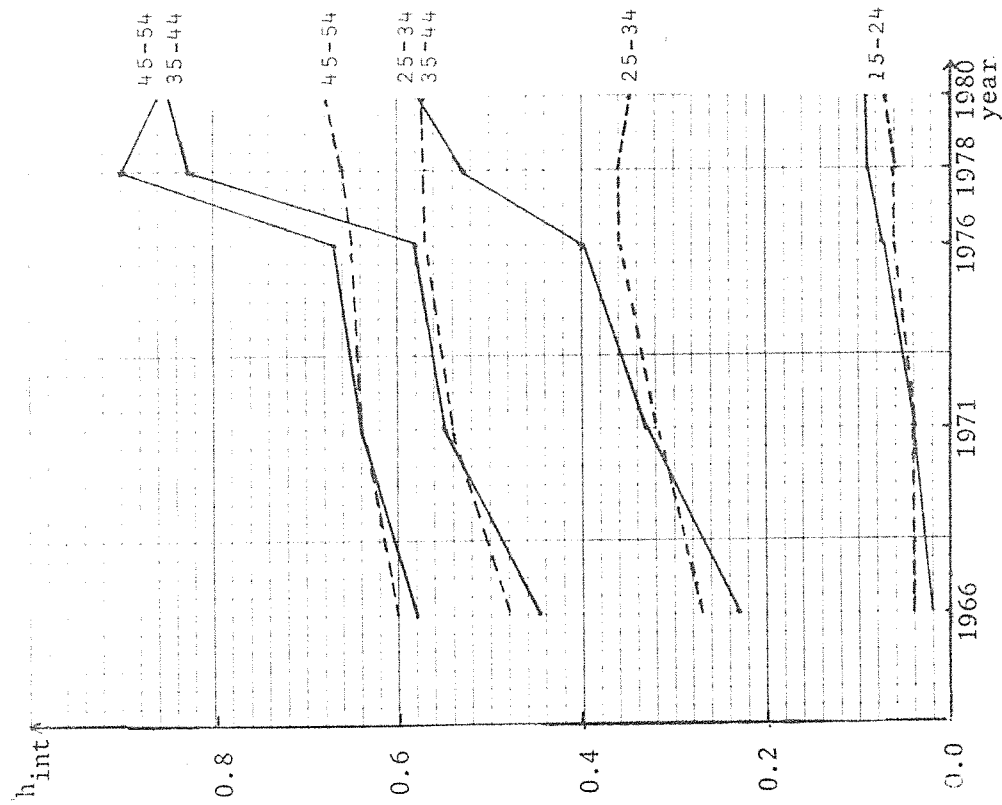


Figure 10 : Comparison of Actual and Estimated Household Headship Ratios for Not Married Females by Age; 1966, 1971, 1976, 1978 and 1980¹

1. Estimated headships are given by broken lines.

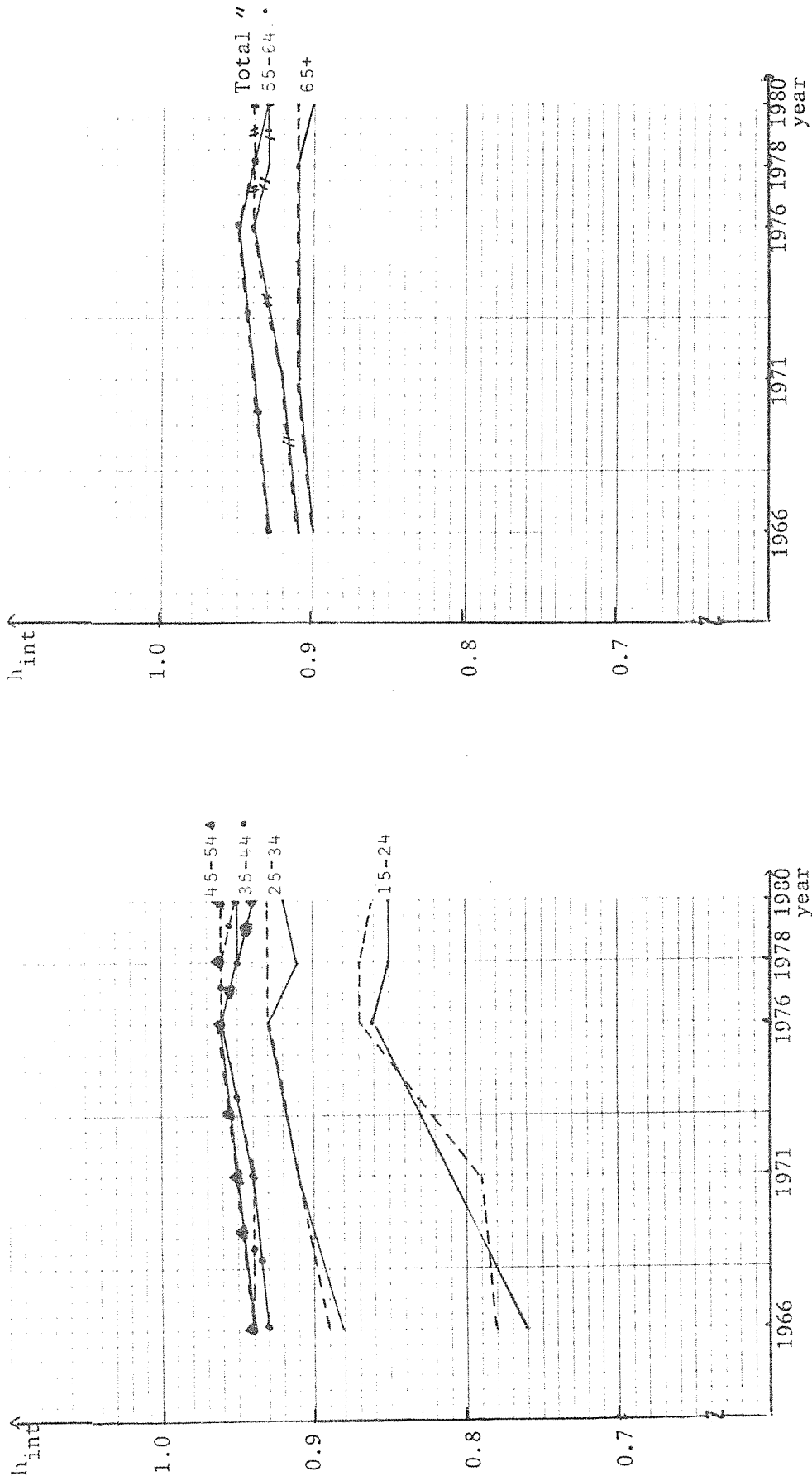


Figure 11 : Comparison of Actual and Estimated Household Headship Ratios for Married Males by Age; 1966, 1971, 1976, 1978 and 1980¹

1. Estimated headships are given by broken lines.

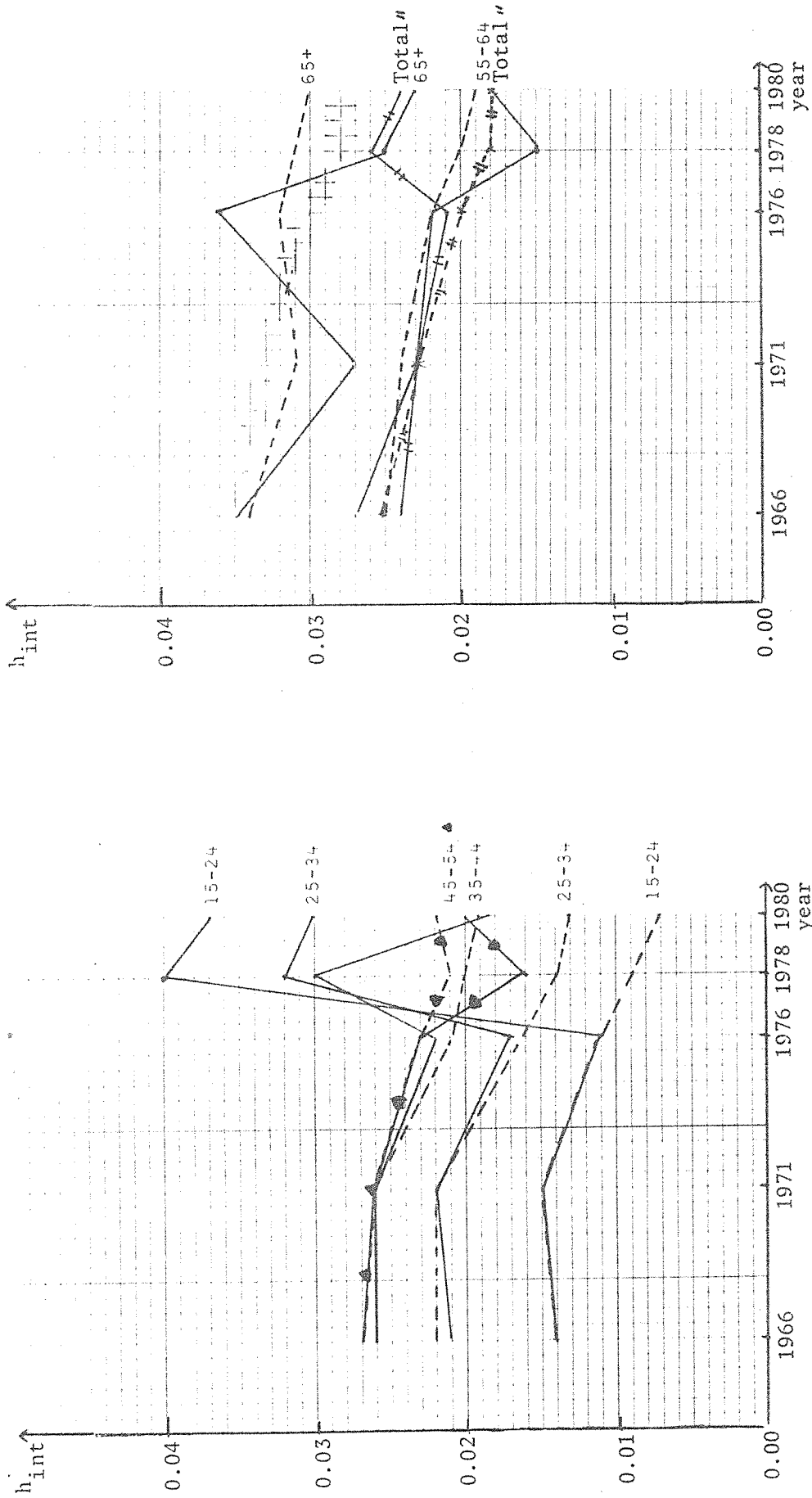


Figure 12 : Comparison of Actual and Estimated Household Headship Ratios for Married Females by Age; 1966, 1971, 1976, 1978 and 1980¹

1. Estimated headships are given by broken lines.

8. CONCLUDING REMARKS

Projections of the number of households are a necessary input into the analysis of many aspects of the Australian economy while, simultaneously, the prevailing economic conditions also influence the number of households and their characteristics. In this paper we have detailed the specification and estimation of an econometric model of household headship ratios which relates household headship ratios for sixty-four demographic groups to their economic determinants. Projections from this model can be used in conjunction with projections of the population from the population projection facility of the IMPACT Project to derive consistent projections of the number of Australian households disaggregated by the demographic characteristics of their head.

An important feature of the model which has been estimated is its ability to capture the combined effect upon household headship behaviour of the changes in, and complex interactions between, employment, unemployment and the income derived from various sources. This has been achieved by relating household headship for each demographic group to the expected level of income received by a typical member of that group and by explicitly specifying the relationship between labour force participation rates, the duration of labour force participation, unemployment rates, the duration of unemployment and incomes received from wages and salaries, unemployment benefits and other government transfer payments and other sources.

Despite the difficulties that the dramatic changes in the economic environment during the 1970's have caused for many econometric models, including the original model of household headship estimated by

the IMPACT Project, the current model has been highly successful in capturing the salient features of household headship over the sample period, 1966 to 1976. Unfortunately, attempts at a comparison between an out-of-sample simulation of the econometric model and recently available survey data were thwarted by apparent inconsistencies between Census and survey data.

The model provides some interesting results regarding the nature of household headship. In line with recent experience, the model suggests that household headship ratios for the less traditional headship groups, such as the young, the old and the not married, will be more responsive to changes in the economic environment than the traditional married male and widowed female groups. It also suggests that household headship ratios are predominantly influenced by the level of labour force incomes, which will be jointly determined by wage rates, labour force participation rates and durations in the labour force. However, for some particular groups, the level of other incomes will also be of importance, for example, the young will be responsive to changes in the level of unemployment benefits and unemployment rates and duration, whilst the old will be responsive to changes in the level of government transfer payments.

Our next task will be to integrate the household headship model within the demographic core of the IMPACT Project. This will enable a simultaneous and consistent approach to the projection of population and households.

Appendix 1 : Alternative Interpretation
of the Respecified Econometric Model

In this Appendix, we develop an alternative interpretation of the model specified in Section 5. This interpretation allows us to aggregate from individual decision-makers to the demographic groups whose household headship we wish to explain.

If the supply of housing does not provide a constraint, and the benefits from setting up or maintaining a separate household remain fixed over time, we can postulate that an individual will become a household head when his supernumerary income, as deflated for changes in the costs of setting up and maintaining a separate household, exceeds some threshold level. To simplify the analysis, we assume, as in Section 5, that individuals can be grouped according to their demographic and labour force status characteristics, such that, within these groups, behaviour with respect to household headship decisions approximates uniformity. If we also make the simplifying assumption that the level of subsistence income does not vary across demographic/labour force status groups, we can denote the supernumerary income, as deflated for changes in the cost of setting up or maintaining a separate household, for persons of the i^{th} sex/marital status and n^{th} age group who belong to labour force status j in period t by

$$(y_{intj} - \Gamma_t) .$$

We also assume that supernumerary income, as deflated for the cost of housing, is distributed exponentially within each of these demographic/labour force status groups. Hence, if $g_{intj}(y_{intj} - \Gamma_t)$

denotes the proportion of persons in the inj^{th} demographic/labour force status group in period t , who receive supernumerary income, $(y_{intj} - \Gamma_t)$, then

$$(A1.1) \quad g_{intj}(y_{intj} - \Gamma_t) = k_{intj} e^{-k_{intj}(y_{intj} - \Gamma_t)},$$

and, if $G_{intj}(y_{intj} - \Gamma_t)$ denotes the proportion of persons in the inj^{th} demographic/labour force status group in period t , who receive supernumerary incomes less than or equal to $(y_{intj} - \Gamma_t)$, then G_{intj} is defined by

$$(A1.2) \quad \begin{aligned} G_{intj}(y_{intj} - \Gamma_t) &= \int_0^{(y_{intj} - \Gamma_t)} g_{intj}(z) dz \\ &= 1 - e^{-k_{intj}(y_{intj} - \Gamma_t)}. \end{aligned}$$

If we assume that persons within each demographic/labour force status group will become household heads when their supernumerary income exceeds some threshold level, denoted by ζ_{intj} , then the proportion of persons in the inj^{th} demographic/labour force status group in period t , who are household heads, that is, the household headship ratio, h_{intj} , will be given by:

$$(A1.3) \quad h_{intj} = e^{-k_{intj} \zeta_{intj}}.$$

If we assume that ζ_{intj} is fixed, and take the log differential of h_{intj} , we have

$$(A1.4) \quad d \ln h_{intj} = - \zeta_{intj} d k_{intj}.$$

We define the mean supernumerary income, as deflated for changes in the cost of setting up or maintaining a separate household, for persons of the inj^{th} demographic/labour force status group as $(Y_{intj} - \Gamma_t)$, hence,

$$\begin{aligned} Y_{intj} - \Gamma_t &= E(y_{intj} - \Gamma_t) \\ (A1.5) \quad &= 1/k_{intj} \end{aligned}$$

Substituting (A1.5) in (A1.4), we have

$$\begin{aligned} d \ln h_{intj} &= - \zeta_{intj} d[1/(Y_{intj} - \Gamma_t)] \\ &= \zeta_{intj} \frac{d(Y_{intj} - \Gamma_t)}{(Y_{intj} - \Gamma_t)^2} \\ (A1.6) \quad &= \frac{\zeta_{intj}}{(Y_{intj} - \Gamma_t)} d \ln(Y_{intj} - \Gamma_t) \end{aligned}$$

Data on household headship ratios are only available for demographic groups, and give no information on headship ratios in the labour force status groups. If w_{intj} are the shares of population of the inj^{th} demographic group in period t who are in the j^{th} labour force status, we have

$$\begin{aligned} d \ln h_{int} &= \sum_{j=1}^3 w_{intj} \frac{h_{intj}}{h_{int}} d \ln h_{intj} \\ (A1.7) \quad &= \sum_{j=1}^3 \left\{ \frac{w_{intj} h_{intj} \zeta_{intj}}{h_{int} (Y_{intj} - \Gamma_t)} \right\} d \ln (Y_{intj} - \Gamma_t) \end{aligned}$$

To simplify the data requirements, we can assume that

$$(A1.8) \quad \frac{h_{intj} \zeta_{intj}}{h_{int}(Y_{intj} - \Gamma_t)} = \sigma_{int}, \text{ for all } j .$$

This simplifying assumption implies that the ratio of threshold to supernumerary income varies only with age/sex/marital status and not between labour force status groups. Lack of data at this level of disaggregation necessitates such a simplification. Hence, substituting (A1.8) into (A1.7), we have,

$$(A1.9) \quad d \ln h_{int} = \sigma_{int} \sum_{j=1}^3 w_{intj} d \ln (Y_{intj} - \Gamma_t) .$$

Headship data are available for each age/sex/marital status group for only four time periods, so it will be necessary to estimate separate equations for each sex/marital status group only, using information across time and across ages. We are also keen to specify the model such that headship ratios will be constrained to take values within reasonable bounds. Hence, we choose

$$(A1.10) \quad \sigma_{int} = \left[\frac{S_i - h_{int}}{S_i} \right] \phi_i(n) ,$$

where the first part of the equation embodies a logistic specification which ensures that headship has a lower asymptotic limit of zero and an upper asymptotic limit for the i^{th} sex/marital status group of S_i . The second part of equation (A1.10) is an arbitrary sex/marital status specific function of age, which ensures that the response of headship to its economic determinants is age dependent.

Now, if we substitute (A1.10) into (A1.9), we have

$$(A1.11) \quad d \ln h_{int} = \left[\frac{S_i - h_{int}}{S_i} \right] \phi_i(n) \sum_{j=1}^3 w_{intj} d \ln(Y_{intj} - \Gamma_t).$$

As discussed in Section 5, we postulate that the strength of the response of individuals, in terms of their headship decision, to economic stimuli will decline with age. If we select,

$$\phi_i(n) = \beta_i + \gamma_i n + \delta_i n^2, \quad \gamma_i > 0,$$

then this postulate will be incorporated into the model and, despite the fact that the model is estimated separately for sex/marital status groups, it will be able to take account of the life-cycle characteristics of headship.

Substituting into equation (A1.11), we have

$$(A1.12) \quad d \ln h_{int} = \left[\frac{S_i - h_{int}}{S_i} \right] (\beta_i + \gamma_i n + \delta_i n^2) \cdot \sum_{j=1}^3 w_{intj} d \ln(Y_{intj} - \Gamma_t).$$

Now, equation (A1.12) is the differential of the following

relationship:¹

$$(A1.13) \quad \ln \left[\frac{S_i - h_{int}}{h_{int}} \right] = \alpha_{in} + (\beta_i + \gamma_i n + \delta_i n^2) \cdot \sum_{j=1}^3 w_{intj} \ln (Y_{intj} - \Gamma_t) .$$

Hence, if

$$H_{int} = \ln \left[\frac{S_i - h_{int}}{h_{int}} \right] ,$$

then

$$H_{int} = \alpha_{in} + (\beta_i + \gamma_i n + \delta_i n^2) \cdot \sum_{j=1}^3 w_{intj} \ln (Y_{intj} - \Gamma_t) ,$$

which is the same formulation as that derived in Section 5.

1. The relationship between equations (A1.12) and (A1.13) is easily established if we take the differential of (A1.13):

$$d \ln \left[\frac{S_i - h_{int}}{h_{int}} \right] = (\beta_i + \gamma_i n + \delta_i n^2) \sum_{j=1}^3 w_{intj} d \ln (Y_{intj} - \Gamma_t) .$$

Taking the left-hand side:

$$\begin{aligned} d \ln \left[\frac{S_i - h_{int}}{h_{int}} \right] &= d \ln (S_i - h_{int}) - d \ln h_{int} \\ &= - \frac{d h_{int}}{(S_i - h_{int})} - d \ln h_{int} \\ &= - d \ln h_{int} \left[1 + \frac{h_{int}}{(S_i - h_{int})} \right] \\ &= - d \ln h_{int} \left[\frac{S_i}{(S_i - h_{int})} \right] . \end{aligned}$$

Substituting back into the differential of (A1.13), and dropping the negative sign,

$$d \ln h_{int} = \left[\frac{S_i - h_{int}}{S_i} \right] (\beta_i + \gamma_i n + \delta_i n^2) \sum_{j=1}^3 w_{intj} d \ln (Y_{intj} - \Gamma_t) .$$

Appendix 2 : Calculation of Elasticities
of Household Headship with Respect to
Economic Variables

The specification of the household headship model, as given in Section 5, allows for the calculation of elasticities of household headship with respect to a number of important economic variables - - income (in general and from various sources), labour force participation and unemployment rates, and the durations of labour force participation and unemployment. The mathematical formulations of these elasticities are given in this Appendix.

The model specified in Section 5 is given as follows:

$$(A2.1) \quad h_{int} = S_i \left\{ 1 + \exp [H_{int}] \right\}^{-1},$$

where

$$(A2.2) \quad H_{int} = \alpha_{in} + \epsilon_{in} \xi_{int}.$$

We can calculate the elasticity of household headship, h_{int} , with respect to the expected utility of income, ξ_{int} , as follows:

$$(A2.3) \quad \eta_{int} = \frac{\partial h_{int}}{\partial \xi_{int}} \cdot \frac{\xi_{int}}{h_{int}}$$

$$= \frac{\partial h_{int}}{\partial H_{int}} \cdot \frac{\partial H_{int}}{\partial \xi_{int}} \cdot \frac{\xi_{int}}{h_{int}}.$$

Now, from (A2.1), we have

$$\frac{\partial h_{int}}{\partial H_{int}} = -h_{int} \left(1 - \frac{h_{int}}{S_i} \right),$$

and, from (A2.2), we have:

$$\frac{\partial h_{int}}{\partial \xi_{int}} = \epsilon_{in} .$$

Substituting into (A2.3) ,

$$(A2.4) \quad \eta_{int} = -\epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) \xi_{int} .$$

S_i is the marital status specific upper limit to headship ratios, so $h_{int} < S_i$. Hence, $\eta_{int} > 0$ if $\epsilon_{in} < 0$, which occurred for most age/sex/marital status groups, with the exception of the estimates for married females at older ages. So, for the majority of age/sex/marital status groups, the response of household headship to a percentage change in the expected utility of income will be positive, as was expected.

The expected utility of income can be expressed as

$$(A2.5) \quad \xi_{int} = \sum_{j=1}^3 w_{intj} \ln (Y_{intj} - \Gamma_t) .$$

The elasticity of household headship with respect to the income of persons of the i^{th} demographic and j^{th} labour force status group, Y_{intj} , is given by

$$\begin{aligned} \eta_{intj} &= \frac{\partial h_{int}}{\partial Y_{intj}} \cdot \frac{Y_{intj}}{h_{int}} \\ &= \frac{\partial h_{int}}{\partial \xi_{int}} \cdot \frac{\partial \xi_{int}}{\partial Y_{intj}} \cdot \frac{Y_{intj}}{h_{int}} \end{aligned}$$

$$(A2.6) \quad = \eta_{int} \cdot \frac{\partial \xi_{int}}{\partial Y_{intj}} \cdot \frac{Y_{intj}}{\xi_{int}} .$$

Now, from (A2.4), we have

$$(A2.7) \quad \frac{\partial h_{int}}{\partial \xi_{int}} = \eta_{int} \cdot \frac{h_{int}}{\xi_{int}} \\ = -\epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) \cdot h_{int} ,$$

and, from (A2.5) ,

$$(A2.8) \quad \frac{\partial \xi_{int}}{\partial Y_{intj}} = w_{intj} \left(\frac{1}{Y_{intj} - \Gamma_t} \right) , \text{ if } Y_{intj} > \Gamma_t .$$

Substituting (A2.7) and (A2.8) into (A2.6) gives

$$(A2.9) \quad \eta_{intj} = -\epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) w_{intj} \left(\frac{Y_{intj}}{Y_{intj} - \Gamma_t} \right) .$$

Now, $\left(\frac{Y_{intj}}{Y_{intj} - \Gamma_t} \right)$ is the ratio of total income to supernumerary income for each demographic/labour force status group and will therefore always exceed unity. The w_{intj} are population shares, so $w_{intj} > 0$, and, as previously discussed, $\left(1 - \frac{h_{int}}{S_i} \right) > 0$. Hence, if the estimated parameters, $\epsilon_{in} < 0$, as they are in most cases, $\eta_{intj} > 0$.

The response of household headship for each demographic group to changes in the level of real per capita income for each of the labour force status groups will generally be positive.

The expected utility of income can also be expressed in terms of real per capita income according to its source, I_{intk} , as follows:

$$(A2.10) \quad Y_{int1} = \lambda_{int} I_{int1} + (1 - \lambda_{int}) I_{int3} + I_{int4} ,$$

$$(A2.11) \quad Y_{int2} = \lambda_{int} \left[\mu_{int} I_{int2} + (1 - \mu_{int}) I_{int1} \right] \\ + (1 - \lambda_{int}) I_{int3} + I_{int4} ,$$

and

$$(A2.12) \quad Y_{int3} = I_{int3} + I_{int4} + I_{int5} .$$

The elasticity of household headship with respect to income from the k^{th} source for persons of the int^{th} demographic group, I_{intk} , is given by

$$\eta_{int}^k = \frac{\partial h_{int}}{\partial I_{intk}} \cdot \frac{I_{intk}}{h_{int}} \\ (A2.13) \quad = \sum_{j=1}^3 \left\{ \frac{\partial h_{int}}{\partial Y_{intj}} \cdot \frac{\partial Y_{intj}}{\partial I_{intk}} \right\} \cdot \frac{I_{intk}}{h_{int}} .$$

Now, from (A2.9), we have

$$\frac{\partial h_{int}}{\partial Y_{intj}} = \eta_{intj} \cdot \frac{h_{int}}{Y_{intj}} \\ (A2.14) \quad = - \epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) w_{intj} \left(\frac{h_{int}}{Y_{intj} - \Gamma_t} \right) ,$$

and, from (A2.10) to (A2.12) ,

$$(A2.15) \quad \frac{\partial Y_{intj}}{\partial I_{intk}} = \sigma_{int}^{jk} I_{intk} ,$$

where σ_{int}^{jk} is given in the following table:

σ_{int}^{jk}	k = 1	k = 2	k = 3	k = 4	k = 5
j=1	λ_{int}	0	$(1-\lambda_{int})$	1	0
j=2	$\lambda_{int}(1-\mu_{int})$	$\lambda_{int}\mu_{int}$	$(1-\lambda_{int})$	1	0
j=3	0	0	1	1	1

Substituting (A2.14) and (A2.15) into (A2.13), we have

$$(A2.16) \quad \eta_{int}^k = - \epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) \sum_{j=1}^3 \left\{ w_{intj} \left(\frac{\sigma_{int}^{jk}}{Y_{intj} - \Gamma_t} \right) \right\} I_{intk} .$$

This formulation suggests that the response of household headship for each demographic group to percentage changes in real per capita incomes according to source will be positive.

The population shares which are used in the construction of the expected utility of income can be expressed as follows:

$$(A2.17) \quad w_{int1} = \frac{\ell_{int}}{\lambda_{int}} - \frac{\ell_{int} u_{int}}{\mu_{int}} ,$$

$$(A2.18) \quad w_{int2} = \frac{\ell_{int} u_{int}}{\mu_{int}} ,$$

and

$$(A2.19) \quad w_{int3} = 1 - \frac{\ell_{int}}{\lambda_{int}} .$$

Thus, it is possible to calculate elasticities of household headship with respect to the labour force variables. For ease of expression, let M_{intm} represent the four labour force behaviour variables, such that M_{int1} refers to labour force participation rates, M_{int2} refers to

unemployment rates, M_{int3} refers to duration of labour force participation and M_{int4} refers to duration of unemployment. Therefore, the elasticity of household headship with respect to labour force behaviour of the m^{th} type for persons of the in^{th} demographic group, M_{intm} , is given by

$$\begin{aligned} \eta_{int}^{(m)} &= \frac{\partial h_{int}}{\partial M_{intm}} \cdot \frac{M_{intm}}{h_{int}} \\ (A2.20) \quad &= \frac{\partial h_{int}}{\partial \xi_{int}} \cdot \frac{\partial \xi_{int}}{\partial M_{intm}} \cdot \frac{M_{intm}}{h_{int}} \end{aligned}$$

Now, from (A2.4), we have

$$\begin{aligned} \frac{\partial h_{int}}{\partial \xi_{int}} &= \eta_{int} \cdot \frac{h_{int}}{\xi_{int}} \\ (A2.21) \quad &= -\epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) h_{int} \end{aligned}$$

and, from (A2.5), (A2.10) - (A2.12) and (A2.17) - (A2.19),

we have

$$\begin{aligned} (A2.22) \quad \frac{\partial \xi_{int}}{\partial M_{intm}} &= \sum_{j=1}^3 \left\{ v_{int}^{jm} \ln(Y_{intj} - \Gamma_t) \right. \\ &\quad \left. + w_{intj} \rho_{int}^{jm} \left(\frac{1}{Y_{intj} - \Gamma_t} \right) \right\} \end{aligned}$$

where

$$v_{int}^{jm} = \frac{\partial w_{intj}}{\partial M_{intm}} \quad ,$$

and

$$\rho_{int}^{jm} = \frac{\partial Y_{intj}}{\partial M_{intm}} \quad .$$

The values of v_{int}^{jm} and ρ_{int}^{jm} are given in the following tables

v_{int}^{jm}	$m = 1$	$m = 2$	$m = 3$	$m = 4$
$j = 1$	$\frac{1}{\lambda_{int}} - \frac{u_{int}}{\mu_{int}}$	$-\frac{\ell_{int}}{\mu_{int}}$	$-\frac{\ell_{int}}{\lambda_{int}^2}$	$\frac{\ell_{int} u_{int}}{\mu_{int}^2}$
$j = 2$	$\frac{u_{int}}{\mu_{int}}$	$\frac{\ell_{int}}{\mu_{int}}$	0	$-\frac{\ell_{int} u_{int}}{\mu_{int}^2}$
$j = 3$	$-\frac{1}{\lambda_{int}}$	0	$\frac{\ell_{int}}{\lambda_{int}^2}$	0

ρ_{int}^{jm}	$m = 1$	$m = 2$	$m = 3$	$m = 4$
$j = 1$	0	0	$(I_{int1} - I_{int3})$	0
$j = 2$	0	0	$\mu_{int} I_{int2} + (1 - \mu_{int}) I_{int1} - I_{int3}$	$\lambda_{int} (I_{int2} - I_{int1})$
$j = 3$	0	0	0	0

Substituting (A2.21) and (A2.22) into (A2.20), we have

$$(A2.25) \quad \eta_{int}^{(m)} = -\epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) M_{intm} \cdot \sum_{j=1}^3 \left\{ v_{int}^{jm} \ln(Y_{intj} - \Gamma_t) + w_{intj} \rho_{int}^{jm} \left[\frac{1}{Y_{intj} - \Gamma_t} \right] \right\}$$

By way of example, consider the elasticity of response of headship to changes in the unemployment rate; that is, $m = 2$:

$$\eta_{int}^{(2)} = -\epsilon_{in} \left(1 - \frac{h_{int}}{S_i} \right) u_{int} \cdot$$

$$\left(\frac{\ell_{int}}{u_{int}} \right) \left\{ \ln (Y_{int2} - \Gamma_t) - \ln (Y_{int1} - \Gamma_t) \right\} \cdot$$

The elasticities for all other labour force variables can be expressed in a similar manner.

REFERENCES

- Australian Bureau of Statistics, Australian National Accounts: National Income and Expenditure, Cat. No. 5204.0, various issues.
- Australian Bureau of Statistics, Commonwealth Government Finance, Australia, Cat. No. 5502.0, various issues.
- Australian Bureau of Statistics, Consumer Price Index, Cat. No. 6401.0, various issues.
- Australian Bureau of Statistics, Labour Force, Cat. No. 6203.0, various issues.
- Australian Bureau of Statistics, Labour Force Experience, Cat. No. 6206.0, various issues.
- Australian Bureau of Statistics, Labour Report, various issues.
- Australian Bureau of Statistics, Social Indicators, Australia, Cat. No. 4101.0, various issues.
- Australian Bureau of Statistics, Survey of House Rental and Ownership, Cat. No. 8710.0, November 1978.
- Australian Bureau of Statistics, Survey of Housing Occupancy and Costs, Australia, Cat. No. 8724.0, August 1980.
- Department of Environment, Housing and Community Development, A Method for the Projection of Households and Dwelling Completions 1975-2000 (Canberra: Australian Government Publishing Service, 1977).
- Department of Environment Housing and Community Development, Household Head to Population Ratios and Marital Status Proportions. 1961, 1966 and 1971 (Canberra: Australian Government Publishing Service, January, 1977).
- Department of Housing and Construction, Preliminary Household Head and Population Data, 1976 (Canberra: Department of Housing and Construction, Building Division, 1978).
- O.B. Di Iulio, Household Formation: 1911-2001; An Historical Analysis and Projection, National Population Inquiry, Working Paper No. 24, April 1976.
- M. Friedman and L.J. Savage, "The Utility Analysis of Choices Involving Risk", Journal of Political Economy, Vol.56, No.4, August 1948.
- R. Frisch, "A Complete Scheme for Computing all Direct and Cross-Demand Elasticities in a Model with many Sectors", Econometrica, Vol.27, 1959.
- A.R. Hall and M.R. Hill, "Housing Demand in Australia," The Economic Record, Vol.36, No.76, December 1960.

- L.R. Klein and H. Rubin, "A Constant-Utility Index of the Cost of Living", Review of Economic Studies, Vol. 15, 1947-48.
- Constantino Lluch, Alan A. Powell and Ross A. Williams, Patterns in Household Demand and Saving (New York: Oxford University Press, 1977).
- Alan A. Powell, The IMPACT Project : An Overview, First Progress Report of the IMPACT Project, Volume 1 (Canberra: Australian Government Publishing Service, 1977).
- R. Riner and H.M. Bingham, Household Formation Projections (Melbourne: Melbourne Metropolitan Board of Works, 1975).
- Dennis Sams, Lynne Williams, Pamela Williams and Jim Stevenson, "A Comparison between the ABS Population Projection, 1980 to 2001 and a Compatible Projection using the IMPACT Population Projection Facility", Draft Preliminary Working Paper, Melbourne, July 1981.
- Dennis Sams, "Income Data Requirements for the IMPACT Project's Household Headship Model", IMPACT Research Memorandum, BACHUROO Module, Melbourne, July 1981.
- Dennis Sams and Pam Williams, "The IMPACT Project's Facility for Disaggregated Population Projections : A Brief Exposition and Progress Report," IMPACT Preliminary Working Paper No. BP-22, Melbourne, May 1980.
- Dennis Sams, "The Demographic Core of the IMPACT Project : An Overview," IMPACT Preliminary Working Paper No. BP-18, Melbourne, September 1979.
- United Nations, "Methods of Projecting Households and Families", Manual VII, Population Studies No.54 (ST/SDA/Ser A/54), Sales No. E73 XIII, 2.
- P.J. Williams and R.C. Brooks, "An Econometric Model of Household Headship," IMPACT Preliminary Working Paper No. BP-14, Melbourne, July 1978.
- Pamela Williams, "Labour Force Data Requirements for the IMPACT Project's Household Headship Model", IMPACT Research Memorandum, BACHUROO Module, Melbourne, July 1981.