THE ADJUSTMENT OF POPULATION AND HOUSEHOLD PROJECTIONS FOR STRATEGIC PLANNING PURPOSES

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Abstract

One key component of development plan preparation is the assessment of future housing need. Many local authorities in England and Wales have been involved in formulating Regional Planning Guidance with the Department of the Environment (DoE), a process which results in forecasts of the number of new dwellings required by 2006. The demand for housing is clearly driven to a large extent by demographic factors which influence the size and structure of the population and the propensity of people to form households.

This paper reports on an applied research project undertaken for the DoE and for those local authorities in Yorkshire and Humberside responsible for producing unitary development plans or structure plans. The research aimed to investigate the validity of the existing OPCS/DoE 1989-based population and household projections for local authority areas in the light of data from the 1991 Census and other sources. This paper contains a description of historical and projected population and household change, a comparison of the 1989-based projections for mid-1991 with the revised final mid-1991 rebased population estimates, a time series analysis of migration trends, a comparison of the assumptions about marital status used in the official projections with those recorded by the 1991 Census, and a comparison of the headship rate assumptions used in the projections with those identified in the 1991 Census.

Ideally, the accurate projection of populations and households requires a multiregional demographic model that enables the various components of and influences on population and household change to be incorporated and alternative projections to be generated on the basis of different combinations of assumptions about fertility, mortality, migration, marital status and household formation. The approach followed in this research is much more pragmatic: a methodology is developed which adjusts existing projections on the basis of the results of the analyses of particular components reported earlier. The result is a range of population and household projections to 2001 and 2006 that can be compared with the existing OPCS/DoE projections and have been used to assist the local authorities in formulating their draft advice on Regional Planning Guidance to the Secretary of State for the Environment.

Acknowledgements

This paper is based on research undertaken for the Yorkshire and Humberside Regional Research Observatory by John Stillwell and Tony Gore from the School of University, University of Leeds, and Peter Ramsden and Christina Beatty from the Centre for Regional Economic and Social Research, University of Hallam. The author wishes to acknowledge the contributions to the project of the other three members of the research team as well as the inputs made by members of the Steering Group and other individuals concerned with the project.

THE ADJUSTMENT OF POPULATION AND HOUSEHOLD PROJECTIONS FOR STRATEGIC PLANNING PURPOSES

1. INTRODUCTION

Projections of future populations and households, and their relationship with stocks of housing, are vital components in the provision of land by local authorities for future housing development in England and Wales. Whilst many district and county planning authorities now possess the capacity to produce their own demographic and housing projections, there is still considerable reliance placed on the 'official' projections of populations and households produced by the Office of Population Censuses and Surveys (OPCS) and the Department of the Environment (DoE). The latest series of projections 20 years ahead are those based on the mid-1989 sub-national estimates of population (*OPCS*, 1991) and households (*DoE*, 1991). These projections have been the subject of certain criticism from local authority planners, mainly on the grounds of their handling of population subgroups such as migrants, students and the armed forces.

The availability of the results of the 1991 Census of Population in 1993 presented a unique opportunity for local authorities, regional planning agencies and Government departments in the UK to assess the accuracy of these 'official' projections, and to utilise the findings in the formulation of a range of updated or adjusted population and household projections which could then be used to estimate new dwelling requirements over a given plan period. In general, it is to be expected that those authorities pursuing a policy of development restraint would opt for lower totals of projected population growth and household formation, whilst those with interests in house-building would be likely to favour higher totals.

These were the circumstances in which the local authorities in Yorkshire and Humberside, drawn together by the Yorkshire and Humberside Regional Planning Conference, in collaboration with the Regional Office of the DoE, commissioned a study by the Yorkshire and Humberside Regional Research Observatory. The project was undertaken as part of the preparation of Regional Planning Guidance for the Secretary of State for the Environment under the provisions of Planning Policy Guidance (PPG) Note 12 (*DoE*, 1992). It examined the existing 1989-based projections for local authority areas in the region in the light of the results of the 1991 Census and other data sources such as the National Health Service Central Register migration records.

The local authority areas included the five metropolitan districts of West Yorkshire, the four metropolitan districts of South Yorkshire, and the two shire counties of North Yorkshire and Humberside (Figure 1). The study also investigated several of the assumptions which underpinned the original projections, and used the results in the formulation of a range of alternative population and household projections. The Regional Planning Conference then took these as the starting point for a provisional estimate of dwelling requirements for each local authority area for the period up to 2006, as set out in its draft advice to the Secretary of State for the Environment (*Yorkshire and Humberside Regional Planning Conference*, 1993).

Figure 1: The boundaries of the metropolitan districts and shire counties of Yorkshire and Humberside

This paper presents a synopsis of the research methodology reported in detail in Yorkshire and Humberside Regional Research Observatory (1993) and of the results of particular analyses that were undertaken as part of the project but subsequently updated in the light of revised mid-1991 population estimates (*OPCS*, 1993). Section 2 provides a concise introductory description of population and household change between 1981 and 1991, and of OPCS and DoE projections to 2011 for the region and its constituent local authorities. Section 3 outlines the methodology used to adjust OPCS population projections to 2006 whilst Section 4 explains how revised household projections were computed. Some conclusions are contained in Section 5.

2. POPULATION AND HOUSEHOLD DYNAMICS

2.1 Population change 1981-91

The mid-year population estimates in Table 1 show that the population of Yorkshire and Humberside increased by 1.3% from 1981 to 4.983 million in 1991. This aggregate change was composed of growth of 6.3% in North Yorkshire, 2.3% in Humberside, 0.8% in West Yorkshire; and a decline of 1.1% in South Yorkshire where losses in Sheffield and Barnsley outweighed increases in Doncaster and Rotherham. The components of change indicate the

important role of net migration losses from the metropolitan areas and gains by the two shire counties.

Table 1: Population change by local authority area, Yorkshire and Humberside, 1981-91

	Revised final estimates 1981 (000)	1991 (000)	Change 1981-91 (000)	(%)	Natural change (000)	Net migration (000)
Bradford	464.9	475.4	10.5	2.3	18.7	-8.2
Calderdale	192.9	194.0	1.1	0.6	1.0	0.1
Kirklees	377.1	381.5	4.4	1.2	7.4	-3.0
Leeds	717.9	717.4	-0.5	-0.1	9.5	-9.6
Wakefield	314.1	316.2	2.1	0.7	6.8	-4.7
West Yorkshire	2066.9	2084.5	17.6	0.8	43.3	-25.8
Barnsley	225.8	224.4	-1.4	-0.6	3.0	-4.4
Doncaster	290.9	293.3	2.4	0.8	9.0	-6.6
Rotherham	252.7	254.9	2.2	0.9	7.8	-5.6
Sheffield	547.8	529.3	-18.5	-3.3	-6.2	-12.3
South Yorkshire	1317.1	1301.9	-15.2	-1.1	13.6	-28.8
Humberside	857.7	877.3	19.6	2.3	14.9	4.7
North Yorkshire	676.7	719.1	42.4	6.3	-6.7	49.1
Yorkshire & Humbs	4918.4	4982.8	64.4	1.3	65.1	-0.7

Notes:

(i) Figures may not sum exactly due to rounding

(ii) Net migration figures for Bradford include loss of population (-0.1) and for North Yorkshire include population gain (0.1) due to boundary change

Source: OPCS (1993)

Changes in total population conceal considerable fluctuations in quinary age group populations as five year birth cohorts of different size progress through the age structure. The changes depicted in Figure 2 indicate that the main increases in the 25-29, 40-44 and 80+ ages occurred with equal magnitude across all the authorities. The decline in those aged 5-19 will mean a smaller number of entrants to the labour market during the next decade. Spatial variations occurred in other age groups. Doncaster, for example, was the only area to experience a fall in 20-24 year olds, whereas Sheffield's population aged 35-39 and Bradford's population aged 45-49 both fell when populations of similar age elsewhere increased. Gender variations are outlined in Stillwell and Gore (1993).

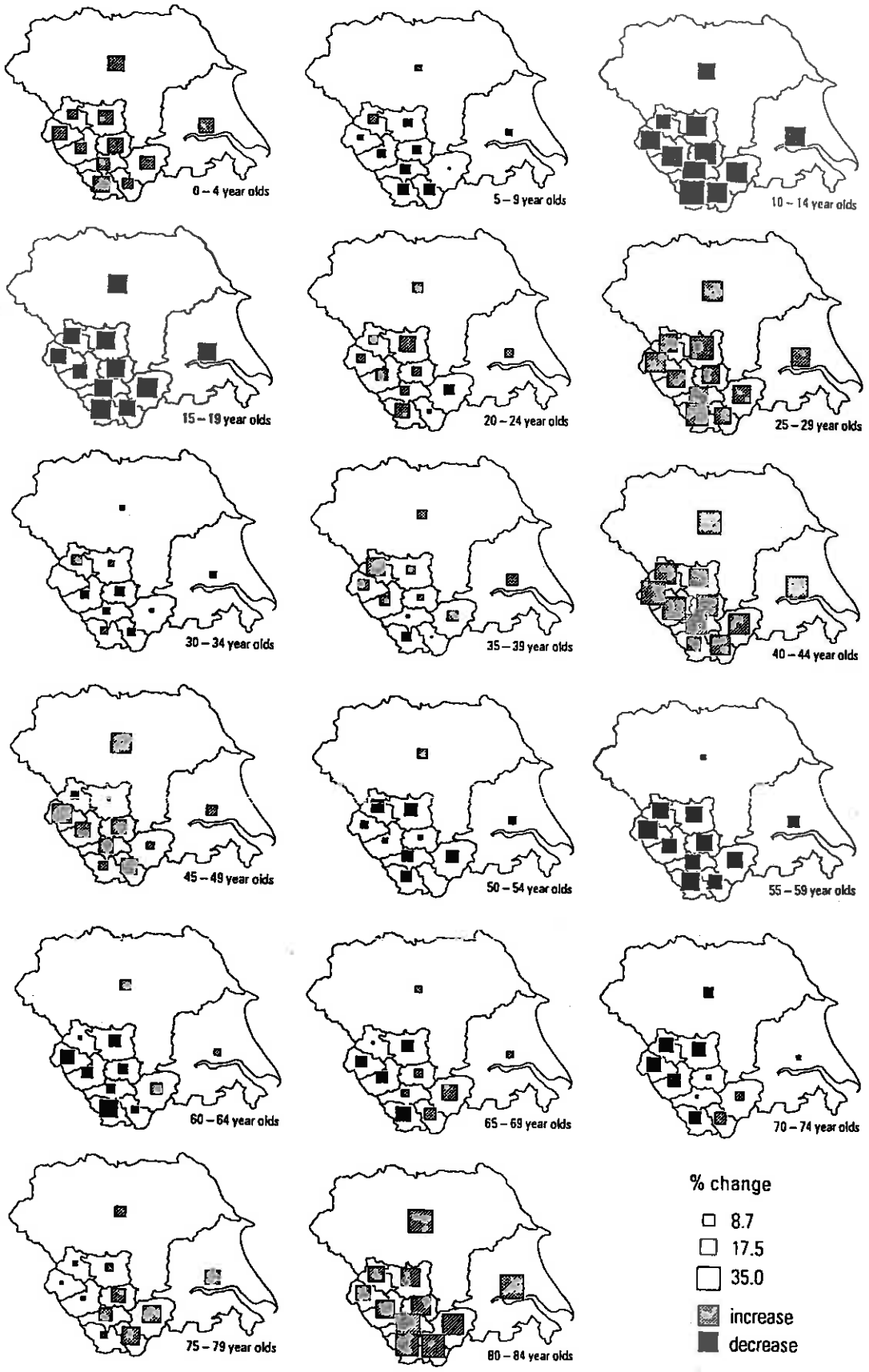


Figure 2: Percentage population changes by quinary age group, local authority areas, 1981-91

2.2 Household change 1981-91

Data from the 1981 and 1991 Censuses can be used to derive changes in the number of private households by broad household type. The figures presented in Table 2, which have not been adjusted for underenumeration, indicate varying rates of growth in household numbers between local authority areas. Humberside and North Yorkshire both experienced appreciable increases in household numbers compared with the two metropolitan counties, where Sheffield, Bradford and Leeds, the three major cities, have the lowest rates of growth.

Significant changes occurred during the decade in the number of households of particular types. In the region as a whole, single adult households increased by 38.2% and two adult households increased by 6%, whereas households with three or more adults declined by 15.4%. This general pattern was evident across most local authority areas although variations in rates of change were apparent.

Table 2: Change in household composition by local authority area, 1981-91

	1981 (000)	1991 (000)	Change 1981-1991 Total %	1 Adult %	2 Adults %	3+ Adults %
Bradford	163.9	174.1	6.2	29.8	2.9	-14.5
Calderdale	71.9	77.5	7.7	28.7	4.8	-13.5
Kirklees	136.0	146.7	8.0	31.4	3.5	-9.6
Leeds	262.8	281.2	7.0	36.2	2.6	-19.8
Wakefield	112.4	123.5	9.8	41.9	5.4	-12.2
West Yorkshire	747.1	803.1	7.5	33.9	3.5	-15.1
Barnsley	81.1	87.1	7.4	39.1	3.5	-12.9
Doncaster	102.7	112.7	9.8	46.5	6.5	-16.4
Rotherham	88.8	97.9	10.1	48.1	5.0	-11.1
Sheffield	203.1	211.0	3.9	33.8	-1.7	-19.9
South Yorkshire	475.7	508.7	6.9	39.5	2.3	-16.2
Humberside	304.6	340.2	11.7	45.6	9.7	-17.9
North Yorkshire	241.7	281.4	16.5	41.4	16.4	-11.5
Yorkshire & Humberside	1769.1	1933.4	9.3	38.2	6.0	-15.4

Note : Total household count may include a small number of households with no resident adults.

Source: Censuses of Population, 1981 and 1991

2.3 OPCS 1989-based population projections

OPCS forecast (*OPCS*, 1991) that the resident population of Yorkshire and Humberside would reach 5.05 million by 2001 (an increase of 1.8% from 1991), and would grow at a slower rate (0.5%) over the following decade, giving a total of 5.07 million by 2011 (Table 3). These figures conceal considerable variation between counties. North Yorkshire is predicted to display the fastest growth, increasing by 6.8% by 2001, and a further 3.3% by 2011. Continued growth over the two decades is also forecast for West Yorkshire, with increases of 1.3% and 0.6% respectively, although Kirklees and Leeds are forecast to experience population decline. In contrast, Humberside is seen as increasing by 1.7% to 2001, before a marginal decline of 0.1% between 2001 and 2011, while South Yorkshire shows continued gradual decline, by 0.1% and 0.9% for the two decades, due primarily to Sheffield's continued decline by 2.4% in both decades.

Table 3: 1989-based population projections by local authority area, 1991-2001

	1989	1991	1996	2001	2006	2011	1991-2001 (%)	2001-2011 (%)
			(Thousands)					
Bradford	467.7	470.6	479.6	488.6	495.9	502.6	3.8	2.9
Calderdale	197.4	198.8	202.0	205.0	207.6	209.9	3.1	2.4
Kirklees	375.6	374.9	373.8	372.7	370.7	368.6	-0.6	-1.1
Leeds	711.7	711.3	710.9	711.2	709.8	707.4	-0.0	-0.5
Wakefield	314.2	315.2	317.9	319.7	320.3	320.5	1.4	0.3
West Yorkshire	2066.6	2070.8	2084.2	2097.2	2104.3	2109.0	1.3	0.6
Barnsley	221.7	222.0	222.8	222.9	222.4	221.6	0.4	-0.6
Doncaster	293.3	294.9	298.7	301.4	303.0	304.2	2.2	0.9
Rotherham	253.6	254.7	252.5	259.1	259.3	258.9	1.7	-0.1
Sheffield	526.6	523.0	515.9	510.4	504.5	498.4	-2.4	-2.4
South Yorkshire	1295.2	1294.6	1294.8	1293.8	1289.2	1283.2	-0.1	-0.9
Humberside	856.3	860.9	869.9	875.2	876.0	874.1	1.7	-0.1
North Yorkshire	722.3	732.8	759.3	782.3	798.1	808.1	6.8	3.3
Yorkshire & Humbs	4940.3	4959.0	5008.2	5048.4	5067.6	5074.3	1.8	0.5

Source: DOE (Regional Office) Computer printout of 1989-based projections

Time series indices can be used to indicate the relative magnitude of changes that are projected to take place in the age structure of male and female populations from 1989. The trend over time in each of the four counties (Figure 3) is for the 0-16 age group to increase

from its 1989 base to a peak and then decline. Significant declines are projected to take place in the younger working age populations in all areas with upturns occurring after 2001. In contrast, considerable gains in populations aged 29-59 are projected in all counties by 2001. The most variation between local authorities and between males and females is projected to occur in the 60+ age group. North Yorkshire is set to experience a major expansion of its elderly male and female populations by 2011 whereas the metropolitan counties are projected to sustain increases in their male populations but declines in their female populations over the 20 year projection period.

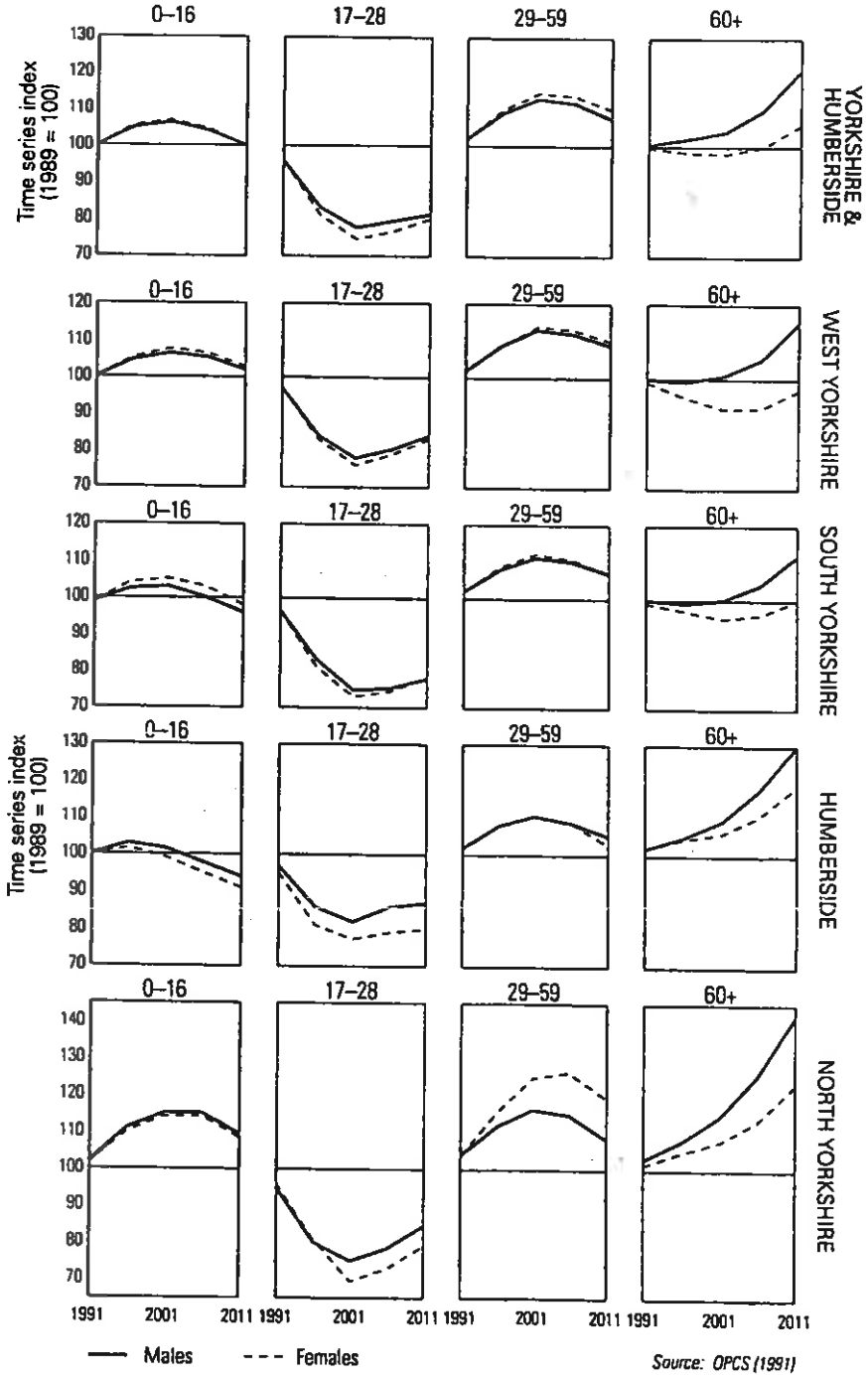


Figure 3: Population projections by county, time series indices by gender and age group, 1991-2011

2.4 1989-based household projections to 2011

DoE projections (*DoE*, 1991) indicate that, in response to changing demographic and social factors, the number of households within the region should increase at a much more rapid rate than the population, and that this pattern is repeated in all local authority areas (Table 4). Thus, South Yorkshire is forecast to have an additional 5.2% of households by 2001, and a further 3.7% by 2011, in spite of population decline. Areas of population increase show commensurately larger household increases. Hence, the growth rate in North Yorkshire is predicted to be 12.7% between 1991 and 2001, and 8.5% over the following decade, while West Yorkshire has figures of 6% and 4.8%, and Humberside 7.9% and 5.7% respectively.

Table 4: 1989-based household projections by local authority area, 1989-2011

	1989	1991	1996	2001	2006	2011	1991-2001	2001-2011
Bradford	179	183	191	199	206	213	8.7	7.0
Calderdale	79	80	83	85	88	90	6.3	5.9
Kirklees	149	150	154	157	159	162	4.7	3.2
Leeds	289	293	302	308	313	319	5.1	3.6
Wakefield	123	125	129	133	136	140	6.4	5.3
West Yorkshire	819	831	859	881	902	923	6.0	4.8
Barnsley	86	87	89	91	93	95	4.6	4.4
Doncaster	112	114	119	123	127	130	7.9	5.7
Rotherham	97	99	103	106	109	112	7.0	5.7
Sheffield	217	219	223	225	227	230	2.7	2.2
South Yorkshire	512	519	534	546	555	566	5.2	3.7
Humberside	332	340	355	367	378	388	7.9	5.7
North Yorkshire	283	292	313	329	343	357	12.7	8.5
Yorkshire & Humberside	1947	1982	2067	2123	2178	2234	7.1	5.2

Source: DoE (1991)

The immediate reason for this faster rate of household growth may be found in the changes in marital status factors and headship rates assumed in the projections. These reflect the prediction that current trends towards lower marriage and remarriage rates, and increasing divorce rates will continue, resulting in a greater number of households emanating from a similar population base. However, the fact that these 1989-based projections rely on the 1981 Census as their principal base, especially in computing assumptions for individual local authority areas, places their accuracy in some doubt.

3. DERIVING ALTERNATIVE POPULATION PROJECTIONS

Most local authorities in Yorkshire and Humberside do not accept the 'official' OPCS/DoE projections. The results of a consultation exercise with each local authority indicated that most were concerned with the base population estimates for the 1989-based projections and the with the net migration assumptions. Consequently, two analyses to compare the projections/assumptions against observed data were undertaken and a methodology derived to adjust the 'official' projections to take into account recent change.

3.1 Evaluation of 1989-based population projections for mid-1991

An assessment of the 1989-based population projections can be made by comparing the projections for mid-1991 with the revised final mid-1991 population estimates for mid-1991 (*OPCS*, 1993). The comparison reveals considerable inconsistency. At the county scale, the mid-1991 population estimates for Humberside, West Yorkshire and South Yorkshire were lower than the 1989-based projections by 16,400 (or 1.9%), 13,700 (or 0.6%) and 7,300 (or 0.6%) respectively. In contrast, the population estimate for North Yorkshire increases the discrepancy, with 13,600 fewer than expected. Overall this gives a total underprojection for Yorkshire and Humberside of 23,800 (or 0.5%).

Moreover, these aggregate differences conceal variations by age group and by gender in each local authority area. Two local authorities are selected to exemplify. The aggregate discrepancy in Sheffield (Figure 4), for example, is accounted for by particularly severe underprojection in the 20-24 year age group whereas in North Yorkshire (Figure 5), overprojection is apparent in the 0-9 and 15-39 age ranges, with underprojection for all other groups.

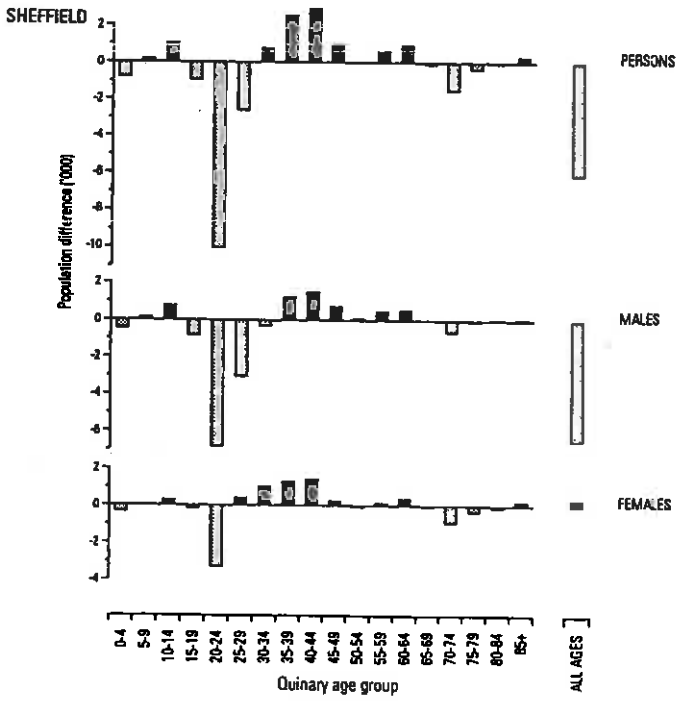


Figure 4: Differences between the 1989-based projections for mid-1991 and the population estimates for mid-1991 for Sheffield

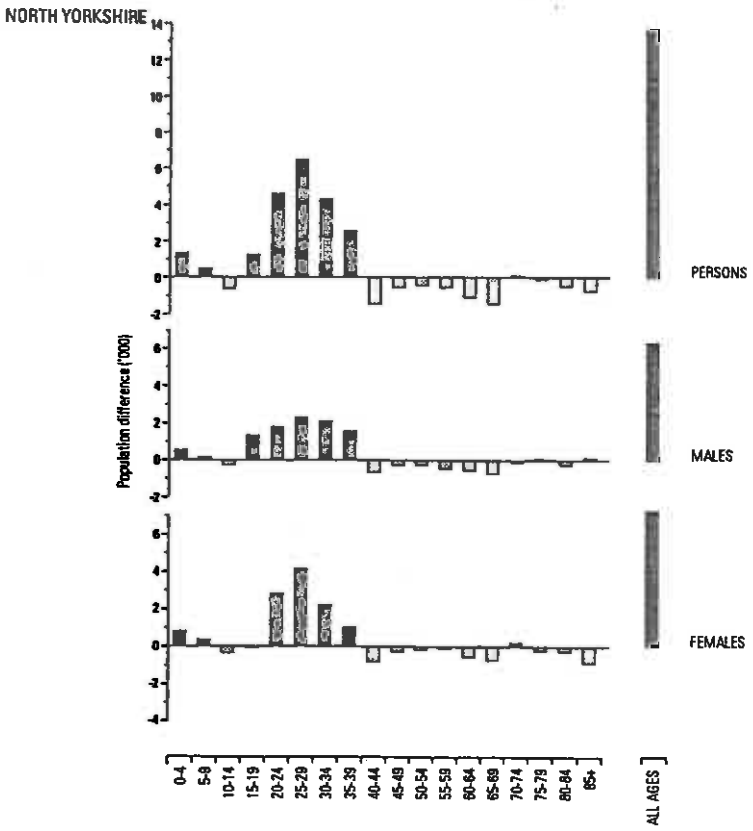


Figure 5: Differences between the 1989-based projections for mid-1991 and the population estimates for mid-1991 for North Yorkshire

The explanation of these differences and those observed in other local authorities lies in a combination of factors, including fluctuations in births, deaths and migrations between 1989 and 1991, but also inadequacies in the measurement of student and military populations which lead to errors in the 1989 base populations used in the projection exercise. In the case of Sheffield, underprojection in the 20-24 age group is likely to be due to the underprojection of students in the base population. The 1981 census recorded students at their home address. OPCS includes students within the cohort that is rolled forward from 1981 to produce the 1989-base. Students are therefore assumed to remain in the population and to behave demographically in a manner equivalent to the rest of the population. This is likely to cause the overprojection identified in the 30-44 age range in Sheffield. In contrast, the overprojection in North Yorkshire is likely to be related to the rolling forward of a mid-1981 population containing around 500 military personnel and their dependants returning from Germany who were counted by the 1981 Census. It has been assumed that these people have remained in the population since then.

3.2 Migration assumptions

One of the most contentious issues for local authorities relating to the 1989-based population projections has been the assumptions about net migration between each local authority area and the rest of England. This is the component of the projections upon which local authorities are formally asked to comment by the DoE as part of the projection procedure. Data from the National Health Service Central Register (NHSCR) provides some valuable

insights into recent trends in net movements of the population. The characteristics and shortcomings of the NHSCR data have been outlined in Stillwell, Rees and Boden (1992).

Comparison of recorded NHSCR net movements with net migration assumptions for mid-1989 to mid-1992 indicates that, with the exception of Rotherham, the official net migration assumptions indicate larger net losses than those observed in all metropolitan districts, whereas assumed net gains in the two shire counties are greater than actual net gains (Table 5). In absolute terms, the differences are most noticeable for Leeds and Sheffield.

Table 5: Differences between recorded NHSCR net movements and 1989-based net migration assumptions by local authority area for 1989-92

	1989-92 net migration		Observed - projected net migration	
	Observed(i)	Projected(ii)	Out	In
Bradford	-2349	-4800	-2451	
Calderdale	-654	-1500	-846	
Kirklees	-2028	-3150	-1122	
Leeds	-3969	-9450	-5481	
Wakefield	136	-1950	-2086	
Barnsley	-123	-600	-477	
Doncaster	-170	-2100	-1930	
Rotherham	-1033	-900	133	
Sheffield	-2402	-6150	-3748	
Humberside	4318	4800		-482
North Yorkshire	11777	12750		-973

Notes:
(i) NHSCR net migration with rest of England for the period mid-1989 to mid-1992
(ii) 1989-based assumptions of net-migration with rest of England for the period mid-1989 to mid-1992

Sources: NHS Central Register; DoE (Regional Office) Computer printout of 1989-based projections

Why should these differences arise? Construction of net migration time series balances for the local authorities using NHSCR data indicates that changes have occurred between the mid

1980s and the late 1980s/early 1990s in net migration with the rest of England. The result has been quite a dramatic change of fortune for the region as a whole (Figure 6) as several of the metropolitan districts in the region shifted from being net losers to gainers of population and as Humberside experienced net in-migration after a decade of net migration loss.

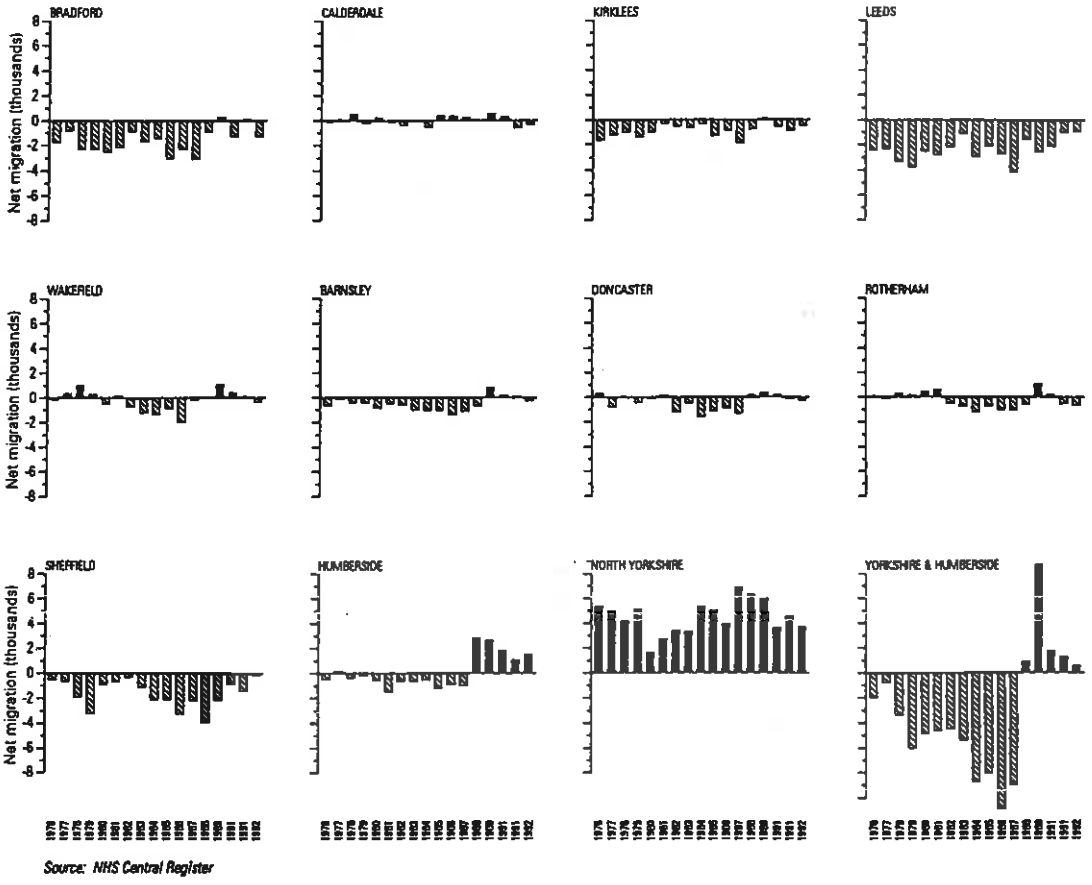
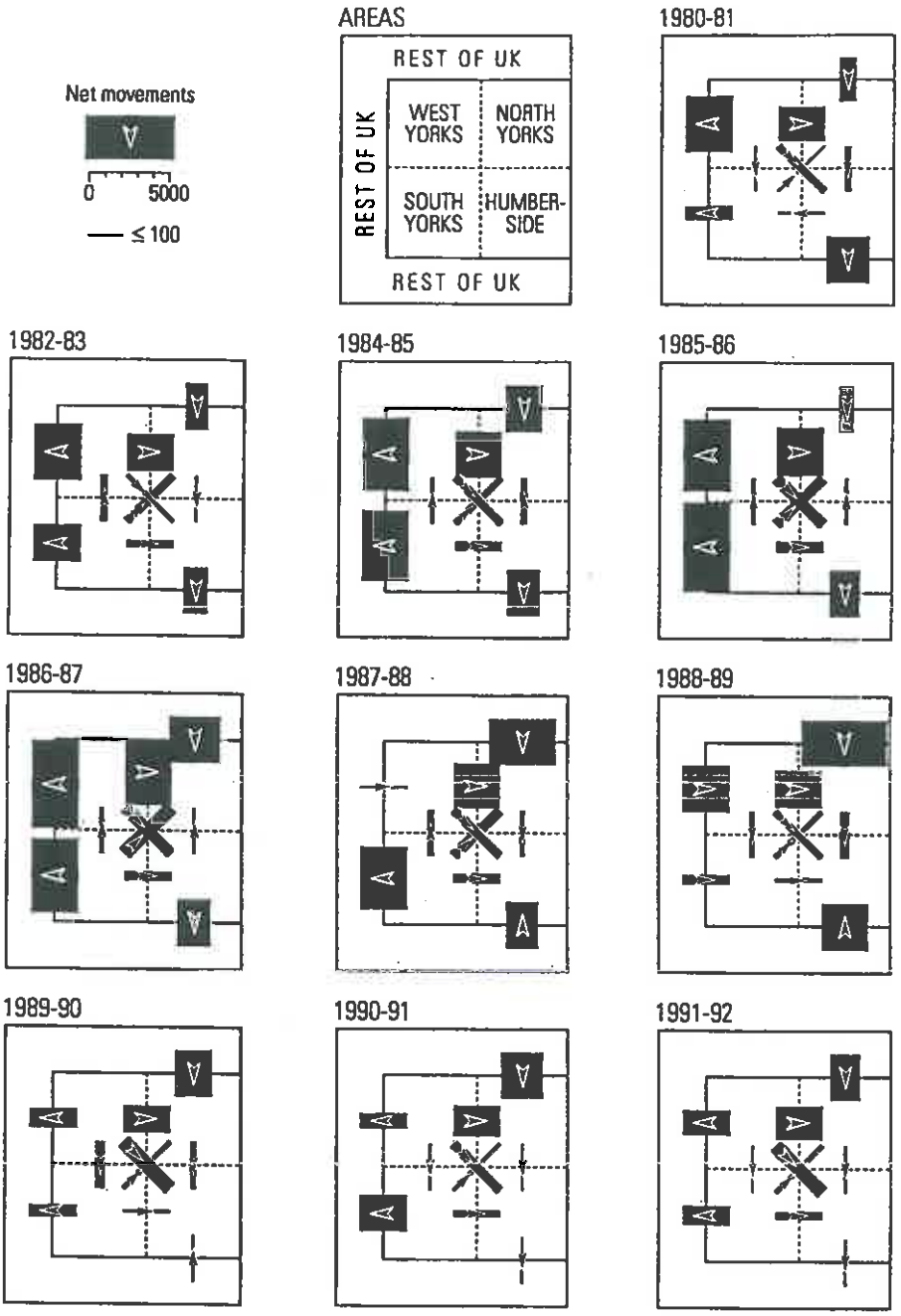


Figure 6: Net migration by local authority area, 1975-91

The volatility of net migration trends over time, as exemplified by directional flows for each year from 1980-81 to 1991-92 at the county scale (Figure 7), renders migration projection far from straightforward and suggests that it makes sense to generate sets of projections using different scenarios of net migration.



Source: NHS Central Register

Figure 7: Directional net migration by county, 1981-92

3.3 An adjustment methodology

The results of the comparisons of poulation and migration reported in the previous sections have implications for future totals of population in the region. The preferred solution for evaluating the effects of different base populations and net migration assumptions on population projections is through the use of a multi-regional population projection model. Since this approach was ruled out on grounds of time and resource constraints, an ad hoc solution was developed which involved adjusting the original projections in two stages:

* application of revised population base factors (mid-1991 estimate divided by mid-1991 projection) to existing projections for 2001 and 2006 by age and gender, assuming that the error in the population base remains constant over the period;

* adjustment of the net migration assumptions as follows:

  (i) sum the all age net migration assumptions for males and females for individual years over the projection period;

  (ii) sum the recorded NHSCR net migration balances over the first three years of the projection period, 1989-92;

  (iii) Recalculate net migration assumptions for the remaining years of the projection period (1992-2001 and 1992-2006) using three assumptions based on averaged data from:

  * the last three years of the net migration time series, 1989-92;

  * the last five years of the net migration time series, 1987-92; and

  * the last ten years of the net migration time series, 1982-92.

  These three sets of assumptions allow three alternative scenarios to be incorporated, thus representing a range of possible futures.

  (iv) Subtract the new revised migration assumptions from the original assumptions to give a set of all age adjustments to the population totals in 2001 and 2006. These are first disaggregated into males and females using the sex ratio evident from the NHSCR in-migration totals for 1990-91 and distributed into quinary age groups using the same data but adjusted to take the direction and size of net migration into account.

3.4 Alternative population projections

Alternative sets of population projections have been computed for 2001 and 2006 using this methodology. Five sets of projections for 2001 are presented in Table 6 for illustration. The first set is the official 1989-based projections which are used as the benchmark against which to compare new projections. The second set of projections is that which adopts official net migration assumptions but adjusts for the population base errors. The effect of applying the population base adjustment factors is to increase the region's population by around 15,000.

Table 6: Alternative population projections by local authority area, 2001

	1989-based projection	Adjusted projection	A	B	C
Bradford	488588	492206	503110	504847	497503
Calderdale	205043	200246	203629	205348	205898
Kirklees	372658	378975	381412	382529	380405
Leeds	711198	711962	730716	727995	723659
Wakefield	319693	320563	328253	329991	323987
West Yorkshire	2097180	2103952	2147120	2150710	2131452
Barnsley	222942	225072	226280	226613	221654
Doncaster	301374	300255	307972	308827	303670
Rotherham	259070	259289	258760	260852	255777
Sheffield	510386	511430	522168	514320	511792
South Yorkshire	1293772	1296046	1315180	1310612	1292893
Humberside	875173	891185	884654	889217	876580
North Yorkshire	782315	771953	768115	775799	776081
Yorkshire & Humberside	5048440	5063136	5115069	5126338	5077006

Notes:

(i) Adjusted projection calculated by applying adjustment factors derived from comparison between 1989-based projections for 1991 and rebased mid-1991 estimates

(ii) Projection A calculated from adjusted population base revised with reference to last three years' net migration differences

(iii) Projection B calculated from adjusted population base revised with reference to last five years' net migration differences

(iv) Projection C calculated from adjusted population base revised with reference to last ten years' net migration differences

The three remaining sets (A,B,C) are those which adjust for the revised population base and assume different net migration adjustments. Under each set of projections, the region's population is shown to be higher than the 'official' projection. The difference is a much as 78,000 under the five year migration scenario and 28,500 under the ten year migration scenario. The medium term net migration adjustments generate higher populations than those using the short term trends because the former include the exceptional net migration figures for 1988-89. Conversely, the long term adjustment results in a lower figure because it balances these more recent gains with the net migration losses of the early 1980s. West Yorkshire is projected to have a higher population under all three migration scenarios whilst North Yorkshire has a lower total in each case. The populations of South Yorkshire and Humberside are projected to be higher than the 'official' 1989-based projections under the

short and medium term net migration scenarios, but lower when the 10 year net migration assumption is used. Selection of the long term migration scenario would mean that the populations of West Yorkshire and Humberside would be 1.6% and 0.2% above the 'official' projections for 2001, whereas the populations of South Yorkshire and North Yorkshire would be 0.07% and 0.8% below the OPCS figures.

4. DERIVING ALTERNATIVE HOUSEHOLD PROJECTIONS

4.1 Conversion from populations to households

In order to consider housing land requirements, local authorities require projections of households which are conventionally derived by applying marital status factors and headship rates to projections of the private household population (Capron and Corner, 1990). The methodology used to derive a revised set of household projections involved three stages:

* subtraction of the institutional populations from the total population to produce a private household population for each quinary age group and sex;

* application of marital status factors - the proportions of a given population group that are single, married and widowed or divorced - to male and female populations by quinary age group; and

* application of headship rates - the proportion of members of a population group defined by age, sex and marital status that are heads of specific types of households - to corresponding population groups.

The first step in the conversion methodology involves the projection of institutional and student populations for local authority areas. These have to be subtracted from the projected population base in order to apply marital status factors and headship rates to the remaining populations. Separate projections of student households are then added back into the household projections at a later stage.

The procedure adopted to estimate the institutional populations was based on the assumption that the proportion of people living in medical and care establishments, defence establishments and prisons at Census 1991 will remain constant. However, additional adjustments were included for North Yorkshire on the basis of information provided by the County Council, and in recognition of the area's special position with regard to armed forces personnel.

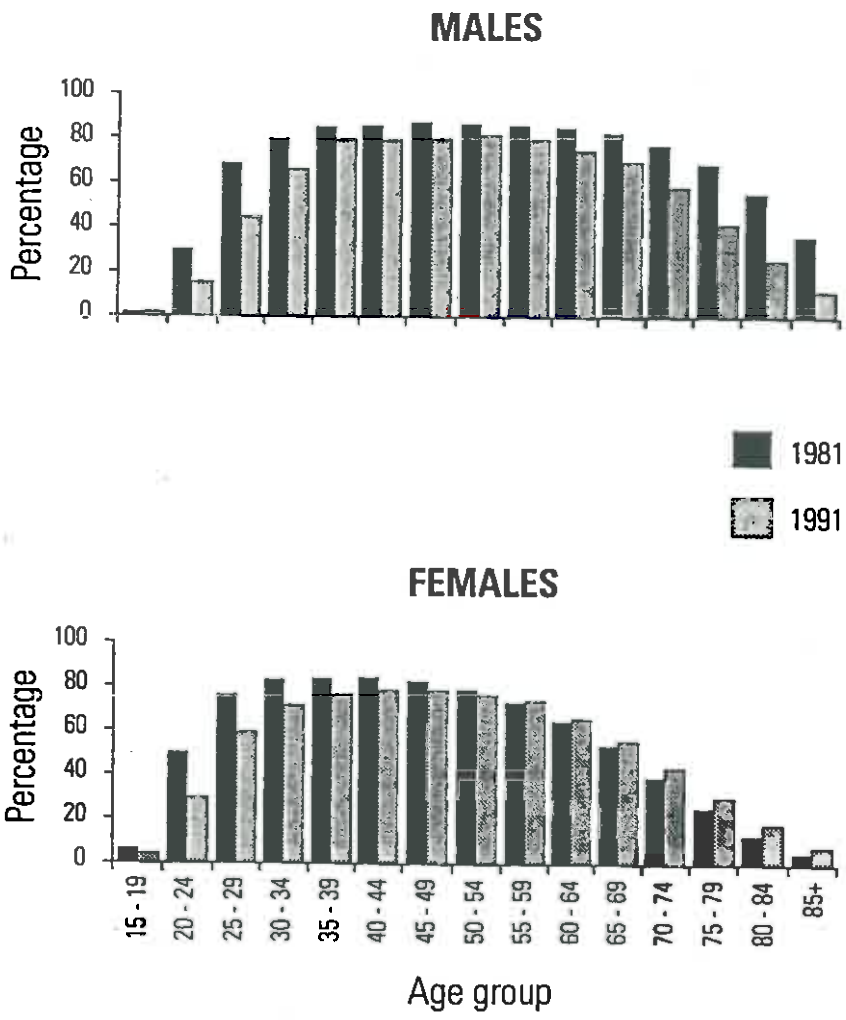
The method of projection of students, outlined in more detail in Gore and Stillwell (1994), was based on a breakdown of the population into imported (those from elsewhere who are studying in the region), exported (those from the region studying elsewhere), locally based (those living and studying in the region) and visiting (those who neither live or study in the region but who happened to be enumerated there on Census night) students, and the application of differing rates of growth to each category. The latter were derived from admission forecasts communicated by several of the higher education institutions in the region. Thus, for example, it was assumed that for the period 1993 to 2006, there would be a steady increase of 2% per year in imported and exported students and a 5% per year increase for

locally based students.

Projections were then made of the likely number of student households that the different categories would be likely to generate, assuming that student household formation remained constant at the levels revealed by the 1991 Census. These projections were subsequently added to the mainstream household projections to give an aggregate total for each local authority area.

4.2 Comparison of marital status factors

One of the most ubiquitous changes during the 1980s in the marital status complexion of the population has been the decline in the proportion of the working population who are married. Figure 8 displays the trends by using Bradford as an example.

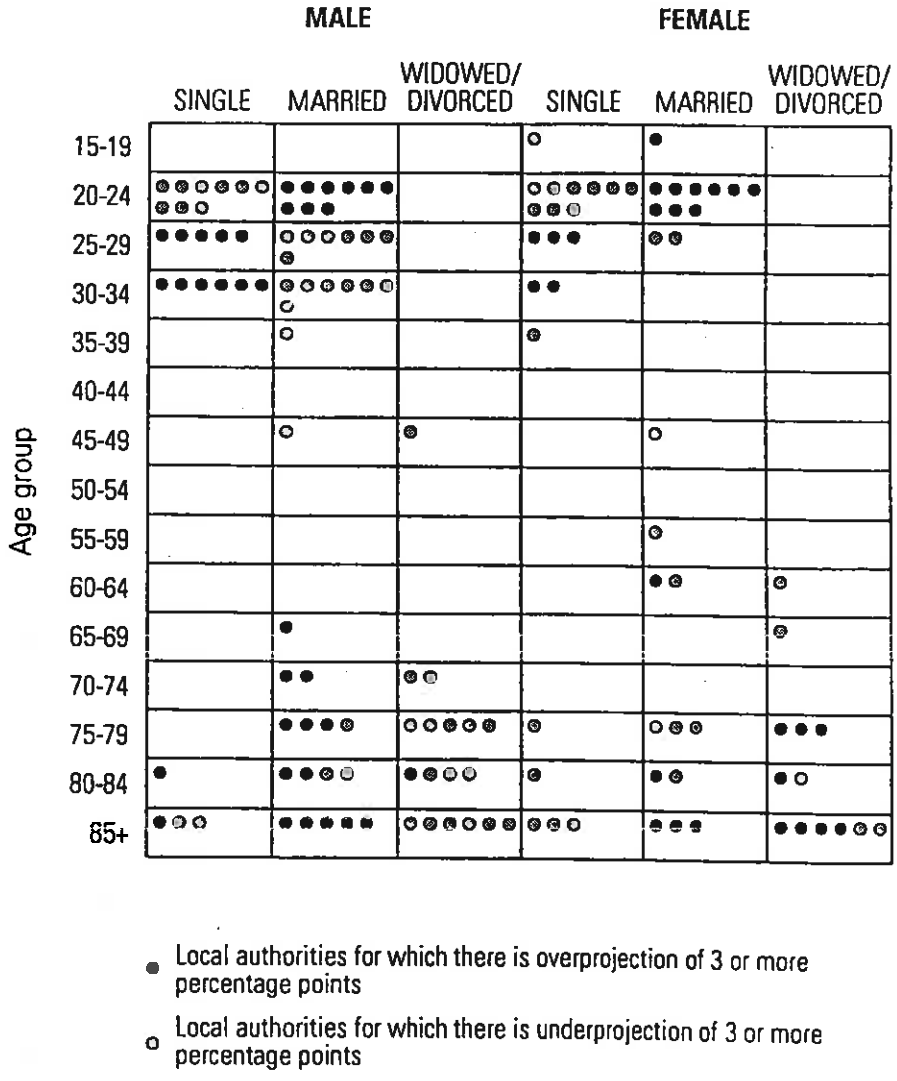


Source: Censuses of Population, 1981, 1991

Figure 8: Percentage of the population married by age and gender, Bradford, 1981 and 1991

Local authorites expressed particular concern about the marital status factors applied to their populations in the OPCS/DoE methodology for generating the 1989-based projections. In

order to examine this issue, marital status factors for 1991 produced by GAD and those derived from the 1991 Census LBS Table L35, were compared. Across all the local authorities, the most significant differences in marital status factors were found in the working age groups 20-24, 25-29, 30-34 and in the elderly age groups 75-79, 80-84 and 85+ (Figure 9). In nine of the local authority areas, for example, the marital status factor for single males aged 20-24 was, according to the Census, over three percentage points higher than that used in the 1989-based projections, whereas single males aged 25-29 and 30-34 were underprojected in seven local authority areas.



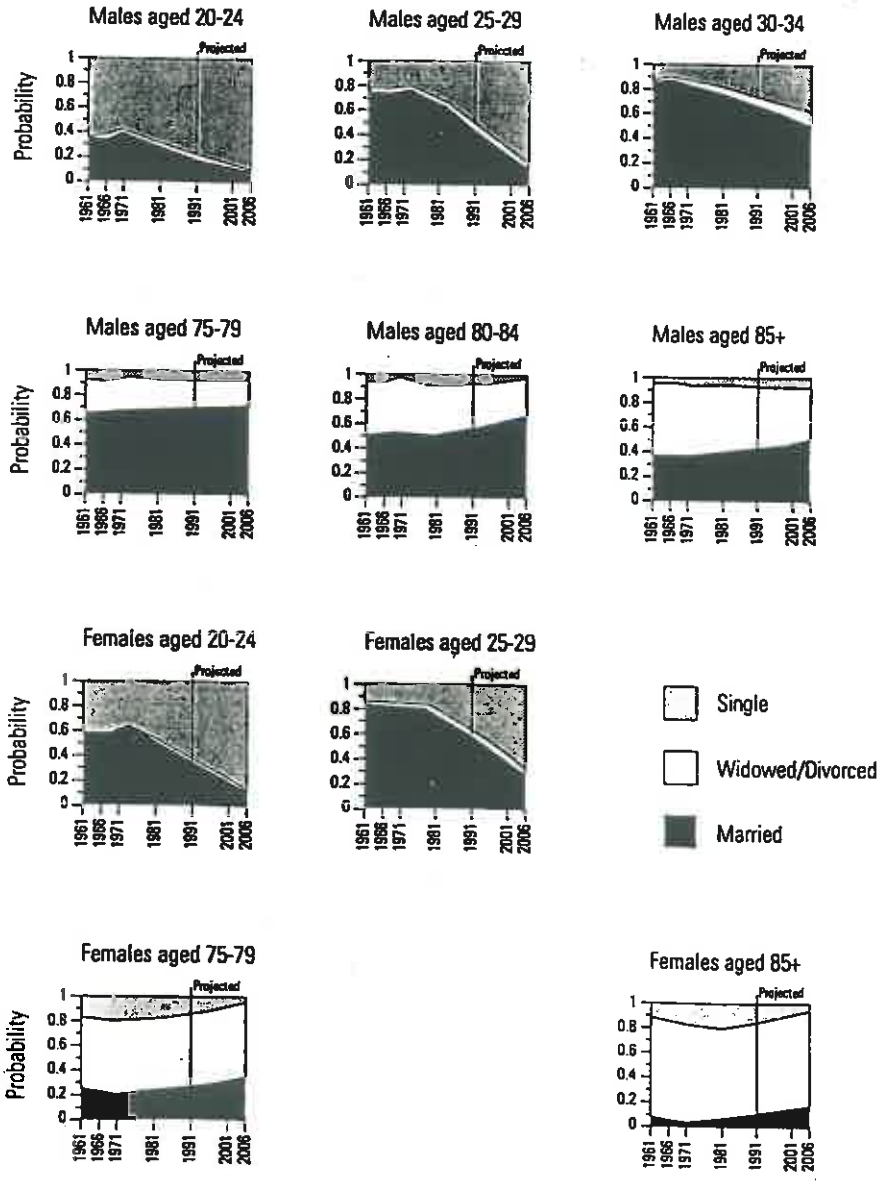
Source: Yorkshire and Humberside Regional Research Observatory (1993)

Figure 9: Comparison of 1991 Census and 1989-based marital status factors for 1991 by age, gender and marital status

The relative convergence between the two sets of marital status factors suggested that while for the most part, existing projected marital status factors could still be used, modifications were required in the following ten key categories: males aged 20-24, 25-29, 30-34, 75-79, 80-84 and 85+; females aged 20-24, 25-29, 75-79 and 85+. Revision of the marital status factors

for the ten categories was therefore undertaken for each local authority area by assembling the time series of factors drawn from the 1961, 1966, 1971 1981 and 1991 Censuses and using an algorithm based on extrapolating the change recorded between 1981 and 1991. To exemplify the methodology, graphs for Bradford are presented in Figure 10.

The trend towards fewer people getting married in their twenties is a combination of two factors: the increase in the number of people getting married later; and the result of more people either staying single or cohabiting with a partner.

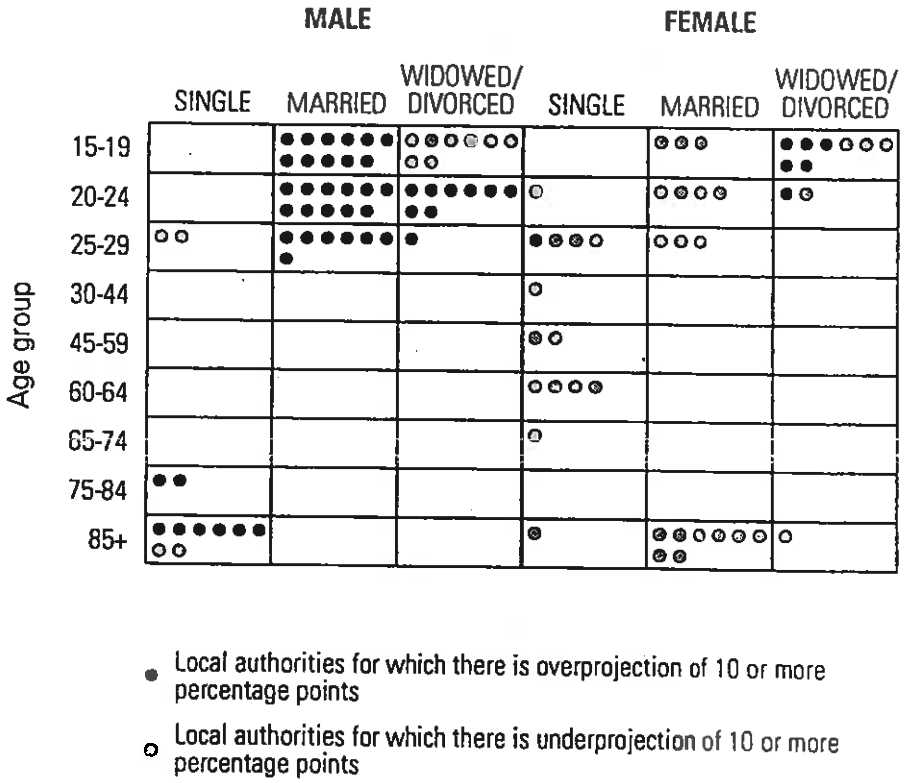


Source: Yorkshire and Humberside Regional Research Observatory (1993)

Figure 10: Marital status factors for Bradford, by selected age and gender groups, 1961-2006

4.3 Comparison of headship rates

A similar comparative analysis was undertaken with respect to headship rates, although the age basis was different because data from the 1991 Census (LBS Table L39) was only available for nine broader age groups. Differences were calculated by subtracting the 1991 Census headship rates fom the 1989-based projected headship rates and then multiplying by 100 to give values in percentage points. A comparison of headship rates showed that differences were more marked and again concentrated in the younger age groups (15-19, 20-24 and 25-29), especially in the married and widowed/divorced categories (Figure 11). With the former, an element of the difference is likely to stem from the different ways in which the projections and the Census treat heads of married households; the self-reporting mechanism of the Census means that there are more female heads in that data set than in the projections.

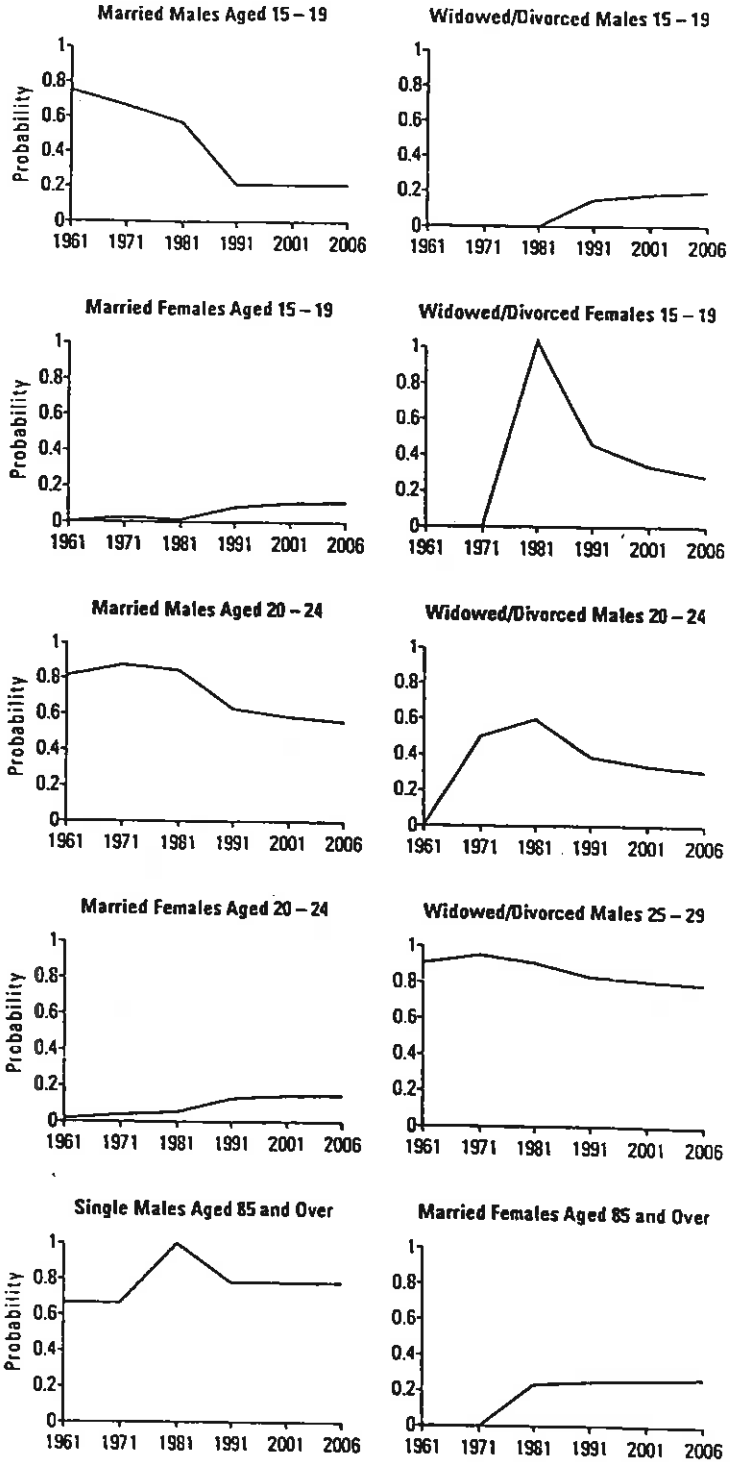


Source: Yorkshire and Humberside Regional Research Observatory (1993)

Figure 11: Comparison of 1991 Census and 1989-based headship rates for 1981 by age, gender and marital status

Revision of the projected headship rates for the ten key categories in each local authority area was made with reference to intercensal change from 1961. Initially, the three absolute variations for the periods 1961-71, 1971-81 and 1981-91 were averaged to give an adjustment to the 1991 Census figures but three constraints were then introduced. First, if the direction of change to 2001 proved to be different from that occurring in 1981-91, only the figure for the latter period was used. Second, if the rate of change appeared to be unacceptably large,

then half the average figure was applied. Third, in cases where extrapolation generated headship rates above 1 or below 0, the 1991 Census figures were maintained through to 2006. Example headship rates for Bradford are illustrated in Figure 12.



Source: Yorkshire and Humberside Regional Research Observatory (1993)

Figure 12: Headship rates for Bradford by age, gender and marital status, 1961-2006

4.4 Alternative household projections

Thus, the methodology employed for handling marital status factor and headship rate projections was to rely on the 1989-based values but to substitute adjusted values for key categories as identified by the comparative analysis. These adjusted values were projected on the basis of trends since 1961 as indicated in the examples for Bradford.

A range of alternative household projections for the local authorities in Yorkshire and Humberside based on the four sets of population projections summarised in Table 6 can therefore be generated. In each case the population aged 15 and over, disaggregated by gender and quinary age group, and minus institutional populations and students, was multiplied by the revised marital status factors and headship rates. The resulting figures in each category were then summed over gender, marital status and age to give totals to which student household projections were subsequently added. The revised household projections are presented in Table 7.

Unlike the population projections, these revised calculations generate marginally smaller numbers for the region than those projected by the DoE methodology. This pattern is repeated for all four counties. There are three main reasons for this paradox. First, the initial adjustments made to the official population projections for 2001 might have altered the age structures in such a way as to lessen the effects of applying marital status factors and headship rates. Secondly, the alternative household projections treated students separately from the rest of the private household population, applying different household formation rates based on the 1991 Census. This is in contrast to the official projections which include students as an integral component of the private household population. Thirdly, the revised marital status factors and headship rates derived from the Census analysis and used in the calculations indicate a slowing down of the trend towards smaller households during the 1990s. Both of the latter changes contributed to an overall reduction in the number of households generated by the alternative population projections. This also implies that, if the official projections had been used, the household numbers would have been reduced even more.

5. CONCLUSIONS

This paper has reported on a research project undertaken for a group of public sector planning authorities by the Yorkshire and Humberside Regional Research Observatory over a three month period. It represents an example of applied research in population geography in action. The projection adjustment methodology had to be derived on the basis of issues considered important by the local authorities concerned and much of the discussion contained in the paper highlights some of the complexities relating to the projection of population and household numbers. Decisions had to be taken in the face of short deadlines to adopt particular estimation methods and there are therefore, inevitably, several ways in which the methodology might have been improved. Moreover, various complementary analyses might have been undertaken.

The research reported in the paper has produced a number interesting findings which can be summarised as follows:

* migration has played an influential role in accounting for the population change

occurring in several local authority areas in the region between 1981 and 1991;

* aggregate population change data mask considerable variation in quinary age group population change;

* all local authority areas have experienced similar trends in the 1980s of increasing numbers of single adult households and declining numbers of 3+ adult households;

* the future growth rates of households to 2006 are projected by OPCS/DoE to be appreciably higher than the rates of growth of population in the region;

Table 7: Alternative household projections for 2001 based on disaggregated assumptions and revised marital status factors and headship rates

	A	B	C	D	1989-based
Bradford	198867	199722	196106	193501	198696
Calderdale	82362	83203	83470	80712	85096
Kirklees	154702	155223	154223	153550	156668
Leeds	307855	306949	304815	299054	308054
Wakefield	133844	134670	131819	130193	133359
West Yorkshire	877630	879767	870433	857010	881873
Barnsley	90172	89324	87063	88621	91176
Doncaster	123112	123500	121194	119601	123238
Rotherham	101934	102907	100546	102180	105801
Sheffield	222588	218780	217554	217378	225362
South Yorkshire	537806	534511	526357	527780	545577
Humberside	358946	361083	355168	362005	366956
North Yorkshire	315607	319169	319297	317385	329236
Yorkshire & Humberside	2089989	2094530	2071255	2064180	2123642

Notes:

(i) Projections A, B, C and D calculated by use of revised marital status factors and headship rates for population over 15 (excluding institutional population) by quinary age group, with students treated separately

(ii) Projection A calculated from population base revised with reference to last three years' net migration differences

(iii) Projection B calculated from population base revised with reference to last five years' net migration differences

(iv) Projection C calculated from population base revised with reference to last ten years' net migration differences

(v) Projection D calculated from adjusted population base

* comparison the 1989-based population projections with population estimates for mid-1991 provides evidence to suggest that, in certain local authority areas, the 1989 base populations used in the projections were inaccurate;

* comparison of net migration asumptions with observed NHSCR patient transfers for 1989-92 indicates that net out-migration has been overprojected by OPCS/DoE in all but one of the metropolitan districts whereas net in-migration has been underprojected in the two shire counties;

* time series NHSCR data reveals a dramatic reversal in the regional net migration pattern between 1987 and 1989, and fluctuating migration balances between counties and with the rest of the UK during the 1980s and early 1990s;

* a methodology of adjusting 'official' population projections on the basis of alternative net migration scenarios results in a set of alternative projections, all of which suggest that OPCS projections for 2001 for the region as a whole are too low;

* comparison of projected and Census marital status factors indicated most inconsistency in the 20-34 age range for single and married people, especially males, and for married and widowed/divorced aged over 75 years;

* comparison of projected and Census headship rates indicated that major differences were concentrated in the younger ages (15-29 years), especially in married and widowed/divorced categories;

* the production of revised sets of household projections, achieved by applying adjusted sets of marital status factors and headship rates to revised sets of population projections less projections of institutional populations, suggested that the DoE projections of households for Yorkshire and Humberside in 2001 were too high.

Responsibility for the conversion of the alternative household projections into dwelling requirements was left to the constituent members of the Yorkshire and Humberside Regional Planning Conference, the local planning authorities themselves. Clearly the alternative projections would have acted as only one of many inputs into these calculations and into the political processes involved. However, the provision of overall household projections inevitably constrains the nature of dwelling requirement calculations to global totals for each local authority area. Unfortunately, disaggregation into different household types, and hence assessment of the requirement for different types of dwelling, are not feasible using the approach adopted.

The need to incorporate such increased sophistication, along with many of the other problems encountered and issues raised in the paper, point to the need for a comprehensive, local authority area-based population and household projection model for the region. Not only might a model-based demographic information and projection system provide local planning authorities in Yorkshire and Humberside with a valuable up-to-date source of demographic data, but it would also enable the testing of a variety of projection scenarios based on different combinations of assumptions relating to the components of population change and the mechanisms involved in household formation.

References

Department of the Environment (1991) *Household Projections England 1989-2011: 1989-based Estimates of the Numbers of Households for Regions, Counties, Metropolitan Districts and London Boroughs*, DoE, London.

Department of the Environment (1992) *PPG 12 Development Plans and Regional Planning Guidance*, DoE, London.

Capron, D. and Corner, I. (1990) Subnational population and household projections by Central Government, in *OPCS Occasional Paper 38*, BSPS Conference Papers 1990 Population projections: trends, methods, uses, HMSO, London, pp 55-63.

Gore, A. and Stillwell, J.C.H. (1994) Yorkshire and Humberside household composition and projections to 2006, *Working Paper 94/1*, Yorkshire and Humberside Regional Research Observatory, Leeds.

Office of Population Censuses and Surveys (1991) Sub-national Population Projections : Population Projections by Sex and Age for Standard Regions, Counties, London Boroughs, Metropolitan Districts and Regional and District Health Authorities of England from mid-1989, *Series PP3 No.8,* HMSO, London

Office of Population Censuses and Surveys (1993) Revised Final mid-1991 Population Estimates for England and Wales and Constituent Local and Health Authorities, *OPCS Monitor PP1 93/2,* HMSO, London.

Stillwell, J.C.H., Rees, P.H. and Boden, P. (eds) (1992) *Migration Processes and Patterns Volume 2 Population Redistribution in the United Kingdom*, Belhaven Press, London.

Stillwell, J.C.H. and Gore, T. (1993) Yorkshire and Humberside mid-year population estimates and projections to 2006, *Working Paper 93/4*, Yorkshire and Humberside Regional Research Observatory, Leeds.

Yorkshire and Humberside Regional Planning Conference (1993) *Advice to the Secretary of State for the Environment on Regional Planning Guidance for Yorkshire and Humberside,* Consultation Draft, YHRPC, Beverley, Humberside

Yorkshire and Humberside Regional Research Observatory (1993) *An Analysis of the Implications of the 1991 Census for Population and Household Projections in Yorkshire and Humberside*, ReRO, Leeds.

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