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IMPACT OF DEMOGRAPHIC CHANGE ON INDUSTRY STRUCTURE IN AUSTRALIA

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AN ECONOMETRIC MODEL OF HOUSEHOLD HEADSHIP

by

P. J. Williams

and

R. C. Brooks

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

IMPACT Project, Industries Assistance Commission, 608 St. Kilda Road, Melbourne, Victoria 3004 Australia
Area Code 03 Telephone 51 8611

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continued ...

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_{10}(W_1=0.65)$	-.2084 (9.71)	.0020 (8.52)		-.0752 (2.31)			-.3447 (2.23)		13.0986 (4.37)	12.3642 (4.02)	11.0531 (3.65)	0.9309
$H_{10}(W_1=0.70)$	-.1956 (8.76)	.0019 (7.66)		-.0814 (2.41)			-.3564 (2.23)		12.3222 (3.96)	11.4617 (3.59)	10.4849 (3.33)	0.9489
$H_{10}(W_1=0.75)$	-.1956 (9.02)	.0019 (7.87)		-.0803 (2.44)			-.3536 (2.27)		12.2188 (4.04)	11.4507 (3.68)	10.4514 (3.41)	0.9498
$H_{10}(W_1=0.80)$	-.1957 (9.21)	.0019 (8.05)		-.0794 (2.47)			-.3511 (2.30)		12.1285 (4.10)	11.4404 (3.76)	10.4210 (3.47)	0.9540
$H_{10}(W_1=0.85)$	-.1958 (9.38)	.0019 (8.18)		-.0785 (2.49)			-.3487 (2.33)		12.0491 (4.14)	11.4311 (3.82)	10.3937 (3.52)	0.9508
$H_{10}(W_1=0.90)$	-.1959 (9.52)	.0019 (8.29)		-.0778 (2.49)			-.3467 (2.35)		11.9789 (4.17)	11.4226 (3.87)	10.3690 (3.57)	0.9510
$H_{10}(W_1=0.95)$	-.1959 (9.63)	.0019 (8.38)		-.0772 (2.50)			-.3448 (2.36)		11.9164 (4.20)	11.4150 (3.91)	10.3469 (3.60)	0.9511
$H_{10}(W_1=1.00)$	-.1960 (9.72)	.0019 (8.46)		-.0766 (2.51)			-.3430 (2.36)		11.8604 (4.22)	11.4082 (3.94)	10.3268 (3.63)	0.9511

1. Columns (1) - (11) contain estimated coefficients (and t-ratios) for the variable shown at the head of the column. For key to notation, see page 19. Column (12) shows the coefficient of determination adjusted for degrees of freedom.

Contents

APPENDIX 2 (continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_8(W_1=0.85)$	-.1740 (11.13)	.0014 (7.51)		-.0079 (1.49)		-.0254 (5.83)			7.6540 (17.03)	6.6801 (11.03)	5.8743 (10.27)	0.9697
$H_8(W_1=0.90)$	-.1751 (11.88)	.0015 (8.04)		-.0075 (1.49)		-.0248 (6.04)			7.5460 (17.81)	6.7081 (11.75)	5.8692 (10.89)	0.9738
$H_8(W_1=0.95)$	-.1761 (12.57)	.0015 (8.51)		-.0071 (1.49)		-.0244 (6.24)			7.4525 (18.50)	6.7371 (12.41)	5.8680 (11.45)	0.9738
$H_8(W_1=1.00)$	-.1770 (13.19)	.0015 (8.95)		-.0068 (1.49)		-.0240 (6.41)			7.3708 (19.10)	6.7659 (13.02)	5.8695 (11.96)	0.9753
$H_9(W_1=0.60)$	-.2707 (8.32)	.0025 (8.47)	-.0059 (4.43)		-.1457 (1.83)				17.9586 (7.35)	12.3842 (4.82)	16.7806 (6.61)	0.9255
$H_9(W_1=0.65)$	-.2717 (10.50)	.0025 (10.54)	-.0042 (3.95)		-.0229 (0.36)				15.6863 (8.08)	13.2524 (6.49)	14.3429 (7.10)	0.9721
$H_9(W_1=0.70)$	-.2629 (9.76)	.0024 (9.90)	-.0050 (4.54)		-.0827 (1.26)				15.9334 (7.88)	12.7713 (6.00)	14.9342 (7.09)	0.9327
$H_9(W_1=0.75)$	-.2601 (10.30)	.0024 (10.44)	-.0047 (4.56)		-.0639 (1.03)				15.2520 (8.05)	12.5307 (6.29)	14.3078 (7.26)	0.9376
$H_9(W_1=0.80)$	-.2577 (10.78)	.0023 (10.90)	-.0044 (4.54)		-.0490 (0.84)				14.6965 (8.19)	12.2996 (6.51)	13.7960 (7.39)	0.9418
$H_9(W_1=0.85)$	-.2556 (11.20)	.0023 (11.30)	-.0042 (4.53)		-.0368 (0.66)				14.2326 (8.31)	12.0912 (6.70)	13.3679 (7.50)	0.9453
$H_9(W_1=0.90)$	-.2538 (11.56)	.0023 (11.67)	-.0040 (4.51)		-.0266 (0.49)				13.8381 (8.40)	11.9062 (6.87)	13.0036 (7.59)	0.9482
$H_9(W_1=0.95)$	-.2522 (11.89)	.0023 (11.99)	-.0039 (4.49)		-.0178 (0.35)				13.4978 (8.48)	11.7426 (7.01)	12.6891 (7.66)	0.9507
$H_9(W_1=1.00)$	-.2508 (12.19)	.0023 (12.27)	-.0038 (4.47)		-.0102 (0.20)				13.2009 (8.54)	11.5974 (7.13)	12.4146 (7.72)	0.9529
$H_{10}(W_1=0.60)$	-.1955 (8.03)	.0019 (7.02)		-.0843 (2.29)			-.3624 (2.07)		12.5790 (3.71)	11.4819 (3.29)	10.5590 (3.07)	0.9450

APPENDIX 2 (continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_7(W_1=0.60)$	-.1614 (11.10)	.0014 (9.97)	-.0042 (5.49)		.0190 (0.61)				11.7920 (8.38)	13.1536 (9.03)	10.9493 (7.59)	0.9711
$H_7(W_1=0.65)$	-.1702 (12.68)	.0014 (11.22)	-.0037 (5.26)		.0019 (0.07)				12.5776 (9.68)	13.5510 (10.08)	11.4741 (8.62)	0.9752
$H_7(W_1=0.70)$	-.1617 (13.09)	.0014 (11.68)	-.0040 (6.17)		.0105 (0.42)				11.5837 (9.69)	12.7307 (10.29)	10.8008 (8.82)	0.9757
$H_7(W_1=0.75)$	-.1620 (13.79)	.0014 (12.30)	-.0039 (6.40)		.0074 (0.31)				11.5250 (10.15)	12.5892 (10.71)	10.7652 (9.24)	0.9768
$H_7(W_1=0.80)$	-.1624 (14.36)	.0014 (12.77)	-.0039 (6.56)		.0049 (0.22)				11.4829 (10.50)	12.4757 (11.02)	10.7429 (9.58)	0.9776
$H_7(W_1=0.85)$	-.1628 (14.79)	.0014 (13.15)	-.0038 (6.68)		.0029 (0.13)				11.4521 (10.76)	12.3827 (11.24)	10.7293 (9.83)	0.9779
$H_7(W_1=0.90)$	-.1632 (15.13)	.0014 (13.42)	-.0038 (6.75)		.0011 (0.05)				11.4292 (10.96)	12.3051 (11.40)	10.7215 (10.02)	0.9781
$H_7(W_1=0.95)$	-.1636 (15.38)	.0014 (13.63)	-.0038 (6.81)		-.0005 (0.03)				11.4121 (11.09)	12.2393 (11.49)	10.7177 (10.16)	0.9781
$H_7(W_1=1.00)$	-.1639) (15.57)	.0014 (13.80)	-.0038 (6.83)		-.0018 (0.09)				11.3991 (11.19)	12.1830 (11.56)	10.7167 (10.26)	0.9871
$H_8(W_1=0.60)$	-.1653 (6.28)	.0013 (4.10)		-.0129 (1.44)		-.0322 (4.38)			8.6836 (11.48)	6.7320 (6.60)	6.1502 (6.38)	0.9376
$H_8(W_1=0.65)$	-.1832 (11.96)	.0015 (8.10)		-.0070 (1.35)		-.0243 (5.68)			9.0941 (20.65)	7.8259 (13.19)	6.6939 (11.94)	0.9721
$H_8(W_1=0.70)$	-.1696 (8.41)	.0014 (5.60)		-.0100 (1.45)		-.0282 (5.01)			8.1198 (14.01)	6.6296 (8.49)	5.9462 (8.06)	0.9574
$H_8(W_1=0.75)$	-.1713 (9.40)	.0014 (6.30)		-.0091 (1.47)		-.0270 (5.32)			7.9329 (15.15)	6.6358 (9.41)	5.9074 (8.86)	0.9628
$H_8(W_1=0.80)$	-.1727 (10.30)	.0014 (6.93)		-.0084 (1.48)		-.0261 (5.59)			7.7810 (16.14)	6.6548 (10.25)	5.8857 (9.60)	0.9667

AN ECONOMETRIC MODEL OF HOUSEHOLD HEADSHIP

by

P. J. Williams

and

R. C. Brooks*

1. INTRODUCTION

Projections of the number and type of households are useful for anticipating future housing needs and analysing consumption patterns, especially for durable goods. Projection can proceed in either of two ways[1] :

1) The cohort method. This method has been used successfully for population projections. It consists of tracing the households formed in a particular period of time through their life cycle to ascertain the proportion that have certain relevant characteristics; for example, number of members. Using these proportions, it is possible to project changes in the stocks and flows of households.

* The authors would like to thank Richard Filmer, Ron Silberberg and Alan Powell for their comments and suggestions.

1. For full details of projection methods, 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.

2) <u>The headship ratio method</u>. This is a two-stage method where initially we project the headship ratio : that is, the proportion of people in any given population category who are heads of households. We then take disaggregated projections of the total population, indicating the numbers of persons who will be in each population category if the assumptions underlying the projections are fulfilled. By multiplying the headship ratios by the numbers of people in the corresponding population categories, we derive projections of the numbers of household heads in each category and, hence, of the number of households whose head belongs to each of the categories distinguished.

Methodologically, the cohort approach is considered to be superior to the ratio method, but lack of prior information and data concerning the flows of people into and out of households, changes in household status, and so on, forces us to rely on the ratio method. Whilst the headship ratio method does not directly take into account the more dynamic aspects of household formation, its two-stage approach does use population projections based on comprehensive cohort analyses of fertility, marriage, divorce, and the like. The headship ratio method is thus able to utilize the results of relevant demographic research, and also to separate out those factors which affect the number of households independently of compositional changes in the population.

APPENDIX 2 (continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_5(W_1=0.90)$	-.1640 (15.78)	.0015 (15.11)	-.0038 (5.85)		.0270 (0.71)				10.6116 (7.79)	10.6869 (8.53)	10.1500 (7.79)	0.9729
$H_5(W_1=0.95)$	-.1640 (15.92)	.0015 (15.20)	-.0037 (5.71)		.0263 (0.70)				10.4408 (7.72)	10.4897 (8.44)	9.9625 (7.71)	0.9725
$H_5(W_1=1.00)$	-.1641 (16.01)	.0015 (15.25)	-.0036 (5.57)		.0258 (0.69)				10.2947 (7.66)	10.3205 (8.36)	9.8013 (7.62)	0.9721
$H_6(W_1=0.60)$	-.1619 (4.53)	.0015 (3.42)		-.0121 (0.94)		-.0371 (3.91)			6.6507 (6.90)	6.9768 (6.57)	5.8353 (5.13)	0.8650
$H_6(W_1=0.65)$	-.1764 (8.87)	.0016 (6.63)		-.0055 (0.77)		-.0234 (4.44)			7.2212 (13.48)	7.0802 (11.60)	6.0386 (9.53)	0.9316
$H_6(W_1=0.70)$	-.1630 (6.17)	.0015 (4.62)		-.0096 (1.01)		-.0302 (4.32)			6.3009 (8.86)	6.4706 (7.99)	5.4953 (6.54)	0.9053
$H_6(W_1=0.75)$	-.1639 (6.81)	.0015 (5.08)		-.0088 (1.02)		-.0282 (4.43)			6.2215 (9.59)	6.3439 (8.59)	5.4174 (7.07)	0.9151
$H_6(W_1=0.80)$	-.1647 (7.35)	.0015 (5.48)		-.0082 (1.03)		-.0267 (4.49)			6.1678 (10.22)	6.2529 (9.10)	5.3662 (7.53)	0.9221
$H_6(W_1=0.85)$	-.1655 (7.84)	.0015 (5.83)		-.0078 (1.03)		-.0254 (4.55)			6.1300 (10.77)	6.1846 (9.54)	5.3301 (7.92)	0.9275
$H_6(W_1=0.90)$	-.1663 (8.26)	.0015 (6.13)		-.0074 (1.02)		-.0244 (4.58)			6.1025 (11.26)	6.1317 (9.93)	5.3038 (8.28)	0.9317
$H_6(W_1=0.95)$	-.1669 (8.64)	.0015 (6.40)		-.0070 (1.02)		-.0236 (4.60)			6.0820 (11.69)	6.0897 (10.28)	5.2842 (8.59)	0.9352
$H_6(W_1=1.00)$	-.1676 (8.99)	.0015 (6.65)		-.0068 (1.01)		-.0228 (4.62)			6.0666 (12.07)	6.0556 (10.58)	5.2692 (8.88)	0.9380

APPENDIX 2 (continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_4(W_1=0.65)$	-.0267 (4.48)			-.0111 (1.47)					5.0447 (12.28)	4.8867 (10.74)	4.2779 (9.22)	0.9913
$H_4(W_1=0.70)$	-.0200 (3.60)			-.0104 (1.47)					2.6333 (6.88)	2.5358 (5.98)	2.0119 (4.66)	0.9330
$H_4(W_1=0.75)$	-.0217 (3.75)			-.0104 (1.42)					2.6865 (6.73)	2.5863 (5.86)	2.0872 (4.63)	0.9273
$H_4(W_1=0.80)$	-.0233 (3.85)			-.0105 (1.36)					2.7345 (6.54)	2,6319 (5.69)	2.1559 (4.57)	0.9207
$H_4(W_1=0.85)$	-.0248 (3.91)			-.1015 (1.31)					2.7783 (6.34)	2.6737 (5.50)	2.2195 (4.48)	0.9132
$H_4(W_1=0.90)$	-.0262 (3.92)			-.0106 (1.25)					2.8186 (6.12)	2.7124 (5.31)	2.2789 (4.38)	0.9049
$H_4(W_1=0.95)$	-.0275 (3.91)			-.0107 (1.20)					2.8563 (5.89)	2.7487 (5.11)	2.3350 (4.26)	0.8959
$H_4(W_1=1.00)$	-.0287 (3.88)			-.0108 (1.15)					2.8917 (5.66)	2.7830 (4.92)	2.3886 (4.13)	0.8753
$H_5(W_1=0.60)$	-.1648 (12.64)	-.0016 (12.50)	-.0053 (6.53)		.0335 (0.71)				12.8549 (7.52)	13.2242 (8.41)	12.5502 (7.66)	0.9708
$H_5(W_1=0.65)$	-.1625 (14.30)	.0015 (13.60)	-.0035 (4.91)		.0273 (0.67)				11.1278 (7.47)	11.0093 (8.04)	10.3482 (7.26)	0.9609
$H_5(W_1=0.70)$	-.1641 (14.40)	.0016 (14.03)	-.0046 (6.43)		.0305 (0.74)				11.7290 (7.85)	11.9601 (8.71)	11.3584 (7.94)	0.9732
$H_5(W_1=0.75)$	-.1640 (14.93)	.0015 (14.46)	-.0043 (6.30)		.0294 (0.74)				11.3554 (7.89)	11.5371 (8.72)	10.9576 (7.95)	0.9734
$H_5(W_1=0.80)$	-.1639 (15.31)	.0015 (14.77)	-.0041 (6.15)		.0285 (0.74)				11.0573 (7.88)	11.1978 (8.68)	10.6356 (7.92)	0.9734
$H_5(W_1=0.85)$	-.1639 (15.58)	.0015 (14.97)	-.0040 (5.99)		.0277 (0.73)				10.8139 (7.84)	10.9194 (8.62)	10.3711 (7.85)	0.9732

In this paper, we report our estimates of a model explaining household headship disaggregated by age, sex and marital status. In a future paper we hope to combine the results with projections of population made by Filmer and Silberberg[1] in order to project the number of households disaggregated by the age, sex and marital status of the household head.

In Sections 2 and 3 respectively we discuss the determinants of household headship and the available data. We follow in Section 4 with a presentation of the reduced form model and in Section 5 we present the estimates. Future research perspectives are discussed in Section 6.

1. See R. Filmer and R. Silberberg, "Fertility, Family Formation and Female Labour Force Participation in Australia, 1922-1974," Impact of Demographic Change on Industry Structure in Australia, Preliminary Working Paper No. BP-08, Industries Assistance Commission, Melbourne, July, 1977 (mimeo).

2. DETERMINANTS OF HEADSHIP

The headship behaviour of an individual is closely related to his demographic and socio-economic characteristics. A model of household headship should attempt to incorporate as much of this information as possible.

2.1 Demographic Determinants

Analysis of headship ratios for Australia[1] and for most other countries[2], suggests the importance of demographic factors - - age, sex and marital status - - in determining the likelihood that any given individual will be a household head. Headship ratios will exhibit certain characteristics depending upon the age, sex and marital status of the group we are considering. These characteristics will persist over time, and, to a large extent, between countries. For instance, never married persons have lower headship ratios than married or previously married persons (except for married females, who have extremely low headship). Never married females are less likely to be heads than never-married males, except in the older age groups. Predictably, married males have the highest headship ratios at all ages. Previously married persons have higher headship ratios than never marrieds, except in some of the older age groups, whilst previously married females tend to have higher headships than previously married males.

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1. See Appendix 1.
2. See United Nations, op. cit..

APPENDIX 2 (continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_2(W_1=0.85)$	-.1900 (6.36)	.0014 (3.62)	-.0025 (1.86)	.0010 (0.10)	.3071 (2.60)			9.8450 (3.34)				0.9252
$H_2(W_1=0.90)$	-.1908 (6.47)	.0014 (3.66)	-.0025 (1.87)	.0007 (0.06)	.3002 (2.58)			9.9160 (3.41)				0.9279
$H_2(W_1=0.95)$	-.1916 (6.58)	.0014 (3.70)	-.0025 (1.89)	.0004 (0.04)	.2942 (2.55)			9.9787 (3.47)				0.9302
$H_2(W_1=1.00)$	-.1922 (6.67)	.0014 (3.73)	-.0025 (1.90)	.0001 (0.01)	.2889 (2.54)			10.0346 (3.53)				0.9322
$H_3(W_1=0.60)$	-.2272 (13.17)	.0022 (13.53)	-.0021 (2.51)		.6781 (2.64)				4.7141 (2.80)	4.7434 (2.53)	5.1522 (3.12)	0.9938
$H_3(W_1=0.65)$	-.1882 (18.53)	.0018 (18.55)	-.0019 (3.79)		.4394 (2.91)				5.3076 (5.35)	5.0658 (4.58)	5.0564 (5.20)	0.9960
$H_3(W_1=0.70)$	-.2215 (15.22)	.0022 (15.48)	-.0022 (3.07)		.5995 (2.77)				5.1584 (3.63)	5.0665 (3.20)	5.4032 (3.89)	0.9952
$H_3(W_1=0.75)$	-.2195 (15.94)	.0021 (16.15)	-.0022 (3.29)		.5742 (2.81)				5.3200 (3.96)	5.1829 (3.46)	5.4989 (4.17)	0.9956
$H_3(W_1=0.80)$	-.2179 (16.52)	.0021 (16.69)	-.0022 (3.47)		.5542 (2.82)				5.4547 (4.23)	5.2795 (3.68)	5.5801 (4.43)	0.9959
$H_3(W_1=0.85)$	-.2165 (16.98)	.0021 (17.11)	-.0023 (3.63)		.5379 (2.84)				5.5689 (4.47)	5.3609 (3.86)	5.6499 (4.63)	0.9961
$H_3(W_1=0.90)$	-.2154 (17.36)	.0021 (17.46)	-.0023 (3.77)		.5244 (2.84)				5.6669 (4.68)	5.4305 (4.02)	5.7103 (4.82)	0.9962
$H_3(W_1=0.95)$	-.2145 (17.69)	.0021 (17.74)	-.0023 (3.88)		.5131 (2.84)				5.7520 (4.85)	5.4907 (4.16)	5.7633 (4.96)	0.9963
$H_3(W_1=1.00)$	-.2136 (17.94)	.0020 (17.97)	-.0023 (3.98)		.5034 (2.84)				5.8266 (5.01)	5.5434 (4.28)	5.8100 (5.10)	0.9964
$H_4(W_1=0.60)$	-.0158 (3.02)			-.0102 (1.54)					2.5048 (6.94)	2.4145 (6.04)	1.8340 (4.50)	0.9411

APPENDIX 2

COMPARISON OF OLS RESULTS FOR AGE- AND TIME-SPECIFIC DUMMIES WITH VARYING VALUES OF THE ELASTICITY OF ADJUSTMENT (W_1)[1]

Equation	n	n^2	Y_t	WPP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$(\bar{R}^2)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$H_1(W_1=0.60)$	-.2412	.0017	-.0048	-.0133	.1549			16.3523				0.9345
	(6.52)	(3.55)	(3.79)	(1.37)	(1.19)			(6.43)				
$H_1(W_1=0.65)$	-.2493	.0015	-.0042	-.0277	.2108			18.0902				0.9428
	(5.17)	(2.42)	(2.53)	(2.19)	(1.24)			(5.46)				
$H_1(W_1=0.70)$	-.2354	.0016	-.0044	-.0140	.1617			15.5228				0.9408
	(6.79)	(3.63)	(3.66)	(1.54)	(1.33)			(6.52)				
$H_1(W_1=0.75)$	-.2337	.0016	-.0042	-.0142	.1643			15.2249				0.9430
	(6.89)	(3.67)	(3.60)	(1.60)	(1.37)			(6.52)				
$H_1(W_1=0.80)$	-.2323	.0016	-.0041	-.0144	.1666			14.9774				0.9447
	(6.97)	(3.70)	(3.54)	(1.65)	(1.42)			(6.53)				
$H_1(W_1=0.85)$	-.2313	.0016	-.0039	-.0145	.1685			14.7683				0.9466
	(7.03)	(3.72)	(3.48)	(1.68)	(1.45)			(6.53)				
$H_1(W_1=0.90)$	-.2304	.0016	-.0038	-.0146	.1702			14.5892				0.9474
	(7.09)	(3.74)	(3.43)	(1.71)	(1.49)			(6.53)				
$H_1(W_1=0.95)$	-.2297	.0016	-.0037	-.0147	.1717			14.4338				0.9484
	(5.61)	(3.76)	(3.39)	(1.74)	(1.52)			(6.52)				
$H_1(W_1=1.00)$	-.2292	.0016	-.0037	-.0147	.1731			14.2979				0.9493
	(7.18)	(3.78)	(3.34)	(1.76)	(1.54)			(6.52)				
$H_2(W_1=0.60)$	-.1843	.0014	-.0027	.0039	.3666			9.2774				0.9031
	(5.54)	(3.30)	(1.75)	(0.35)	(2.79)			(2.83)				
$H_2(W_1=0.65)$	-.2074	.0013	-.0029	-.0140	.3971			13.3863				0.9496
	(5.87)	(2.85)	(1.80)	(1.17)	(2.85)			(3.84)				
$H_2(W_1=0.70)$	-.1871	.0014	-.0026	.0024	.3357			9.5616				0.9143
	(5.93)	(3.45)	(1.80)	(0.22)	(2.69)			(3.08)				
$H_2(W_1=0.75)$	-.1882	.0014	-.0026	.0018	.3245			9.6707				0.9186
	(6.09)	(3.51)	(1.83)	(0.18)	(2.66)			(3.17)				
$H_2(W_1=0.80)$	-.1892	.0014	-.0026	.0014	.3151			9.7640				0.9222
	(6.23)	(3.56)	(1.84)	(0.13)	(2.62)			(3.26)				

The data table in Appendix 1 also shows the similarity between life-cycle patterns in headship for all sex and marital status categories. Headship tends to be fairly low at very young ages, increasing (at a greater or less rate depending on sex and marital status characteristics) to late middle age, levelling out and then decreasing at older ages. Obviously, our model must take explicit account of these demographic factors, preferably by modelling headship ratios separately for each age, sex and marital status group.

2.2 Economic Determinants

Certain economic and social variables may also affect headship. We consider in turn three classes of influences.

(i) Ability to Afford a Separate Household

An individual will balance the costs of setting up a household against what he can afford to pay. Headship should therefore be positively related to income or, more precisely, permanent disposable income (which recognizes the long-term nature of the headship decision). It is also necessary to take account of the distribution of income; for example, the proportion of senior citizens receiving social security payments may help to explain the level of headship of older people[1]. Increasing affluence can only lead to increased headship if it prompts people to move out into separate households. The potential demand for independent household status is higher amongst groups whose incomes historically have been insufficient to support such independent status.

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1. See F. E. Kobrin, "The Fall in Household Size and the Rise of the Primary Individual in the United States," Demography, Vol. 13, No. 1 (1976), p. 134.

Income changes are therefore likely to be more important for the very young and very old age groups, and also for the unmarried of all ages.

To some extent, personal disposable income reflects general economic conditions. Over time we expect headship to rise according to increasing standards of living reflecting increases in real disposable income. In particular, we expect males to conform to socially expected living patterns which will be closely related to general economic conditions; for example, a married adult male is expected to fulfil a dominant role in the household in which he lives and will normally head his own household unless economic conditions are particularly perverse.

There is conflicting evidence concerning the relationships postulated between headship and income. Whilst Swedish cross-sectional analysis[1] suggests that income is closely related to headship in most age/marital status groups, time series evidence is less conclusive. Beresford and Rivlin[2] found that the significant increases in income before World War II in the United States were not associated with large increases in headship ratios comparable to those experienced after World War II following similar increases in income. In their behavioural model of headship ratios, Frieden and Solomon[3] found that demographic and housing market factors were more important determinants of headship

1. See United Nations, op. cit., p. 55.
2. See J. C. Beresford and A. M. Rivlin, "Privacy, Poverty and Old Age," Demography, Vol. 3 (1966), pp. 247-258.
3. See B. J. Frieden and A. P. Solomon, The Nation's Housing : 1975-1985 (Cambridge : Joint Centre for Urban Studies, 1977).

APPENDIX 1 : HEADSHIP DATA 1961-1971

AGE GROUP	YEAR	NEVER MARRIED		MARRIED		PERMANENTLY SEPARATED		DIVORCED		WIDOWED	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
15-19	1961	.0062	.0052	.4077	.0072	.0588	.0588	.0500	.1000	.0500	.1268
	1966	.0072	.0074	.5546	.0088	.1111	.0966	.0686	.0361	.0500	.0993
	1971	.0110	.0119	.5795	.0104	.1791	.1446	.0500	.1165	.2727	.1724
20-24	1961	.0418	.0376	.6991	.0118	.1402	.1688	.0889	.1305	.1342	.2972
	1966	.0549	.0604	.7747	.0148	.2037	.2374	.1448	.2224	.1194	.3363
	1971	.0889	.1001	.8229	.0152	.3177	.3327	.2320	.2960	.3264	.4553
25-29	1961	.1066	.0775	.8253	.0160	.2663	.2711	.2100	.2626	.2704	.5025
	1966	.1362	.1253	.8613	.0195	.3359	.3704	.2760	.3389	.2942	.5652
	1971	.1894	.1976	.8862	.0199	.4288	.4964	.3627	.4383	.4082	.6182
30-34	1961	.1670	.1075	.8824	.0193	.3519	.3671	.2913	.3339	.4054	.6453
	1966	.2091	.1539	.9056	.0228	.4233	.4658	.3827	.4643	.4769	.7165
	1971	.2856	.2420	.9333	.0232	.5355	.6232	.4921	.6038	.6224	.7744
35-39	1961	.2154	.1491	.9119	.0205	.4248	.4720	.3655	.4523	.5378	.7166
	1966	.2573	.1821	.9283	.0248	.4787	.5511	.4204	.5303	.5931	.7935
	1971	.3023	.2359	.9384	.0258	.5598	.6644	.4880	.6390	.6682	.8174
40-44	1961	.2737	.1943	.9227	.0241	.4713	.5321	.3968	.5108	.6189	.7431
	1966	.3016	.2354	.9397	.0262	.5189	.6021	.4670	.5902	.6532	.8174
	1971	.3519	.3024	.9501	.0270	.6033	.7223	.5379	.7070	.7311	.8395
45-49	1961	.3169	.2503	.9276	.0269	.4809	.5687	.4134	.5648	.6463	.7517
	1966	.3568	.2954	.9430	.0266	.5298	.6133	.5002	.6161	.7098	.7999
	1971	.4004	.3362	.9514	.0266	.5902	.6868	.5542	.6790	.7664	.8341

APPENDIX 1 : (Continued)

AGE GROUP	YEAR	NEVER MARRIED		MARRIED		PERMANENTLY SEPARATED		DIVORCED		WIDOWED	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
50-54	1961	.3587	.3195	.9270	.0292	.4727	.5608	.4324	.5674	.6444	.7308
	1966	.4012	.3456	.9429	.0263	.5337	.6034	.5120	.6282	.6958	.7673
	1971	.4470	.3891	.9510	.0262	.5930	.6718	.5650	.6900	.7509	.7985
55-59	1961	.3786	.3722	.9234	.0302	.4753	.5475	.4367	.5546	.6451	.6996
	1966	.4269	.4157	.9368	.0276	.5219	.5846	.4931	.6181	.6833	.7280
	1971	.4869	.4399	.9468	.0240	.5807	.6322	.5777	.6671	.7394	.7627
60-64	1961	.3852	.4113	.9151	.0325	.4657	.5320	.4331	.5406	.6054	.6656
	1966	.4445	.4551	.9278	.0266	.4997	.5576	.5166	.6017	.6514	.6915
	1971	.5051	.4894	.9373	.0221	.5707	.5935	.5677	.6409	.7086	.7275
65-69	1961	.4059	.4427	.9065	.0375	.4577	.5396	.4598	.5529	.5850	.6453
	1966	.4420	.4846	.9134	.0284	.4934	.5496	.4930	.5861	.6041	.6720
	1971	.5165	.5220	.9218	.0234	.5567	.6023	.5694	.6514	.6570	.7063
70-74	1961	.4127	.4481	.9010	.0486	.4501	.5216	.4470	.5195	.5561	.6015
	1966	.4476	.4916	.9087	.0355	.4658	.5374	.4740	.5954	.5790	.6376
	1971	.4897	.5283	.9141	.0267	.5277	.5549	.5430	.6186	.6158	.6721
75-79	1961	.4063	.4329	.8813	.0701	.4299	.4785	.4149	.4854	.5158	.5383
	1966	.4225	.4755	.8952	.0435	.4352	.4908	.4603	.5417	.5378	.5700
	1971	.4726	.5048	.8992	.0357	.4711	.5459	.5189	.5932	.5818	.6175
80+	1961	.3394	.3618	.8319	.1190	.3526	.3455	.3162	.3840	.4227	.4099
	1966	.3600	.3700	.8489	.0602	.3772	.3722	.4137	.4119	.4343	.4152
	1971	.3977	.4038	.8568	.0407	.4325	.4029	.4856	.5416	.4782	.4498

than income. Despite these conflicting observations, many authors have proposed a strong relationship between headship and income over time[1].

The ability to afford a separate household can also be captured partially by workforce participation rates, which have the advantage of reflecting the independence of particular groups, such as young people and women of all ages. We expect workforce participation and headship to be positively associated and that this relationship would persist over time. For the particular case of widowed females, it may be useful to consider two types of widows - those who are working and those who are not. For the first type, headship will be closely related to workforce participation, which measures their ability to afford a separate household. However, for non-working widows, ability to afford a separate household will be related to the widows' pension.

Unemployment rates are also relevant to a discussion of the effect on headship of income, or of general economic conditions. To some extent, unemployment rates reflect the relative uncertainty with which economic conditions impinge on particular groups; for example, unemployment rates are high for young males of all marital states and this added uncertainty may act to reduce their headship.

The cost of setting up a separate household, which will depend (among other things) upon rental and housing prices and on costs of removal, would be expected to bear a negative relationship to headship. We expect

1. See for example, United Nations, op. cit.; B. Campbell, Population Change and Building Cycles (Urbana : University of Illinois Press, 1966) and G. Carliner, "Determinants of Household Headship," Journal of Marriage and the Family, Vol. 37, No. 1 (1975).

rental prices to be directly related to the cost of building and maintaining houses, so that an average rental price, compared to the prices of all other goods, would be associated with household headship. Increased availability and lower cost of housing credit will reduce the present sacrifice necessary for home ownership, and also increase the supply of available dwellings[1]. The effect of housing credit upon household headship, however, is difficult to interpret; easier credit may simply cause a shift in the distribution of households between rented and owned accommodation. Easier credit is only likely to affect headship ratios significantly if there has been a prolonged period of housing shortage[2]. Still, for married males, the gap between savings and the cost of home ownership could be useful in explaining why married couples share accommodation, and hence have such relatively low headships at younger ages.

(ii) Availability of Alternative Accommodation

At the abstract level, we postulate a demand for household formation schedule and a supply of available dwellings schedule, which interact to determine an equilibrium price that clears the market. In such a model, the headship desires of all individuals would be met at the prevailing price. In practice, this instantaneous adjustment of supply and demand may not occur due to rigidities in price, imperfect capital markets and lags in the adjustment of supply. The availability of housing is of major

1. See B. Campbell, op. cit., p. 47.

2. See ibid., p. 48 and S. J. Maisel, "The Relationship of Residential Financing and Expenditures on Residential Construction," in M. A. Stegman (ed.) Housing and Economics : The American Dilemma (Cambridge : MIT Press, 1970), p. 46 ff..

The limited use of supply variables, due to data unavailability, indicates that our model may not be a fully reduced form model of headship, but in fact reflect more of the characteristics of the demand for headship. This may cause the model to over-predict headship ratios when there are supply constraints on the housing side. The lack of sensitivity of the results to changes in W_1 suggests that we have insufficient data to uniquely locate this parameter. As more time series data become available, it should be possible to avoid some of these problems and improve the estimates substantially.

The next step in our current research is the projection of the headship ratios over time and their conversion to numbers of households. Hopefully this will be the subject matter of a separate paper.

6. CONCLUSIONS AND PERSPECTIVES FOR FURTHER RESEARCH

In this paper, we have presented an econometric method of estimating headship as an alternative to the standard demographic techniques in which headship is related to demographic characteristics (age, sex and marital status) and time. The model we have estimated has provided plausible explanations of headship for the sample data. It has shown that, whilst demographic influences are important in explaining headship, there is merit in including the influence of other behavioural variables.

Our approach has two principal advantages. First, the introduction of economic variables allows for a more detailed structural interpretation. Second, the method has greater flexibility as a tool for projection. This is because different scenarios on the future time paths of exogenous economic conditions can readily be used to provide different sets of conditional forecasts.

Data availability has severely limited this analysis. The dependence upon cross-sectional data has influenced the nature of our results and it remains to be seen whether this will affect projections into the future. For example, some of our significant variables may only be useful in explaining the difference in headships across the cross-section (that is, between ages) and give little information on the changes in headships over time. Lack of data also prevented us from including proxy variables which may have more adequately measured the changes in social conditions which have brought about the change in "taste" for headship.

importance for particular groups[1], such as :

(a) young people making their first move from the parental home, who must overcome the inertia which keeps them there - - a surplus of small-unit dwellings would increase their likelihood of becoming household heads ;

(b) previously married (in particular, permanently separated and divorced) females who may only decide to live separately if they can find cheap accommodation and who will therefore be more likely to set up separate households if the level of expenditure on welfare housing is high ;

(c) young marrieds who may double-up with parents or other couples if housing market conditions are tight.

To some extent, these factors may only be relevant in the short-term, and as such for long term analysis it would be wise to abstract from cycles in housing market behaviour.

(iii) Social Attitudes

Over time, there have been fluctuations in headship ratios which may not be explained in terms of the sorts of variables considered above. There have been changes in "taste" for headship which are difficult to measure and interpret[2]. For example, since the rise of oral contraceptives has coincided approximately with the change in social attitudes towards women and their independence, we could relate the usage

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1. See B. Campbell, op. cit., p. 48.
2. See J. C. Beresford and A. M. Rivlin, op. cit., p. 254.

of oral contraceptives to changes in the level of household headship of women. It has been suggested that changes in taste are anything that an economist cannot explain[1], and this may well be so; certainly it is difficult to identify the variety of changes in social attitudes that could prompt variations in headship over time.

1. See <u>ibid</u>., p. 255.

TABLE 7

ESTIMATION USING OLS WITH ELASTICITY OF ADJUSTMENT OF 0.90 FOR LIFE CYCLE AND TIME VARIABLES ONLY[1]

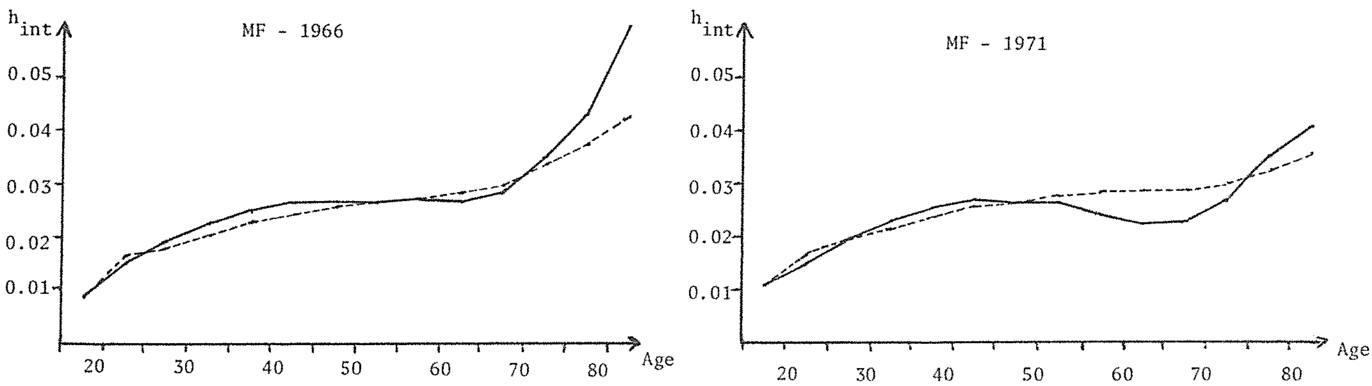
Equation	n	n^2	t	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
H_1 (NMM)	-.2744 (14.09)	.0022 (11.32)	-.4158 (2.98)	8.0672 (16.66)				0.9385
H_2 (NMF)	-.2284 (9.65)	.0017 (7.13)	-.3782 (2.23)	7.2797 (12.36)				0.9111
H_3 (MM)	-.2212 (15.73)	.0021 (15.89)	-.2835 (3.42)		3.0594 (10.09)	3.3067 (9.86)	2.4856 (6.91)	0.9950
H_4 (MF)	-.0188 (6.08)		.1777 (1.54)		2.2076 (6.88)	1.8439 (4.88)	1.3980 (5.75)	0.9079
H_5 (PSM)	-.1633 (15.96)	.0015 (15.50)	-.4865 (8.08)		4.4925 (20.37)	4.4021 (18.04)	3.9428 (15.08)	0.9735
H_6 (PSF)	-.1765 (10.12)	.0017 (10.12)	-.4611 (4.49)		4.9692 (13.22)	4.9693 (11.94)	4.1050 (9.21)	0.9316
H_7 (DM)	-.1630 (16.05)	.0014 (14.38)	-.4541 (7.59)		5.0820 (23.22)	5.9556 (24.59)	4.3733 (16.85)	0.9791
H_8 (DF)	-.1847 (13.54)	.0017 (12.74)	-.4592 (5.71)		6.3551 (21.60)	5.2682 (16.19)	4.5069 (12.92)	0.9704
H_9 (WM)	-.2475 (14.04)	.0023 (13.47)	-.4880 (4.70)		6.8775 (18.10)	5.0824 (12.09)	6.0359 (13.39)	0.9500
H_{10} (WF)	-.2060 (10.34)	.0020 (10.80)	-.2432 (2.07)		5.3327 (12.41)	4.8286 (10.16)	3.8062 (7.47)	0.9490

1. Columns (1) - (7) contain estimated coefficients (and t-ratios) for the variables shown at the head of the column. For key to notation see page 19. Column (7) shows the coefficient of determination adjusted for degrees of freedom.

FIGURE 3

A COMPARISON OF ACTUAL HEADSHIPS AND OLS ESTIMATES

(using $W_1 = 0.90$ and $S_i = 0.25$)[1]



1. Estimated headships are given by the broken lines.

3. DATA

As this model is intended for use in projections of headship over time, we would ideally like to base the model on time series data disaggregated by age, sex and marital status. Such a disaggregation would provide data on headship ratios separately for each age, sex and marital status group, enabling us to take explicit account of the demographic determinants of headship by tracing the headship behaviour of particular cohorts through their life cycles. However, analysis was severely handicapped by data deficiencies. Disaggregated headship ratio data was available for only three Censuses : 1961, 1966 and 1971[1]. It was therefore necessary for us to use cross-sectional information on the age distribution of headship ratios. We were able, however, to disaggregate by sex and marital status in terms of the following groups : never married males, never married females, married males, married females, permanently separated males, permanently separated females, divorced males, divorced females, widowed males and widowed females. Our unavoidable reliance on cross-sectional information creates difficulties in interpretation of results, since the response of headship to changes in explanatory variables over the cross-section may not be equivalent to the response over time (as shown by the conflicting evidence on the relationship between headship and income discussed earlier).

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.

The use of cross-sectional information made it necessary to include life-cycle variables among the explanators of headship behaviour. The variables used were the mid-point of the age group (n) and its square (n^2), where the fourteen age groups used were : 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80 and over (years). Further details are best left to Section 4, in which the mathematical form of the model is discussed.

The availability of other explanatory variables was constrained by data limitations. No data was available for the savings gap, credit availability, the availability of small-unit dwellings and variables to explain social attitudes towards headship. For the last of these, we attempted to use a proxy, the usage of oral contraceptives, to capture the effect of changes in social attitudes towards females in general and towards their headship. The variable used was the percentage of married women under 45 years of age using oral contraceptives; the same variable used in Filmer and Silberberg[1]. The variable was not available in disaggregated form, which led to estimation problems that (as we shall explain later) forced us to drop the variable from the estimated model.

It was also necessary to use a proxy variable to measure the availability of welfare housing. We used a weighted average of observations in the current and previous four periods of real gross fixed capital expenditure by all public authorities and enterprises on dwellings and flats[2]. In some sense, this is a series of "permanent" expenditure. Only one data point for each Census was available, with no disaggregation across age or marital status/sex groups.

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1. See R. Filmer and R. Silberberg, op. cit..
2. This series was compiled from Australian Bureau of Statistics, Australian National Accounts, National Income and Expenditures, Ref. No. 7.1, Canberra, (issues from 1961/2 to 1970/1) supplemented with unpublished information.

However, when the H_{int} calculated using a higher S_i was converted to h_{int} for the sample period, it was found that the higher S_i made little difference to the accuracy of fit ; compare figure 3 with figure 2(b). Hence, we concluded that little could be gained from undertaking an intensive search for the "best" S_i.

To facilitate a comparison between a standard demographic approach involving only trends and life-cycle variables with the model which we have put forward in this paper, in Table 7 we give results based on the use of age and time as the only explanatory variables (other than the dummies which we include to keep the comparison fair). If these results are compared with those presented in Table 3, we observe that such a model explains headship almost as well (in terms of $\bar{R}^2$) as our econometric model. However, our model is designed to allow projections over a much longer time period. A trend-based model could project ever-increasing headship over time, which is clearly unsatisfactory. In our model, we assume that headship decisions are the result of a rational decision-making process based on economic variables and, whilst projected headships may still increase substantially over time, this will not occur autonomously but only as the result of projected changes in economic variables.

TABLE 6 (Continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
H_6 (PSF)												
S_6 = 0.85	-.1663	.0015		-.0074		-.0244			6.1025	6.1317	5.3038	.9317
	(8.26)	(6.13)		(1.02)		(4.58)			(11.26)	(9.93)	(8.28)	
S_6 = 0.90	-.1537	.0014		-.0056		-.0215			5.7303	5.7028	4.8776	.9293
	(8.59)	(6.42)		(0.87)		(4.53)			(11.88)	(10.38)	(8.56)	
S_6 = 1.00	-.1369	.0013		-.0037		-.0180			5.3158	5.2241	4.4086	.9267
	(8.84)	(6.67)		(0.66)		(4.39)			(12.75)	(11.00)	(8.95)	
H_7 (DM)												
S_7 = 0.75	-.1632	.0014	-.0038		.0011				11.4292	12.3051	10.7215	.9781
	(15.13)	(13.42)	(6.75)		(0.05)				(10.96)	(11.40)	(10.02)	
S_7 = 0.80	-.1506	.0013	-.0034		.0015				10.5984	11.4259	9.8369	.9738
	(14.00)	(12.41)	(6.06)		(0.07)				(10.19)	(10.61)	(9.22)	
S_7 = 1.00	-.1239	.0011	-.0026		.0024				9.0525	9.7833	8.2035	.9717
	(11.87)	(10.49)	(4.81)		(0.11)				(8.96)	(9.35)	(7.92)	
H_8 (DF)												
S_8 = 0.85	-.1751	.0015		-.0075		-.0248			7.5460	6.7081	5.8692	.9738
	(11.88)	(8.04)		(1.49)		(6.04)			(17.81)	(11.75)	(10.89)	
S_8 = 0.90	-.1603	.0013		-.0064		-.0219			7.1730	6.2550	5.4150	.9704
	(11.78)	(7.98)		(1.39)		(5.79)			(18.34)	(11.87)	(10.88)	
S_8 = 1.00	-.1408	.0012		-.0053		-.0185			6.7494	5.7436	4.9063	.9686
	(11.43)	(7.75)		(1.26)		(5.38)			(19.06)	(12.04)	(10.89)	
H_9 (WM)												
S_9 = 0.90	-.2538	.0023	-.0040		-.0266				13.8381	11.9062	13.0036	.9482
	(11.56)	(11.67)	(4.51)		(0.49)				(8.40)	(6.87)	(7.59)	
S_9 = 0.95	-.2328	.0021	-.0037		-.0244				12.8842	10.9435	11.9618	.9393
	(10.96)	(11.03)	(4.21)		(0.47)				(8.08)	(6.52)	(7.21)	
S_9 = 1.00	-.2175	.0020	-.0034		-.0229				12.2304	10.2880	11.2495	.9313
	(10.46)	(10.50)	(3.98)		(0.45)				(7.84)	(6.26)	(6.93)	
H_{10} (WF)												
S_{10} = 0.95	-.1959	.0019		-.0778			-.3467		11.9789	11.4226	10.3690	.9510
	(9.52)	(8.29)		(2.49)			(2.35)		(4.17)	(3.87)	(3.57)	
S_{10} = 1.00	-.1770	.0017		-.0630			-.2894		10.5097	9.9303	8.9014	.9483
	(9.74)	(8.57)		(2.29)			(2.22)		(4.15)	(3.81)	(3.47)	

1. Columns (1) - (11) contain estimated coefficients (and t-ratios) for the variable shown at the head of the column. For key to notation, see page 19 . Column (12) shows the coefficient of determination adjusted for degrees of freedom.

The use of cross-sectional data created other problems, as many of the explanatory variables (including the two above) were not available disaggregated by age and/or sex and marital status, and thus provided little information for empirical estimation. It was not possible to obtain information on the distribution of permanent income between the various age, sex and marital status groups, so only one data point for each Census was available. The observations on income were those used by Filmer and Silberberg[1] for real gross national product per head at 1966-67 prices. The observations were undeflated by the consumer price index and were then deflated by the rental price index in order to capture the effect of the relative cost of housing on the determination of headship. The series was then made "permanent" by using a weighted average of observations in the current and previous four periods as our observation for permanent income. The same method was used for the widows' pension (given by the undeflated Commonwealth widows' pension). The observations on the widows' pension were also multiplied by the ratio of widows not working because (as mentioned in the previous section) the widows' pension would be relevant only for those widows who were not working.

The observations on workforce participation (from the 1966 and 1971 Census) were disaggregated by age, sex and marital status. To avoid simultaneity bias, caused by the joint determination of headship and workforce participation, the workforce participation rates were regressed upon their determinants (as specified in Filmer and Silberberg[2]) and the estimated values of workforce participation rates were used in our model.

1. See R. Filmer and R. Silberberg, op. cit..
2. See ibid..

The unemployment rates used were calculated from the 1966 and 1971 Census and were available disaggregated by age, sex and marital status.

It was also necessary to use several dummy variables as explanators. Since we are using data disaggregated by age, sex and marital status, some of the groups being considered are relatively small; in particular there are relatively few 15-19 year old married or previously married persons in the population. For this reason, observations on headship and some of the age-specific explanatory variables for these groups were felt to be unreliable, and their potential effect on the estimates was expected to be greater than their relative importance. It was also felt that this unreliability would not be in the same direction or of the same magnitude over time. To cope with this problem, we assigned separate dummy variables to the 15-19 year age group in each of the years studied. Conscious that year-specific dummies would be an embarrassment for projection purposes, we also estimated the model using age-group specific dummies only.

TABLE 6

COMPARISON OF OLS RESULTS (FOR ELASTICITY OF ADJUSTMENT OF 0.90 WITH AGE- AND TIME-SPECIFIC DUMMIES) FOR DIFFERING VALUES OF MAXIMUM DESIRED HEADSHIP (S_i)[1]

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
H_1 (NMM)												
S_1 = 0.65	-.2304	.0016	-.0038	-.0146	.1702			14.5892				.9474
	(7.09)	(3.74)	(3.43)	(1.71)	(1.49)			(6.53)				
S_1 = 0.70	-.2149	.0014	-.0036	-.0165	.1591			14.0866				.9436
	(6.52)	(3.33)	(3.15)	(1.92)	(1.37)			(6.23)				
S_1 = 1.00	-.1761	.0011	-.0030	-.0204	.1398			13.0346				.9477
	(5.07)	(2.35)	(2.47)	(2.23)	(1.14)			(5.46)				
H_2 (NMF)												
S_2 = 0.65	-.1908	.0014	-.0025	.0007	.3002			9.9160				.9279
	(6.47)	(3.66)	(1.87)	(0.06)	(2.58)			(3.41)				
S_2 = 0.70	-.1777	.0012	-.0024	-.0036	.2951			9.8629				.9333
	(6.41)	(3.46)	(1.89)	(0.36)	(2.70)			(3.61)				
S_2 = 1.00	-.1455	.0009	-.0021	-.0114	.2848			9.7664				.9574
	(5.94)	(2.82)	(1.85)	(1.37)	(2.94)			(4.04)				
H_3 (MM)												
S_3 = 0.97	-.2154	.0021	-.0023		.5244				5.6669	5.4305	5.7103	.9962
	(17.36)	(17.46)	(3.77)		(2.84)				(4.68)	(4.02)	(4.82)	
S_3 = 1.00	-.1436	.0014	-.0013		.3274				3.4279	3.2565	3.0489	.9977
	(18.35)	(18.33)	(3.46)		(2.82)				(4.49)	(3.82)	(4.07)	
H_4 (MF)												
S_4 = 0.08	-.0262			-.0106					2.8186	2.7124	2.2789	.9049
	(3.92)			(1.25)					(6.12)	(5.31)	(4.38)	
S_4 = 0.13	-.0212			-.0089					3.2185	3.1090	2.6637	.9790
	(4.26)			(1.41)					(9.35)	(8.16)	(6.85)	
S_4 = 0.25	-.0187			-.0080					3.8384	3.7287	3.2895	.9931
	(4.40)			(1.48)					(13.06)	(11.46)	(9.92)	
H_5 (PSM)												
S_5 = 0.75	-.1640	.0015	-.0038		.0270				10.6116	10.6869	10.1500	.9729
	(15.78)	(15.11)	(5.85)		(0.71)				(7.79)	(8.53)	(7.79)	
S_5 = 0.80	-.1481	.0014	-.0033		.0252				9.6440	9.6598	9.1255	.9665
	(15.22)	(14.54)	(5.47)		(0.71)				(7.55)	(8.24)	(7.47)	
S_5 = 1.00	-.1164	.0011	-.0025		.0206				7.9631	7.8693	7.3573	.9569
	(13.59)	(12.92)	(4.64)		(0.66)				(7.08)	(7.62)	(6.84)	

The estimated values for 1971 track less closely than those for 1966. This is due to accumulated errors as estimated values for 1971 incorporate the estimated (rather than actual) values of h_{int} for 1966, whilst the estimated values for 1966 incorporate actual values for 1961. Although the results are pleasing, it remains to be seen if the use of predominantly cross-sectional information will impair the ability of the model to project into the future.

5.5 Further Analysis

The selection of values for S_i, the marital status/sex specific upper limit to desired headship ratios was based on an examination of past headship trends with reference to expectations for future headship patterns. Whilst there are, as stated previously, strong priors on the selection of S_i, the basis of their selection is arbitrary. Hence, it was necessary to test the sensitivity of the results to changes in the value of S_i. In Table 6 we present the results for the system, with an adjustment elasticity of 0.90 and age- and time-specific dummies, for various S_i.[1] As Table 6 shows, the alternative values of S_i had minimal effects on results. There was no change in the signs on parameters and their magnitude did not alter markedly, except in the case of married females. For married females, a higher S_i gave the equation higher t-values and a better fit. This is due to the special characteristics of married female headship : age-specific headship does not follow the modified logistic pattern observed for other groups and hence does not appear to have a maximum in the same manner as other groups. Hence, it appears that a larger S_i would improve the fit.

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1. The first S_i quoted for each equation is the original S_i used in estimation.

4. REDUCED FORM MODEL

In the previous studies of which we are aware, projections of headship ratios have been based almost entirely on past headship trends[1]. Few attempts seem to have been made to include behavioural variables in the projection methods[2]. Thus the projections make no explicit use of information concerning the factors which influence people in their decision to head a separate household. In this paper, we attempt to estimate a reduced form model of headship, where the number of households formed is determined by the interaction of factors affecting the demand for household formation and the supply of housing. Using this reduced form model, we can project headship ratios under a variety of different assumptions concerning expected developments in the variables determining headship.

We define h_{int} as the headship ratio for the i^{th} marital status/sex group of people in the age group with mid-point, n, at time, t. We postulate that the headship ratio for any age/marital status/sex group is a weighted geometric mean of two ratios : the headship ratio which has been accepted by the general community for that group in the past, and, secondly, the desired headship ratio which that group would wish to achieve in the absence of any constraints on them to behave in a similar manner to people who were in the same age/marital status/sex group in the past.

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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. Limited attempts were made by B. J. Frieden and A. P. Solomon, op. cit., and also in Sweden, Japan and Norway (see United Nations, op. cit.).

Using an asterisk to denote desired headship ratios, we hypothesize the relationship to be of the form :

(1) $$\log h_{int} = W_1 \log h^*_{int} + W_2 \log h_{in(t-1)} ,$$

where

(2) $$W_1 + W_2 = 1$$

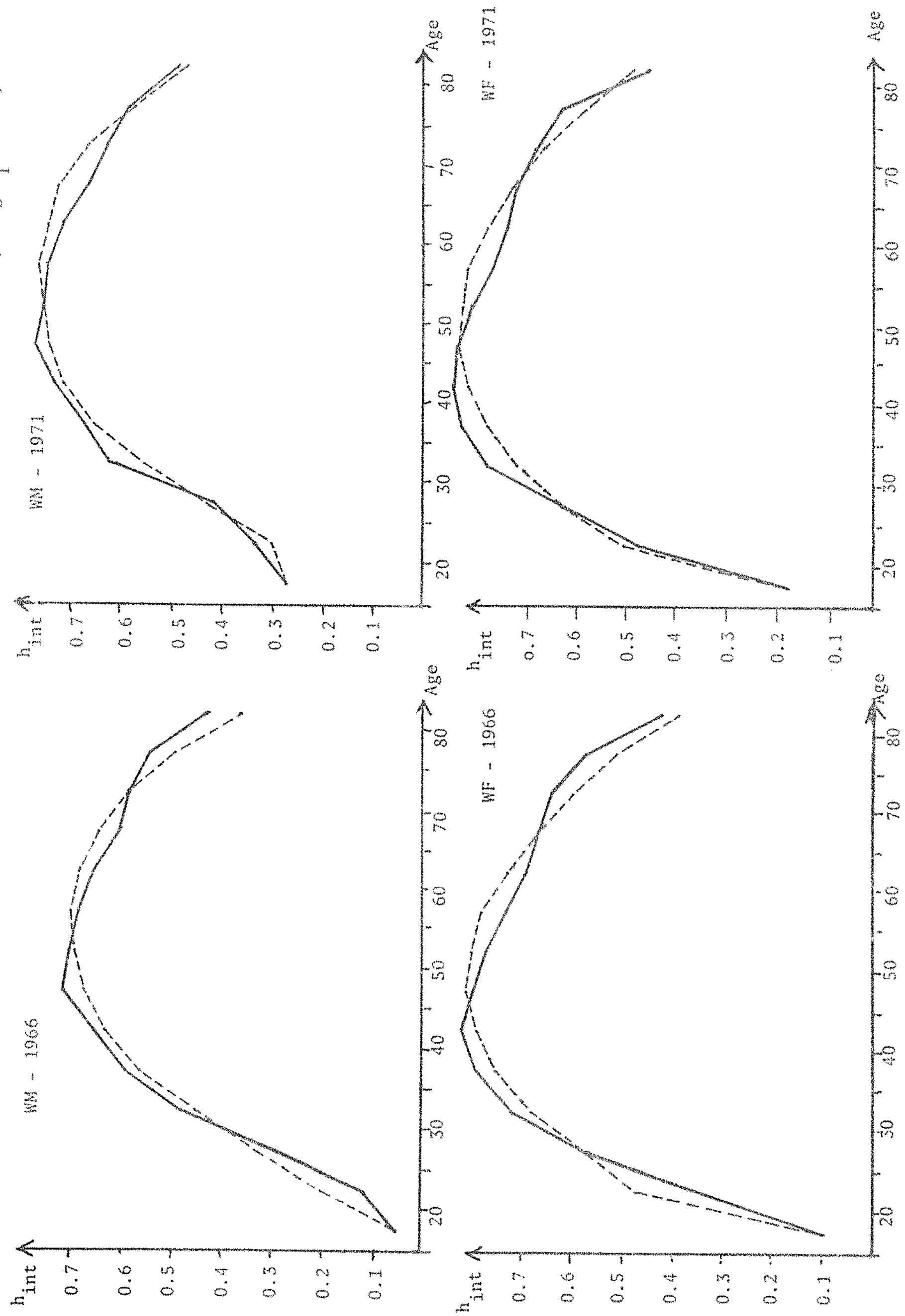
and

(3) $$h^*_{int} = S_i\{1 + \exp[f_i(Z_{int})]\}^{-1} .$$

Equation (1) explains the actual headship ratio in terms of a partial adjustment model, where W_1 is the elasticity of adjustment. The higher the value of W_1 (which lies between zero and unity), the faster the actual headship ratio adjusts to the desired headship ratio.

The relationship (3) explaining desired headship ratios (h^*_{int}) is based on a logistic function which has an upper asymptote of S_i, the marital status/sex specific upper limit for headship ratios (which cannot exceed unity) and a lower asymptote of zero. Hence, if $0 < S_i < 1$, then <u>a fortiori</u> $0 < h^*_{int} < 1$, which is the interpretable range for the ratio. The values of the upper asymptotes are not estimated as part of the model but are judgmentally determined after an examination of the data.

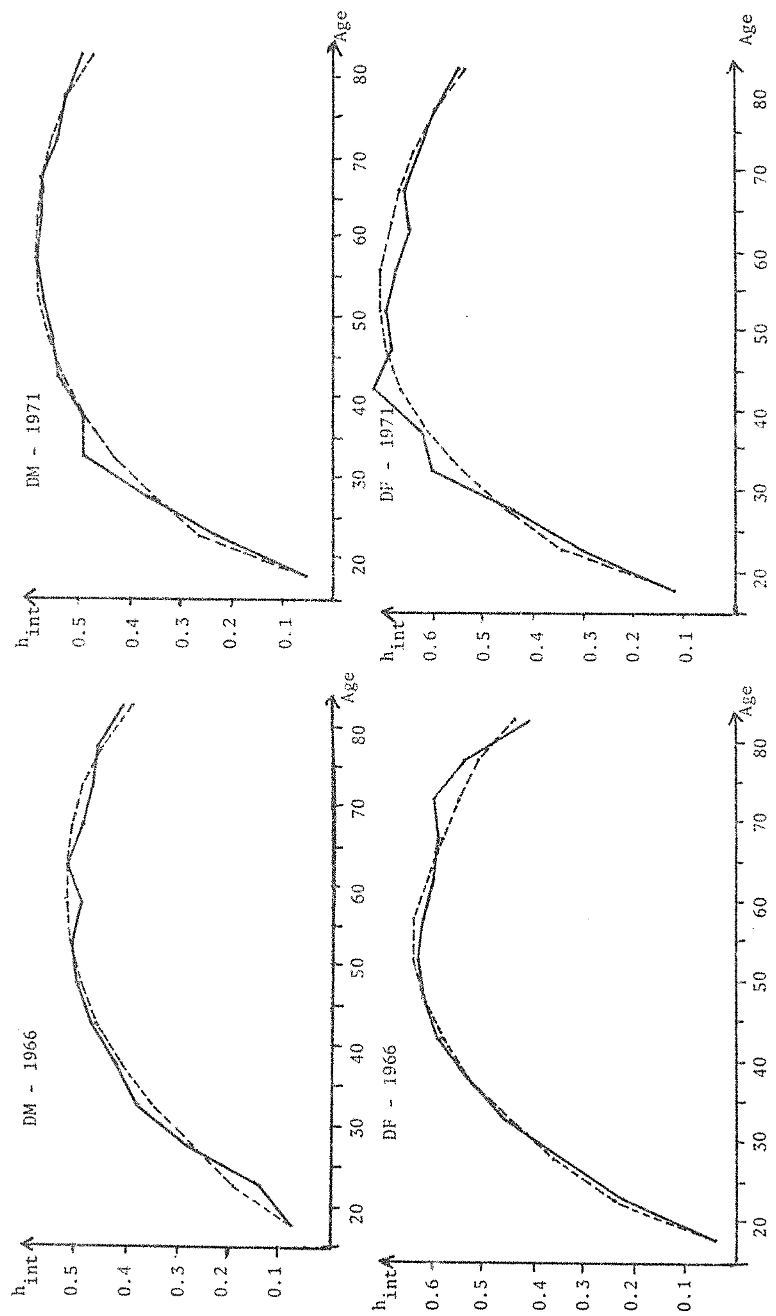
FIGURE 2(e) A COMPARISON OF ACTUAL HEADSHIPS WITH OLS ESTIMATES (using W_1 = 0.90)[1]



1. Estimated headships are given by the broken lines.

FIGURE 2(d)

A COMPARISON OF ACTUAL HEADSHIPS WITH OLS ESTIMATES (using $W_1 = 0.90$)[1]



1. Estimated headships are given by the broken lines.

Z_{int} is a vector of i-specific economic variables, defined as the appropriate behavioural variables expected to affect desired headship ratios, plus two life-cycle variables, n and n^2. As the model is estimated for marital status/sex groups only, the last two variables are introduced to take account of the life-cycle determinants of headship.

In order to estimate equation (1) a linear transformation is derived. Subtracting both sides of (3) from S_i gives :

$$S_i - h^*_{int} = S_i\{1 - [1 + \exp\{f_i(Z_{int})\}]^{-1}\}$$

$$= S_i \exp[f_i(Z_{int})]\{1 + \exp[f_i(Z_{int})]\}^{-1}$$

$$= h^*_{int} \exp[f_i(Z_{int})] .$$

Therefore,

$$\frac{(S_i - h^*_{int})}{h^*_{int}} = \exp[f_i(Z_{int})] ,$$

and

$$\text{(4)} \qquad \log\left\{\frac{(S_i - h^*_{int})}{h^*_{int}}\right\} = f_i(Z_{int}) .$$

From (1) ,

$$\log h^*_{int} = \frac{1}{W_1} \log h_{int} - \frac{W_2}{W_1} \log h_{in(t-1)} ;$$

that is,

$$\text{(5)} \qquad h^*_{int} = \exp[\frac{1}{W_1} \log h_{int} - \frac{W_2}{W_1} \log h_{in(t-1)}] .$$

Substituting (5) into (4) gives

$$\log \left\{ \frac{S_i - \exp\left[\frac{1}{W_1} \log h_{int} - \frac{W_2}{W_1} \log h_{in(t-1)}\right]}{\exp\left[\frac{1}{W_1} \log h_{int} - \frac{W_2}{W_1} \log h_{in(t-1)}\right]} \right\} = f_i(Z_{int}) \ .$$

Let

$$H_{int} = \log \left\{ \frac{S_i - \exp\left[\frac{1}{W_1} \log h_{int} - \frac{W_2}{W_1} \log h_{in(t-1)}\right]}{\exp\left[\frac{1}{W_1} \log h_{int} - \frac{W_2}{W_1} \log h_{in(t-1)}\right]} \right\} \ .$$

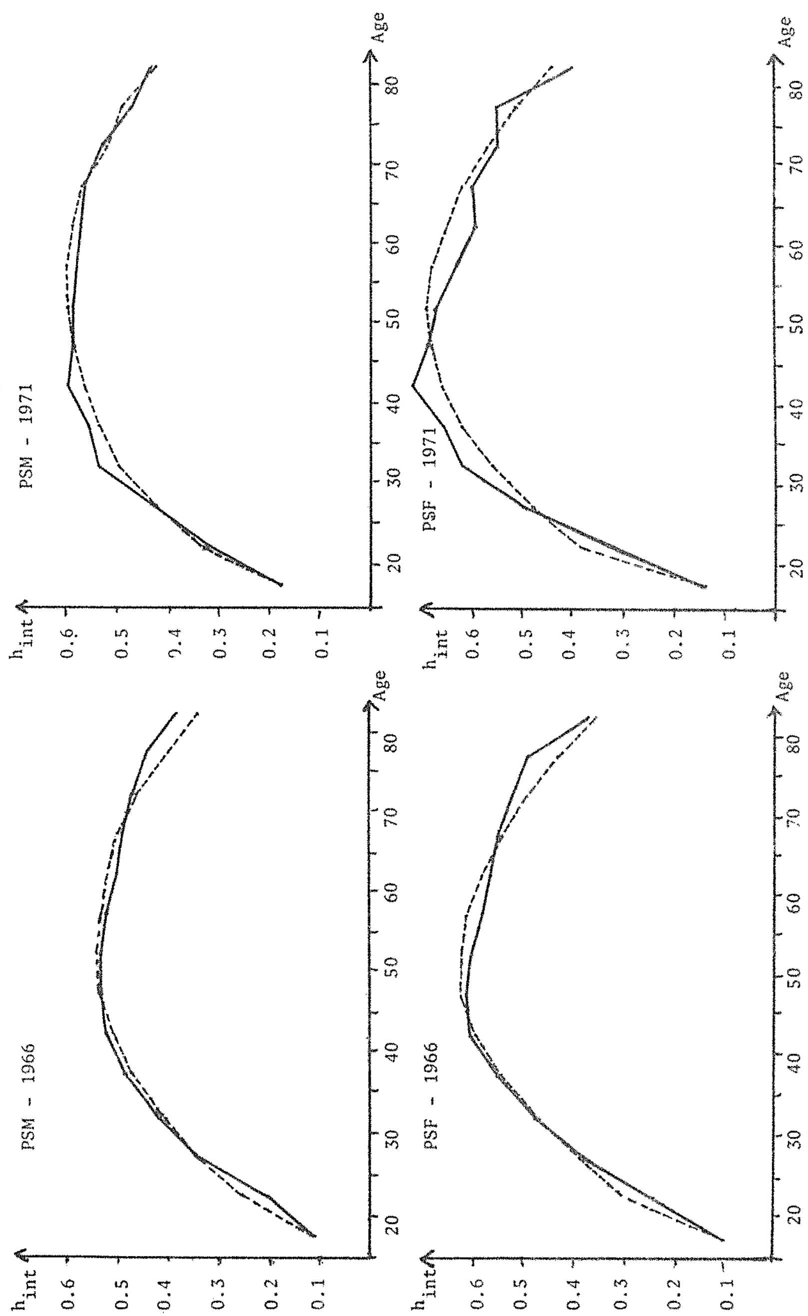
Then

(6) $$H_{int} = f_i(Z_{int})$$

In estimation, we treat (6) as a system of equations, one for each i, with data points generated by variations in age (n) and Census data (t). We estimated this system with externally fixed values for S_i and W_1. From the estimated values of H_{int} we can derive an estimate for h^*_{int} which we can use, with known values of $h_{in(t-1)}$ to calculate the implicit estimate of h_{int}.

FIGURE 2(c)

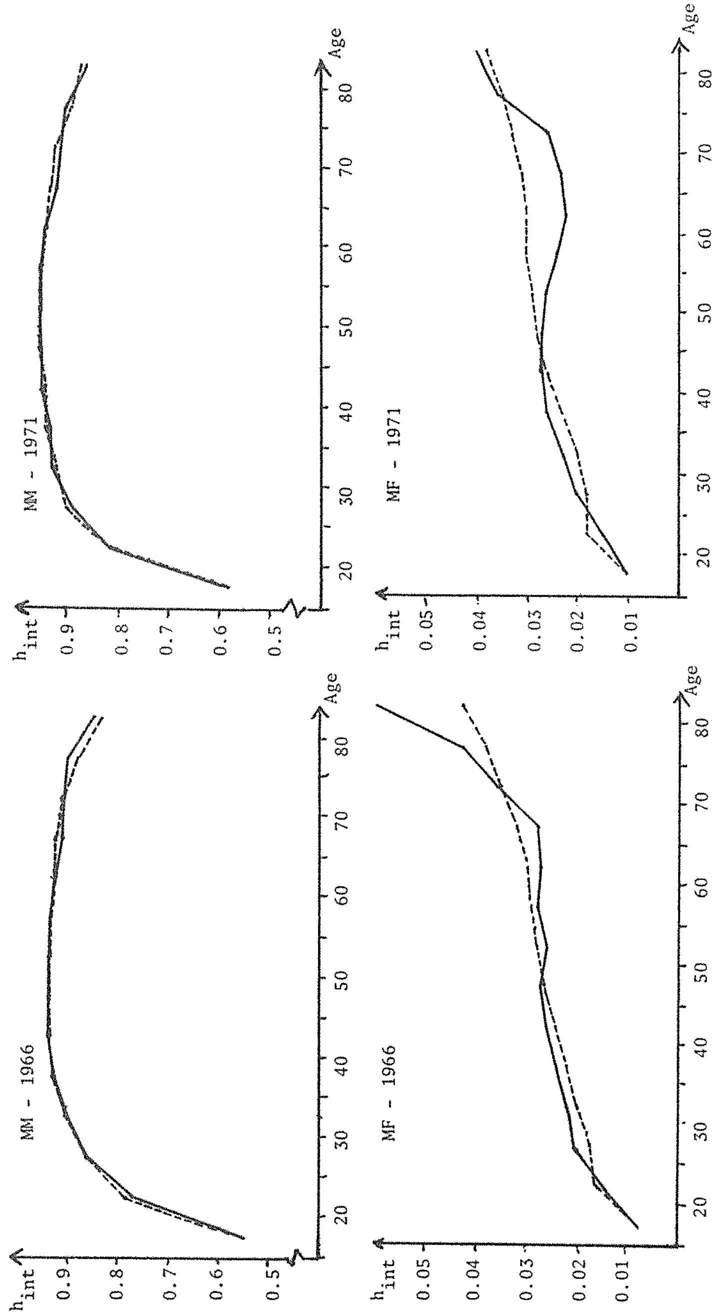
A COMPARISON OF ACTUAL HEADSHIPS WITH OLS ESTIMATES (using $W_1 = 0.90$)[1]



1. Estimated headships are given by the broken lines.

FIGURE 2(b)

A COMPARISON OF ACTUAL HEADSHIPS WITH OLS ESTIMATES (using $W_1 = 0.90$)[1]



1. Estimated headships are given by the broken lines.

The system of equations specified in (6) takes the following form :

$$H_{1nt} = f_1\{n, n^2, WFP_{1nt}, Y_t, U_{1nt}, C_1\} ;$$

$$H_{2nt} = f_2\{n, n^2, WFP_{2nt}, Y_t, U_{2nt}, CU_t, C_2\} ;$$

$$H_{3nt} = f_3\{n, n^2, Y_t, U_{3nt}, D_1, D_2\} ;$$

$$H_{4nt} = f_4\{n, WFP_{4nt}, CU_t, D_1, D_2\} ;$$

$$H_{5nt} = f_5\{n, n^2, Y_t\ U_{5nt}, D_1, D_2\} ;$$

$$H_{6nt} = f_6\{n, n^2, WFP_{6nt}, WH_t, CU_t, D_1, D_2\} ;$$

$$H_{7nt} = f_7\{n, n^2, Y_t, U_{7nt}, D_1, D_2\} ;$$

$$H_{8nt} = f_8\{n, n^2, WFP_{8nt}, WH_t, CU_t, D_1, D_2\} ;$$

$$H_{9nt} = f_9\{n, n^2, Y_t, U_{9nt}, D_1, D_2\} ;$$

$$H_{10nt} \quad f_{10}\{n , n^2, WFP_{10nt}, WPen_{nt}, CU_t, D_1, D_2\} ;$$

where

f_i is a linear function of the variables ;

n, n^2 are the mid-point of the age group and its square respectively ;

Y_t is permanent disposable income deflated by a rental price index at time t ;

WFP_{int} is the workforce participation rate of marital status/sex group i, and age group with mid-point n at time t ;

U_{int} is the unemployment rate of marital status/sex group i and age group with mid-point n at time t ;

WH_t is the welfare housing expenditure proxy at time t ;

$WPen_{nt}$ is the widows' pension of the age group with mid-point n at time t , deflated by a rental price index and multiplied by the proportion of widows not working ;

CU_t is oral contraceptive usage at time t ;

C_i indicates that a constant appears in the equation ;

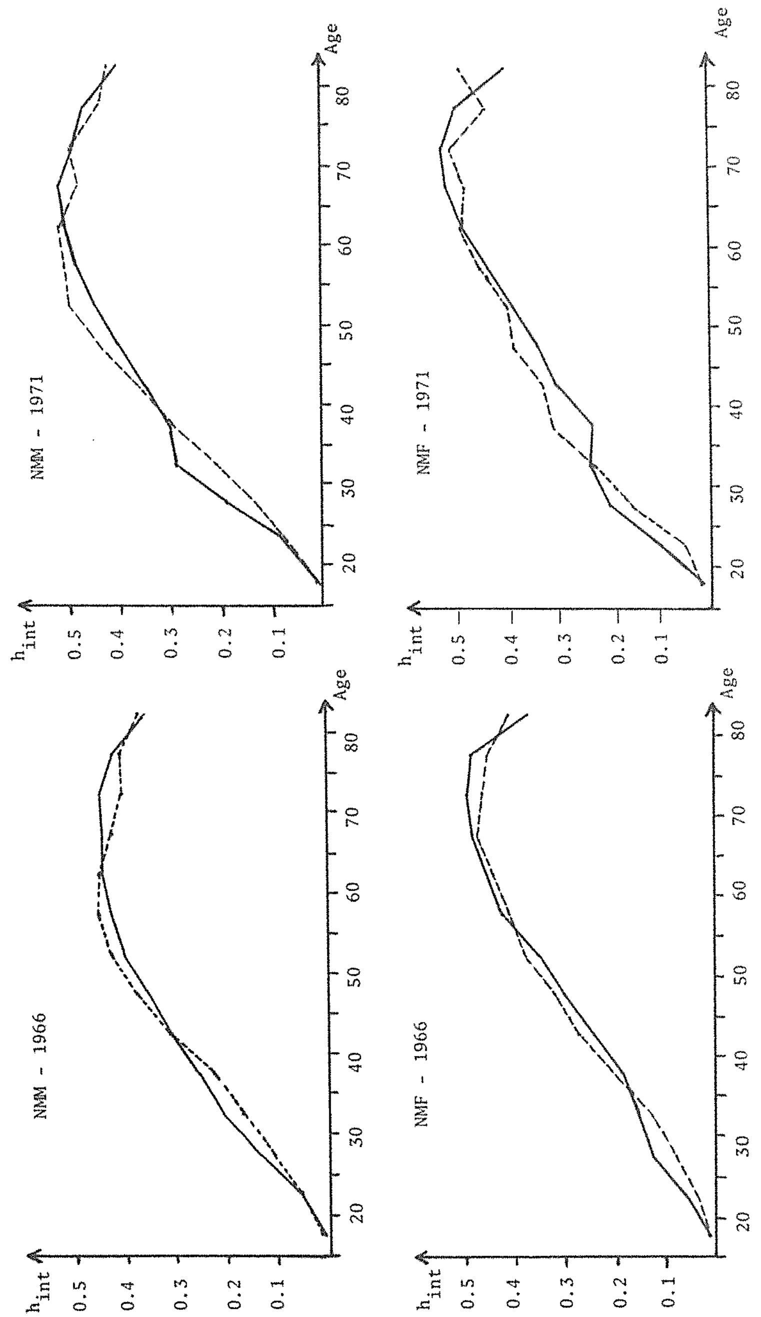
D_1 is a dummy variable which has a value of unity for the 15-19 year old age group and zero for all other age groups. We refer to this as an age-specific dummy. This dummy variable is also partitioned into two dummies, $D_1^{(66)}$ which has a value of unity for the 15-19 year old age group in 1966 and zero for all other age groups in both years and zero for the 15-19 year old age group in 1971, and $D_1^{(71)}$ which has a value of unity for the 15-19 year old age group in 1971 and zero for all other age groups in both years and zero for the 15-19 year old age group in 1966. We refer to these two dummies as age- and time-specific dummies ; and

D_2 is a dummy variable, used in conjunction with D_1 , which has a value of zero for the 15-19 year old age group and unity for all other age groups .

The specification of these equations follows from the discussion in Section 2. The quadratic specification of the age variables (n and n^2) should track the life-cycle effects on headship, because it embodies the idea that the propensity to be a household head increases with age up to a point

FIGURE 2(a)

A COMPARISON OF ACTUAL HEADSHIPS WITH OLS ESTIMATES (using $W_1 = 0.90$)[1]



1. Estimated headships are given by the broken lines.

TABLE 5 (continued)

ESTIMATED VALUES OF HEADSHIP RATIOS FOR 1966 AND 1971 (IN PERCENTAGE TERMS)[1]

(age-specific dummies)

AGE GROUP	YEAR	NEVER MARRIED		MARRIED		PERMANENTLY SEPARATED		DIVORCED		WIDOWED	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
15-19	1966	1.35	1.35	57.05	0.92	10.97	9.56	4.96	4.65	8.26	12.28
	1971	1.72	1.85	56.46	1.00	18.09	14.59	6.70	9.51	19.62	14.44
20-24	1966	5.23	4.53	78.77	1.62	25.14	28.85	19.09	23.82	20.10	46.69
	1971	6.73	5.23	82.13	1.82	33.65	38.68	25.65	33.39	23.94	50.67
25-29	1966	10.38	8.21	87.31	1.70	34.09	38.56	27.50	35.36	34.03	57.12
	1971	13.25	15.33	89.95	1.80	42.53	48.24	35.15	44.86	44.98	61.69
30-34	1966	16.90	13.29	90.90	1.90	41.36	46.84	34.86	44.02	46.51	67.75
	1971	20.87	22.95	92.44	2.00	49.55	55.93	42.21	53.73	60.35	70.66
35-39	1966	24.50	20.04	92.80	2.16	46.88	54.09	41.20	52.99	55.95	74.60
	1971	29.55	30.61	93.75	2.31	53.94	62.01	48.34	61.46	65.67	77.32
40-44	1966	31.17	27.45	93.70	2.41	50.57	58.87	45.97	58.67	62.51	79.08
	1971	37.10	32.66	94.37	2.59	57.30	66.09	52.84	66.80	70.83	80.99
45-49	1966	37.87	31.98	94.13	2.61	52.71	61.66	49.17	62.58	66.53	80.62
	1971	44.22	38.95	94.84	2.78	59.12	68.40	55.72	69.83	74.22	82.90
50-54	1966	42.61	37.94	94.25	2.78	53.62	62.28	51.28	63.71	67.37	79.64
	1971	50.03	40.31	95.02	2.89	59.96	68.92	57.28	70.70	76.39	82.35
55-59	1966	45.40	40.99	93.95	2.89	53.41	61.44	52.10	63.56	67.31	77.37
	1971	50.80	45.07	94.79	2.96	59.76	68.35	57.87	70.64	75.62	80.92
60-64	1966	44.80	44.41	93.10	2.98	52.06	57.81	52.19	59.46	64.90	72.43
	1971	52.39	49.33	94.25	2.97	58.76	65.28	58.17	67.66	74.91	77.39
65-69	1966	42.33	47.00	91.97	3.16	49.96	54.06	51.31	56.48	62.15	66.96
	1971	47.50	47.53	93.52	3.07	56.84	61.61	57.38	64.46	71.34	72.54
70-74	1966	40.24	46.49	90.60	3.45	46.25	49.32	49.00	53.21	56.21	59.88
	1971	50.30	51.21	92.13	3.26	53.99	57.16	54.63	61.95	67.81	66.36
75-79	1966	40.78	45.30	87.57	3.82	40.48	43.23	46.38	50.27	48.18	50.88
	1971	43.79	44.22	88.72	3.51	48.97	51.23	51.47	58.85	60.50	57.54
80+	1966	37.14	40.97	82.90	4.26	34.13	34.91	38.97	44.81	36.56	38.81
	1971	42.34	48.80	86.57	3.79	42.20	43.50	46.47	54.98	45.00	48.20

1. Estimates were derived using OLS with elasticity of adjustment of 0.90 and age-specific dummies.

after which propensity to be a household head decreases with age - - at least this will be the case provided that n is negatively , and n^2 positively related to H_{1nt} .

The equation for married females (H_{4nt}) presented special difficulties due to the small numbers involved and the unusual circumstances surrounding married female headship. We would expect the majority of cases of married female headship to occur when the husband has been institutionalized for a long period (for example, imprisoned or hospitalized), the couple is temporarily separated or when the wife takes a dominant role in the household. In the first case, we could suggest a positive relationship between headship of married females and the institutionalization of married males, but it is difficult to find a variable to measure the latter. In the second case, we may posit that changes in social attitudes leading to increased marriage breakdown may increase temporary separations and therefore the headship of married females. However, a variable to measure these changes in social attitudes is not available. In the third case, we can suggest a proxy for increasing female dominance - the workforce participation rate of married females. This variable should capture the growing independence of females and its positive effect on married female headship. Finally, we decided to relate married female headship to one life-cycle variable (since married female headship does not peak over the life-cycle) and the workforce participation of married females. This equation is obviously very crude.

The equation for widowed females (H_{10nt}) may also require some discussion. The headship of widowed females was considered to depend on different factors from those pertaining to the headship of other previously married females. This is because widows are more likely to see their situation as a permanent state (unlike permanently separated and divorced females) and make headship decisions accordingly. Since widows are usually in a better financial and housing position than permanently separated or divorced females, it was not felt necessary to include a welfare housing variable for widowed females, as they are less likely to be affected by the availability of such housing. So the headship of widowed females was related to their workforce participation and the widows' pension, which was deflated by a rental price index and multiplied by the proportion of widows not working. The latter variable was introduced in this way in recognition of the heterogeneity of the widowed female group. Ideally, we would distinguish between widows who are working and those who are not working, since the determinants of headship will differ between these two groups. Data would not allow us this disaggregation, however. Because the widows' pension is only relevant for those not working, we have weighted the pension variable by the relevant proportion.

TABLE 5

ESTIMATED VALUES OF HEADSHIP RATIOS FOR 1966 AND 1971 (IN PERCENTAGE TERMS)[1]

(age- and time-specific dummies)

AGE GROUP	YEAR	NEVER MARRIED		MARRIED		PERMANENTLY SEPARATED		DIVORCED		WIDOWED	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
15-19	1966	1.35	1.35	55.46	0.88	11.11	9.66	6.86	3.61	5.00	9.93
	1971	1.72	1.85	57.95	1.04	17.91	14.46	5.00	11.65	27.27	17.24
20-24	1966	5.23	4.53	78.65	1.62	25.15	28.83	18.53	24.45	19.83	46.87
	1971	6.73	5.23	81.75	1.82	33.49	38.70	26.41	33.65	30.14	50.48
25-29	1966	10.38	8.21	87.41	1.70	34.13	38.54	27.05	35.72	32.56	57.43
	1971	13.25	15.33	90.01	1.80	42.50	48.25	35.05	44.90	42.98	61.54
30-34	1966	16.90	13.29	90.98	1.90	41.43	46.82	34.57	44.54	45.38	67.97
	1971	20.87	22.95	92.46	2.01	49.65	55.94	42.66	53.80	54.80	70.52
35-39	1966	24.50	20.04	92.86	2.16	46.94	54.07	41.01	53.00	56.10	74.75
	1971	29.55	30.61	93.75	2.31	53.92	62.03	48.65	61.04	64.94	77.19
40-44	1966	31.17	27.45	93.75	2.41	50.58	58.86	45.67	58.47	63.22	79.15
	1971	37.10	32.66	94.35	2.59	57.34	66.11	52.98	65.99	70.84	80.86
45-49	1966	37.87	31.98	94.16	2.61	52.71	61.65	48.88	62.21	67.35	80.68
	1971	44.22	38.95	94.84	2.77	59.14	68.42	55.90	68.91	74.09	82.77
50-54	1966	42.61	37.94	94.28	2.78	53.63	62.27	50.97	63.53	69.35	79.75
	1971	50.03	40.31	95.03	2.88	59.98	68.93	57.68	70.00	75.40	82.22
55-59	1966	45.40	40.99	93.96	2.89	53.37	61.43	51.85	63.53	69.54	77.55
	1971	50.80	45.07	94.78	2.96	59.72	68.36	58.46	70.09	75.76	80.79
60-64	1966	44.80	44.41	93.06	2.98	51.96	57.79	51.66	60.88	67.74	72.75
	1971	52.39	49.33	94.21	2.97	58.73	65.28	58.31	68.11	74.28	77.25
65-69	1966	42.33	47.00	91.89	3.17	49.93	54.03	50.86	58.38	63.92	67.36
	1971	47.50	47.53	93.48	3.07	56.84	61.62	57.30	65.52	71.52	72.37
70-74	1966	40.24	46.49	90.59	3.45	46.19	49.30	48.52	54.78	57.81	60.32
	1971	50.30	51.21	92.08	3.26	54.11	57.16	55.29	62.60	65.80	66.12
75-79	1966	40.78	45.30	87.59	3.82	40.24	43.21	44.70	50.56	48.50	51.29
	1971	43.79	44.22	88.52	3.51	49.07	51.24	51.97	58.52	57.14	57.19
80+	1966	37.14	40.97	83.16	4.26	34.14	34.90	39.00	43.79	36.31	39.16
	1971	42.34	48.80	86.82	3.79	42.30	43.53	47.12	53.00	46.09	47.71

1. Estimates were derived using OLS with elasticity of adjustment of 0.90 and age- and time-specific dummies.

use of an age-specific dummy alone resulted in the parameter for the unemployment rate variable having the opposite sign to that expected, whereas an equation using both age- and time-specific dummies yielded the expected signs. In the case of widowed males, on the other hand, the use of a single age-specific dummy proved more satisfactory. The reasons for these differences are not understood. The magnitudes of the expected coefficients were similar for both approaches to the use of dummies. Therefore it seemed that there was little to be gained from the inclusion of time-specific dummies. Since time-specific dummies could not be used for projection work, this lack of sensitivity to their inclusion or exclusion is fortunate.

The fit of the equations, as measured by $\bar{R}^2$, is very good. For the equations estimated with age- and time-specific dummies, $\bar{R}^2$ varies between 0.905 and 0.996, while for the equations estimated with age-specific dummies, $\bar{R}^2$ never falls below 0.823. Residuals between estimated and actual values of H_{int} for the sample period are generally small. The estimated values of H_{int} for the sample period (1966 and 1971) were transformed to give estimates of h_{int} for the period, and these values are presented in Table 5 for the case when the model was estimated using both specifications of the dummy variables. The actual headship ratios are also graphed against these estimates (Figures 2(a) to 2(e)). As the graphs show, the estimated values track the actual values closely in most cases.

5. ESTIMATES

5.1 Estimation Method and Problems

In order to preserve linearity in the estimating equations, our approach involved iteration on the elasticity of adjustment (W_1) externally to the estimation procedure proper. Two methods of estimation are considered below : full information maximum likelihood (FIML), and ordinary least squares (OLS) on an equation by equation basis. As noted above, the logistic ceiling parameters (S_i) for headship ratios were estimated judgmentally and treated as known constants in the formal estimation procedure.

It was our intention to use FIML to estimate the model as a system of seemingly unrelated regressions[1]. Besides yielding efficient estimates, such a systems approach has the additional advantage of providing a convenient criterion for the choice of the common adjustment elasticity, W_1 (that is, by choosing that value of W_1 which maximizes the likelihood). In initial work, however, we used OLS to estimate each equation individually and the results obtained generally agreed with our theoretical expectations. When the model was estimated as a system using FIML, considerably different results were obtained[2]. These differences are shown in Table 1 which compares the OLS and FIML results for the model when $W_1 = 0.60$ and age- and time-specific dummy variables are used. While FIML estimation generally

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1. In the case of a system of equations where the explanatory variables are not identical for each sex/marital status group and where there may be non-zero correlations between the errors of two or more equations, the seemingly unrelated regressions estimates will be asymptotically more efficient than those obtained by OLS applied to each equation. For more detail see A. Zellner, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias," Journal of the American Statistical Association, Vol. 57 (1962).

2. Our FIML estimations were based on Wymer's extremely flexible RESIMUL package. See C. R. Wymer, Computer Programs : RESIMUL Manual (Washington, D.C. : International Monetary Fund, 1977), (mimeo).

TABLE 1

COMPARISON OF OLS AND FIML RESULTS WITH AN ELASTICITY OF ADJUSTMENT OF 0.60 AND AGE- AND TIME- SPECIFIC DUMMIES[1]

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1(66)$	$D_1(71)$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
H_1(OLS)	-.2412 (6.52)	.0017 (3.55)	-.0048 (3.79)	-.0133 (1.37)	.0155 (1.19)			16.3523 (6.43)				0.9345
H_1(FIML)	-.2173 (11.21)	.0014 (6.41)	-.0043 (4.92)	-.0179 (5.52)	-.0130 (0.40)			15.8677 (9.39)				0.9261
H_2(OLS)	-.1843 (5.54)	.0014 (3.30)	-.0027 (1.75)	.0039 (0.35)	.3666 (2.79)			9.2774 (2.83)				0.9031
H_2(FIML)	-.1760 (7.73)	.0011 (4.25)	-.0025 (2.15)	-.0111 (2.59)	.1107 (4.12)			10.6522 (4.82)				0.8768
H_3(OLS)	-.2272 (13.17)	.0022 (13.53)	-.0021 (2.51)		.6781 (2.64)				4.7141 (2.80)	4.7434 (2.53)	5.1522 (3.12)	0.9938
H_3(FIML)	-.2227 (16.50)	.0022 (17.29)	-.0028 (4.21)		.4577 (5.62)				6.5611 (5.27)	6.7939 (5.11)	6.4288 (5.04)	0.9929
H_4(OLS)	-.0158 (3.02)			-.0102 (1.54)					2.5048 (6.94)	2.4145 (6.04)	1.8340 (4.50)	0.9411
H_4(FIML)	-.0029 (0.96)			.0055 (3.53)					2.1524 (8.78)	1.7950 (7.27)	.8005 (4.50)	0.9224
H_5(OLS)	-.1648 (12.64)	.0016 (12.50)	-.0053 (6.53)		.0335 (0.71)				12.8549 (7.52)	13.2242 (8.41)	12.5522 (7.66)	0.9708
H_5(FIML)	-.1698 (15.62)	.0016 (15.66)	-.0016 (11.63)		-.0126 (1.07)				14.9219 (14.75)	15.0093 (14.27)	14.5295 (14.08)	0.9694
H_6(OLS)	-.1619 (4.53)	.0015 (3.42)		-.0121 (0.94)		-.0371 (3.91)			6.6507 (6.90)	6.9768 (6.37)	5.8353 (5.13)	0.8650
H_6(FIML)	-.2021 (10.30)	.0023 (11.62)		.0194 (4.96)		-.0447 (7.92)			6.3479 (9.34)	6.5830 (8.78)	4.8077 (7.01)	0.8389

marital status/sex groups (except married females), workforce participation fell over the period whilst headship ratios generally increased. This rise in headship has occurred despite the negative influence of falling workforce participation, so there must have been other factors exerting a positive influence on headship.

U_{int} : The estimated parameters for the unemployment rate had the expected sign except for two equations : divorced males, with an age-specific dummy , and widowed males with age- and time-specific dummies. Unemployment was significant only for the never married males, never married females and married males equations.

WH_t : The welfare housing variable was used in the permanently separated and divorced female equations and performed very well; its parameter estimate was significant and of the expected sign in both equations.

$WPen_{nt}$: The widows' pension variable was used only in the widowed females equation , where it performed adequately ; its parameter estimate was significant and of the expected sign.

C, D : The constant terms and dummies used were all significant. The use of age-specific versus both age- and time-specific dummies in separate equations was of little consequence for the estimated parameters. In the divorced males equation, however, the

TABLE 4

OLS ESTIMATION WITH ELASTICITY OF ADJUSTMENT OF 0.90 FOR LIFE-CYCLE VARIABLES ONLY[1]

Equation	n	n^2	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
H_1 (NMM)	-.2744 (12.28)	.0022 (9.87)	7.4436 (14.86)				0.9191
H_2 (NMF)	-.2284 (8.96)	.0017 (6.62)	6.7123 (11.74)				0.8970
H_3 (MM)	-.2212 (12.99)	.0021 (13.12)		2.7760 (7.86)	2.7398 (7.76)	2.0604 (5.05)	0.9927
H_4 (MF)	-.0188 (5.92)			2.3853 (7.75)	2.1992 (7.15)	1.6645 (9.48)	0.9027
H_5 (PSM)	-.1633 (8.20)	.0015 (7.97)		4.0060 (9.70)	3.4291 (8.30)	3.2131 (6.73)	0.8995
H_6 (PSF)	-.1765 (7.48)	.0017 (7.49)		4.5081 (9.21)	4.0470 (8.27)	3.4133 (6.03)	0.8746
H_7 (DM)	-.1630 (8.63)	.0014 (7.73)		4.6279 (11.81)	5.0474 (12.89)	3.6922 (8.15)	0.9277
H_8 (DF)	-.1847 (8.78)	.0017 (8.27)		5.8958 (13.52)	4.3498 (9.98)	3.8181 (7.57)	0.9298
H_9 (WM)	-.2475 (10.14)	.0023 (9.73)		6.3895 (12.63)	4.1064 (8.11)	5.3039 (9.06)	0.9042
H_{10} (WF)	-.2060 (9.67)	.0020 (10.11)		5.0895 (11.52)	4.3423 (9.83)	3.4415 (6.73)	0.9418

1. Columns (1) - (6) contain estimated coefficients (and t-ratios) for the variables shown at the head of the column. For key to notation see page 19. Column (7) shows the coefficient of determination adjusted for degrees of freedom.

TABLE 1 (Continued)

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
H_7(OLS)	-.1614 (11.10)	.0014 (9.97)	-.0042 (5.49)		.0190 (0.61)				11.7920 (8.38)	13.1536 (9.03)	10.9493 (7.59)	0.9711
H_7(FIML)	-.1733 (12.80)	.0015 (11.47)	-.0044 (6.30)		.0100 (0.64)				12.3726 (9.43)	13.6932 (10.11)	11.7912 (8.80)	0.9681
H_8(OLS)	-.1653 (6.28)	.0013 (4.10)		-.0129 (1.44)		-.0322 (4.38)			8.6836 (11.48)	6.7320 (6.60)	6.1502 (6.38)	0.9376
H_8(FIML)	-.1909 (9.26)	.0019 (8.94)		.0107 (2.27)		-.0354 (6.09)			8.2232 (13.09)	5.4763 (7.17)	4.7773 (6.69)	0.9191
H_9(OLS)	-.2707 (8.32)	.0025 (8.47)	-.0059 (4.43)		-.1457 (1.83)				17.9586 (7.35)	12.3842 (4.82)	16.7806 (6.61)	0.9255
H_9(FIML)	-.3264 (13.80)	.0030 (13.24)	-.0065 (5.84)		-.3004 (18.98)				20.6142 (9.94)	14.2976 (6.51)	19.7771 (9.25)	0.9164
H_{10}(OLS)	-.1955 (8.03)	.0019 (7.02)		-.0843 (2.29)			-.3624 (2.07)		12.5790 (3.71)	11.4819 (3.29)	10.5590 (3.07)	0.9450
H_{10}(FIML)	-.2235 (8.67)	.0020 (7.60)		-.1349 (3.95)			-.5442 (3.04)		16.6295 (4.89)	15.7213 (4.57)	15.5888 (4.56)	0.9171

. Columns (1) - (11) contain estimated coefficients (and t-ratios) for the variable shown at the head of the column for key to notation, see page 19. Column (12) shows the coefficient of determination adjusted for degrees of freedom.

increased the apparent efficiency of the parameter estimates, occasionally the signs on the parameters were changed from those obtained by OLS estimation. For example, the coefficient on the workforce participation rate changed sign in all but one of the equations for females and the coefficient on the unemployment rate variable changed sign in two out of six cases. These sign changes were a surprise, partly because the FIML estimates would not be expected to differ greatly from the OLS estimates[1] and partly because the opposite signs given by the FIML estimates did not conform to our prior expectations.

We feel that these unusual FIML results were caused by large off-diagonal elements in the variance-covariance matrix of the residuals, which under FIML are taken to be potentially informative structural characteristics. These large covariances, which result in correlations in the error structure across equations, are evident in a comparison of the OLS predictions of headship ratios with the actual data over the sample. For example, for never married males and never married females (refer to figure 1) we note some similarities in that, in the younger and older age groups, the estimates under-predict, while in the middle age groups the estimates over-predict. We are unable to explain this apparent misspecification. Rather than allow our estimates to be affected by it, we have used OLS estimation instead of FIML because of the superior robustness of the former to minor specification errors of the type apparent here.

1. In a seemingly unrelated regressions problem, where there are no parameter constraints operating, the difference between OLS and FIML is generated by the correlations between the errors in different equations. In cross-sectional data, we would not expect these to be large if the model is correctly specified.

headship, we excluded the economic variables and estimated the system with only the age and constant terms as explanators. The results (as shown in Table 4) indicate that, over the short time period being considered, age could explain the majority of headship behaviour (evidenced by a comparison of $\bar{R}^2$ results in Tables 3 and 4). Thus our analysis confirms that demographic variables are very important in determining the level of headship.

The empirical results also confirm the usefulness of economic variables in the explanation of headship. The economic variables used generally performed well and contributed significantly to the explanation of headship. Consider each of these variables in turn :

Y_t : The estimated parameters of permanent disposable income deflated by a rental price index showed the expected positive relationship to headship in the equations in which Y_t appeared. Parameters were significant at least at the five per cent level for all equations except never married females. The result for never married females may have been due to the lack of disaggregated income data.

WFP_{int} : The workforce participation variable did not perform particularly well. Although the estimated parameters had the wrong sign in only one equation (never married females) they were significant for only two equations (divorced females, with an age-specific dummy and widowed females). The poor performance of this variable is particularly disturbing as it is one of the few variables available disaggregated by age, sex and marital status. The problems may be due to the behaviour of the workforce participation rate over the time period being studied; for almost all age groups and all

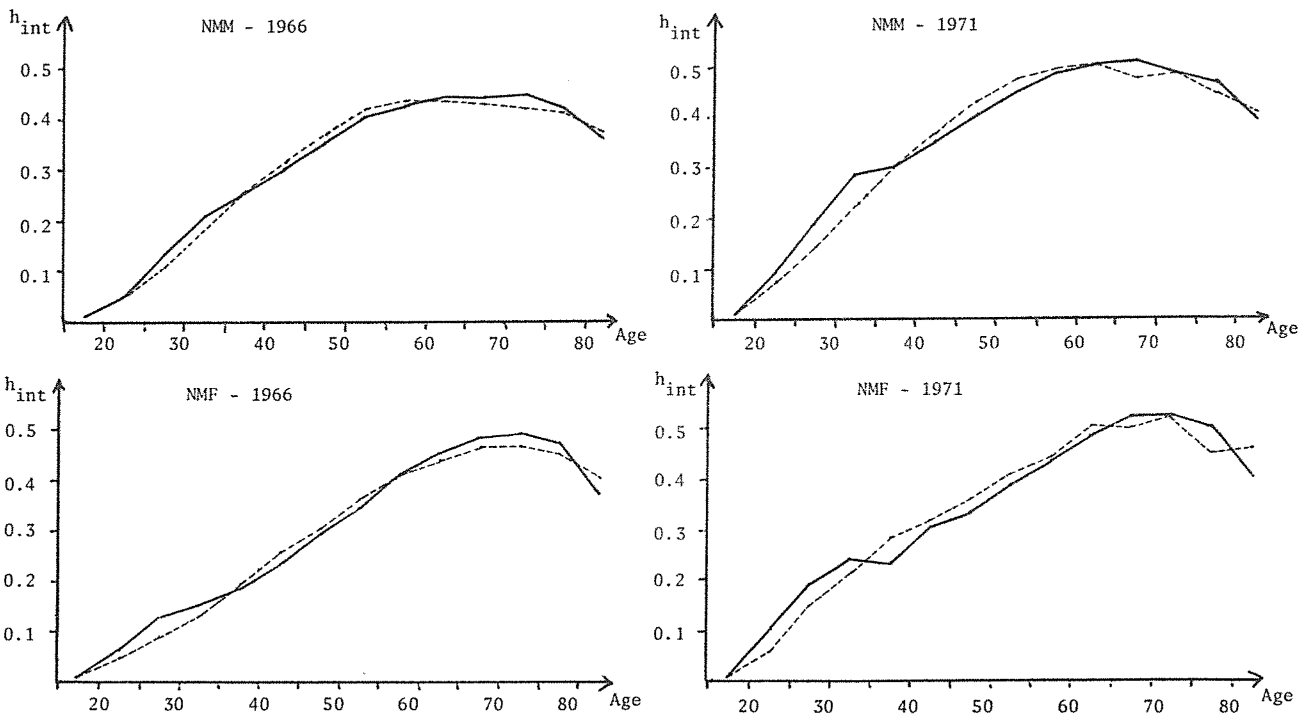
TABLE 3 (continued)

Equation	n	n2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
H_8(DF)	-.1751	.0015		-.0075		-.0248			7.5460	6.7081	5.8692	.9738
(n,t)	(11.88)	(8.04)		(1.49)		(6.04)			(17.81)	(11.75)	(10.89)	
H_8(DF)	-.1673	.0013		-.0136		-.0281			7.6674		6.4481	.8614
(n)	(10.45)	(6.89)		(2.82)		(6.51)			(16.39)		(11.93)	
H_9(WM)	-.2538	.0023	-.0040		-.0266				13.8381	11.9062	13.0036	.9482
(n,t)	(11.56)	(11.67)	(4.51)		(0.49)				(8.40)	(6.87)	(7.59)	
H_9(WM)	-.2248	.0021	-.0051		.0968				14.0883		13.8693	.8234
(n)	(8.36)	(8.46)	(4.58)		(1.69)				(6.59)		(6.28)	
H_{10}(WF)	-.1959	.0019		-.0778			-.3467		11.9789	11.4226	10.3690	.9510
(n,t)	(9.52)	(8.29)		(2.49)			(2.35)		(4.17)	(3.87)	(3.57)	
H_{10}(WF)	-.1955	.0018		-.0856			-.3855		12.4457		11.1125	.8498
(n)	(9.35)	(8.13)		(2.44)			(2.61)		(4.30)		(3.84)	

1. Columns (1) - (11) contain estimated coefficients (and t-ratios) for the variable shown at the head of the column. For key to notation, see page 19. Column (12) shows the coefficient of determination adjusted for degrees of freedom. Estimates for age- and time-specific dummies are given in the rows headed (n,t), whilst estimates for age-specific dummies are given in the rows headed (n).

FIGURE 1

A COMPARISON OF ACTUAL HEADSHIPS WITH OLS ESTIMATES (using $\dot{W}_1$ = 0.60)[1]



1. Estimated headships are given by the broken lines.

It was intended to use an oral contraceptive usage variable in all equations for females, but this variable behaved very poorly in preliminary estimations : some of the parameter estimates had signs opposite to those expected and generally the estimated equations were difficult to interpret. As the data available were not age-specific, there may have been some collinearity between this variable and the other non-age specific variables. It was felt that the influence of this variable as a proxy may have been captured in the workforce participation rate variable. For this reason we present results obtained without the inclusion of a contraceptive usage variable.

5.2 Choosing the Upper Limit for Desired Headship Ratios (S_i)

Before estimation could proceed, it was necessary to select values for S_i , the marital status/sex specific upper limit to desired headship. After examining data on headships and taking account of the previous discussion on the relationship between headship and marital status, we adopted the following values for S_i :

TABLE 3

OLS ESTIMATES OF H_{int}, WITH ELASTICITY OF ADJUSTMENT OF 0.90 AND AGE- AND TIME-SPECIFIC AND AGE-SPECIFIC DUMMIES[1]

Equation	n	n^2	Y_t	WFP_{int}	U_{int}	WH_t	$WPen_{nt}$	C	$D_1^{(66)}$	$D_1^{(71)}$	D_2	$\bar{R}^2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
H_1(NMM)	-.2304 (7.09)	.0016 (3.74)	-.0038 (3.43)	-.0146 (1.71)	.1702 (1.49)			14.5892 (6.53)				.9474
H_2(NMF)	-.1908 (6.47)	.0014 (3.66)	-.0025 (1.87)	.0007 (0.06)	.3002 (2.58)			9.9160 (3.41)				.9279
H_3(MM) (n,t)	-.2154 (17.36)	.0021 (17.46)	-.0023 (3.77)		.5244 (2.84)				5.6669 (4.68)	5.4305 (4.02)	5.7103 (4.82)	.9962
H_3(MM) (n)	-.2162 (17.68)	.0021 (17.79)	-.0024 (4.13)		.4515 (2.93)				5.9601 (5.26)		6.0023 (5.42)	.8837
H_4(MF) (n,t)	-.0262 (3.92)			-.0106 (1.25)					2.8186 (6.12)	2.7124 (5.31)	2.2789 (4.38)	.9049
H_4(MF) (n)	-.0264 (4.06)			-.0109 (1.38)					2.7795 (6.55)		2.2970 (4.55)	.8507
H_5(PSM) (n,t)	-.1640 (15.78)	.0015 (15.11)	-.0038 (5.85)		.0270 (0.71)				10.6116 (7.79)	10.6869 (8.53)	10.1500 (7.79)	.9729
H_5(PSM) (n)	-.1638 (16.15)	.0015 (15.60)	-.0039 (6.32)		.0207 (0.80)				10.7517 (9.01)		10.2513 (8.53)	.8677
H_6(PSF) (n,t)	-.1663 (8.26)	.0015 (6.13)		-.0074 (1.02)		-.0244 (4.58)			6.1025 (11.26)	6.1317 (9.93)	5.3038 (8.28)	.9317
H_6(PSF) (n)	-.1663 (8.47)	.0015 (6.28)		-.0073 (1.05)		-.0243 (4.85)			6.1085 (11.66)		5.2950 (8.60)	.8393
H_7(DM) (n,t)	-.1632 (15.13)	.0014 (13.42)	-.0038 (6.75)		.0011 (0.05)				11.4292 (10.96)	12.3051 (11.40)	10.7215 (10.02)	.9781
H_7(DM) (n)	-.1610 (11.84)	.0014 (10.48)	-.0035 (4.95)		-.0153 (0.56)				11.2452 (8.54)		10.1020 (7.57)	.8612

criterion as well as other values of W_1 and which also conforms well to our theoretical expectations as to the signs on parameters in the equations. If we assume that the adjustment process follows a geometric distribution, then the first yearly adjustment would be given by[1]

$\alpha = 1 - (1 - W_1)^{1/5}$. A value of 0.90 for W_1 would suggest that 37 per cent of the overall adjustment in the logarithms of headship ratios takes place in the first year.

5.4 Results

The results of OLS estimation of H_{int} for $W_1 = 0.90$ with age- and time-specific dummy variables and with age-specific dummy variables are presented in Table 3. Generally, the results are encouraging. In most cases the signs on parameters accord with a priori expectations and the fit of the equations (as measured by $\bar{R}^2$) is very good.

We expected there to be a strong relationship between headship and the demographic variable, age. In all equations, the estimated parameters of the life-cycle variables (n and n^2) were significant and of the expected sign. To test the importance of demographic determinants of

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1. If we have a five year adjustment process which follows a geometric lag distribution, where α is the adjustment in the first period and W_1 is the total adjustment at the end of five periods, then the adjustment in each period is α times the remainder from the previous period. That is :

$$W_1 = \alpha + \alpha(1 - \alpha) + \alpha(1 - \alpha)^2 + \alpha(1 - \alpha)^3 + \alpha(1 - \alpha)^4$$
$$= 1 - (1 - \alpha)^5 .$$

Rearranging terms :

$$\alpha = 1 - (1 - W_1)^{1/5} .$$

For $W_1 = 0.90$,

$$\alpha = 1 - (1 - 0.9)^{1/5}$$
$$= 0.37 .$$

S_1	(never married males)	=	0.65
S_2	(never married females)	=	0.65
S_3	(married males)	=	0.97
S_4	(married females)	=	0.08
S_5	(permanently separated males)	=	0.75
S_6	(permanently separated females)	=	0.85
S_7	(divorced males)	=	0.75
S_8	(divorced females)	=	0.85
S_9	(widowed males)	=	0.90
S_{10}	(widowed females)	=	0.95

Whilst we have confidence in these strong priors on the selection of values for the S_i , it will be useful to test the sensitivity of the results to changes in S_i .

5.3 Choosing the Adjustment Elasticity (W_1)

As OLS was used to estimate each equation individually, we had to derive a criterion by which a value for W_1 could be selected for the system of equations. It was decided to use a systems fit criterion; that is, a weighted sum of the coefficients of determination adjusted for degrees of freedom $(\bar{R}^2)$, where the weights $\{\delta_i\}$ used were a proportion of total households in a particular headship category ; that is

$$\delta_i = \frac{\text{number of households of type } i}{\text{total number of households}}$$

This weighting system gives less weight to those marital status/sex groups which represent smaller proportions of total households. The weights were calculated using 1971 Census data, although it was felt that an average of 1966 and 1971 data would have been preferable. Unfortunately, the necessary data for 1966 was not available.

When estimation was attempted using values of W_1 ranging from 0.60 to 1.00 it was found that the systems fit criterion used could not categorically distinguish between the different values for W_1 . Such an outcome is not surprising given that there were only two transitions in which to capture the adjustment. The estimates obtained are presented in Appendix 2 and a summary of the results for the systems fit criterion used is given in Table 2. Since the sensitivity of the values of the systems fit criterion to changes in W_1 were of the order of the fourth decimal place, it was felt that the information provided by the data was not sufficiently persuasive to allow a choice between different values of W_1 . For this reason, the choice of the value for W_1 was essentially arbitrary. A priori we would expect that W_1 would be close to unity because, as the transitions are over a five year period, people would have had sufficient time to adjust almost completely to their headship desires. For this reason we choose a value of 0.90 for W_1 which fulfils the systems fit

TABLE 2

SENSITIVITY OF SYSTEMS FIT TO THE ELASTICITY OF ADJUSTMENT

Elasticity of Adjustment	Criterion Used to Measure System Fit[1]
W_1	$\sum_i \delta_i \bar{R}_i^2$
0.60	0.9779
0.65	0.9825
0.70	0.9809
0.75	0.9817
0.80	0.9712
0.85	0.9828
0.90	0.9829
0.95	0.9832
1.00	0.9832

1. The weights used in formulating the criterion were :

$\delta_1 = 0.0466$ $\delta_2 = 0.0315$

$\delta_3 = 0.7375$ $\delta_4 = 0.0189$

$\delta_5 = 0.0127$ $\delta_6 = 0.0157$

$\delta_7 = 0.0089$ $\delta_8 = 0.0123$

$\delta_9 = 0.0219$ $\delta_{10} = 0.0940$