

## Incorporating Survey Data in Household Projections

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### 1. Background

- 1.1 Household projections are based on the most recent population projections produced by the General Register Office for Scotland (GROS). The number of people living in private households is then estimated by taking the population projections for each year and subtracting the number of people living in communal establishments.
- 1.2 To estimate the number of households of each type, information on household type and age group is extracted from the 1991 and 2001 Censuses. The proportion of people who head particular household types within any particular age group and local authority area is known as the ‘headship’ rate and this rate is projected forward. We also know the number of people in each area and age group who are not the head of household, for which ‘non-headship’ rates are calculated. The headship and non-headship rates are then applied to the private population projections to give the household projections.
- 1.3 Because the overall projections for Scotland are believed to be more accurate than those for individual local authorities, the local authority figures are constrained to the Scottish total. In addition, household projections are also adjusted to match the latest household estimates based on Council Tax data.
- 1.4 A problem with this approach is that it is reliant on Census data, which is only available every ten years. For the 2008-based household projections, figures up to 2033 were projected forward, based on information on the composition of households from the 1991 and 2001 Censuses. The 2008-based population projections were used and were constrained to the latest household estimates but this is an overall figure of the total number of households in each Local Authority, and does not include any information on household type. Trends in household formation may have changed since the last Census, but using our current methodology, this will not be included in our household projections until after the 2011 Census. It may improve the projections if we were able to incorporate more up-to-date information on household type, between Censuses.

**Note:** HARG members are asked to comment on the analysis presented here and consider whether it is appropriate to make adjustments to the household projections using survey data.

## 2. Survey Data

The most likely option for updating household information between Censuses is to use surveys. Unlike the Census, surveys only cover a sample of the population but are carried out every year (or on a rolling basis), so they can provide more up-to-date overall figures. As a minimum they may ask about the number of people in the household by age and gender which is all the information we need to determine household type. The following are two of the surveys that were considered.

### 2.1 The Scottish Household Survey (SHS)

<http://www.scotland.gov.uk/Topics/Statistics/16002>

The SHS covers around 15,000 households per year, approximately 0.7% of households in Scotland. The structure of the survey is a continuous cross-sectional survey, each complete sample being covered in the course of two years. The sample is drawn from the small user file of the Postcode Address File (PAF). The survey uses a random sample where fieldwork conditions allow, namely in areas of high population and clusters interviews in the remaining areas (also on a random basis).

Data is available for 1991 to 2009.

### 2.2 Labour Force (LFS) and Annual Population Surveys (APS)

<http://www.scotland.gov.uk/Publications/2008/06/25095306/0>

The APS is a UK-wide survey. It is a modular survey, which incorporates what was known as the Labour Force Survey (LFS). From March 2003, the APS sample in Scotland was boosted from 8,000 households to around 23,000. The APS data are based on calendar quarters and are published quarterly on a rolling annual basis.

Data are currently available from the LFS for years 1999–2003 and then from the APS for years 2004–2008. Due to the change in sample size there is a discontinuity between LFS and APS survey data between 2003 and 2004.

### 2.3 Calibrating Survey Data

Unlike the Census, surveys are voluntary so they are affected by under and over counting. For instance, young men are less likely to be included and older couples are more likely to be included. Scottish Household Survey (SHS) data provided to us (and published by the SHS team) is not adjusted to account for this. Therefore we have modified SHS figures by comparing the 2001 SHS figures with the 2001 Census proportions and adjusting accordingly for future years.

APS results are adjusted to account for under and over counting. Data are calibrated to correct for non-response at local authority level, and by age group and gender.

Go to the section on Methodological developments, page 2 in the Office for National Statistics (ONS) publication “Labour Force Survey: reweighting and seasonal adjustment review 2008”

[http://www.statistics.gov.uk/elmr/06\\_08/downloads/ELMR\\_Jun08\\_Palmer.pdf](http://www.statistics.gov.uk/elmr/06_08/downloads/ELMR_Jun08_Palmer.pdf)

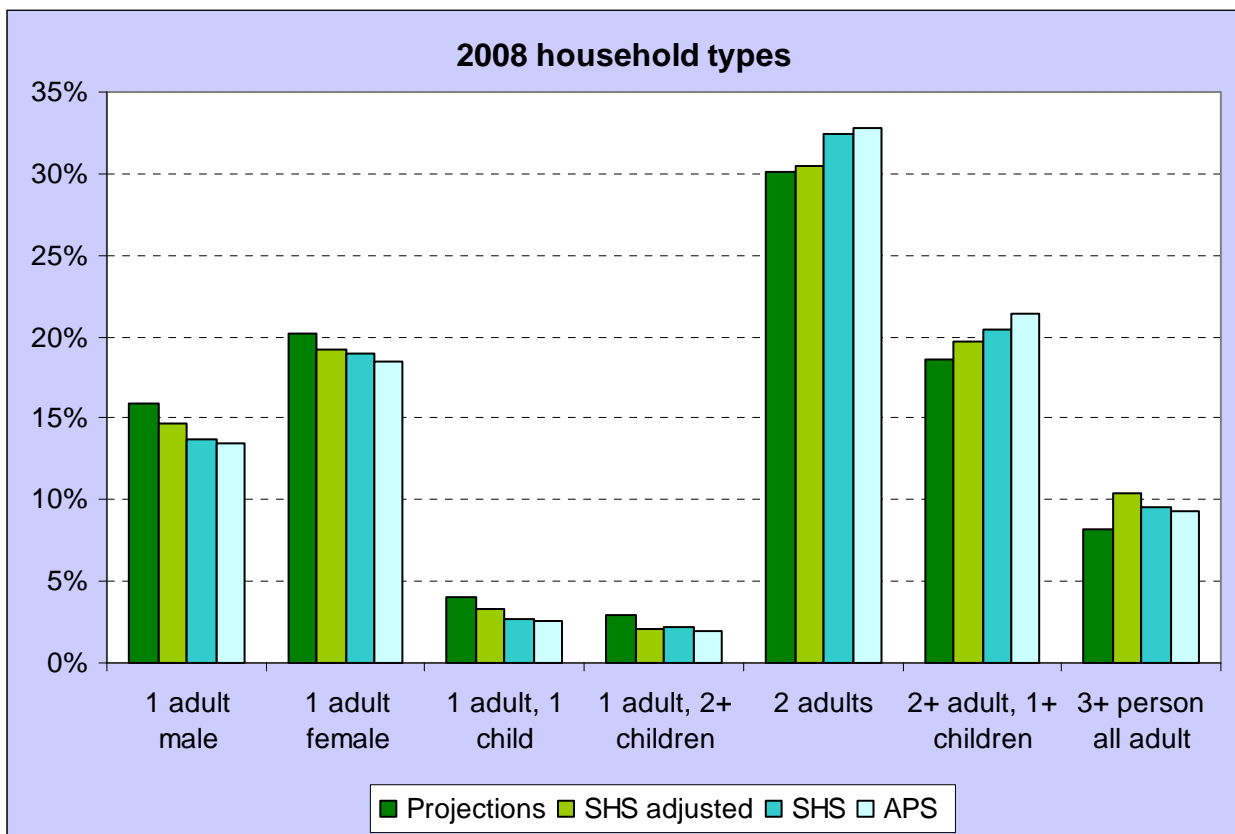
However there is a discontinuity from LFS to APS data between 2003 and 2004 and so it is not possible to calibrate APS data to 2001 Census proportions.

### 3. Comparing survey data to household projections for 2008

3.1 The following chart compares proportions of household types in 2008 from both survey data and projected census data.

An explanation of the different bars in the chart is given here along with approximate sample sizes.

- Projections - the projected proportions of household types from the 1991 and 2001 census points. (~ 5 million population)
- SHS - Scottish Household Survey (~15,000)
- SHS adjusted - The Scottish Household Survey adjusted to the 2001 census.
- APS – Annual Population Survey (~23,000)



3.2 Both SHS and APS survey data suggest that for 2008 there are lower proportions of single adult households (with or without children) than projections data. Conversely survey data suggest higher proportions of multi adult households (with or without children) compared to projections data.

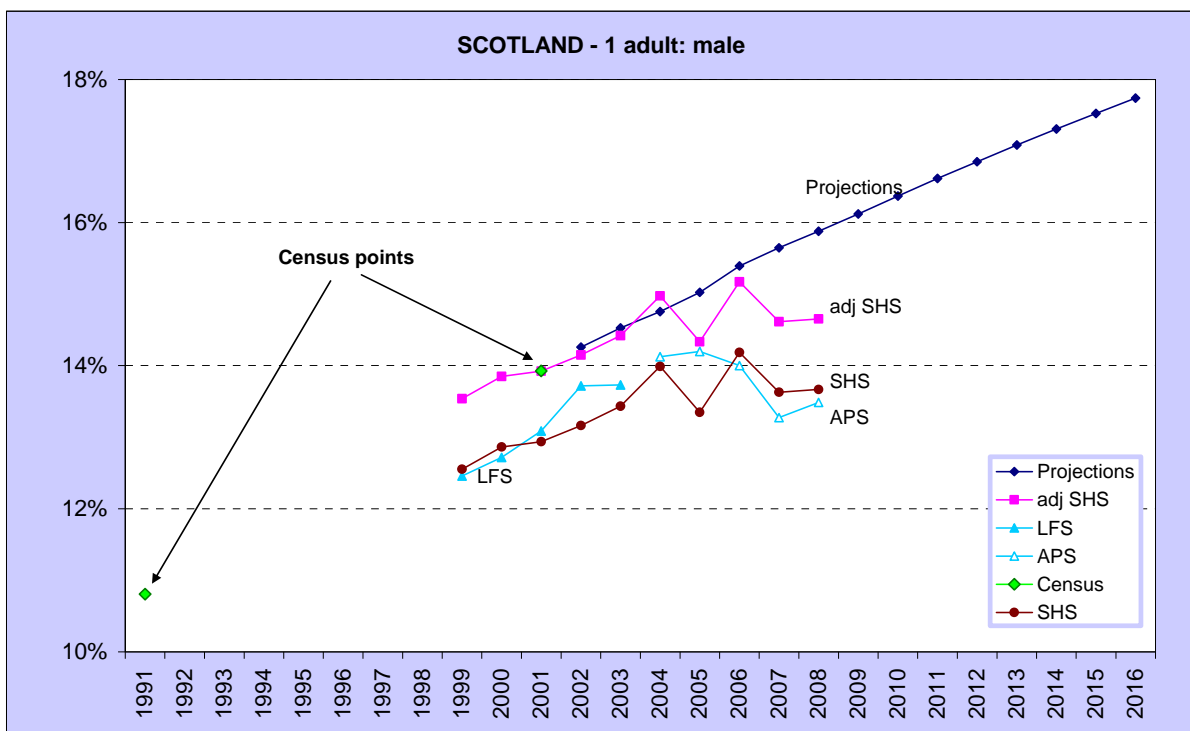
3.3 Perhaps we should not read too much into the smaller proportions that survey data give for single males, because it has been acknowledged that this group are traditionally undercounted in surveys. However, an attempt has been made to adjust for under/over counts by comparing SHS data with 2001 census data and scaling to household estimate totals. The adjusted SHS data still suggests lower proportions of single adult households than projected census proportions.

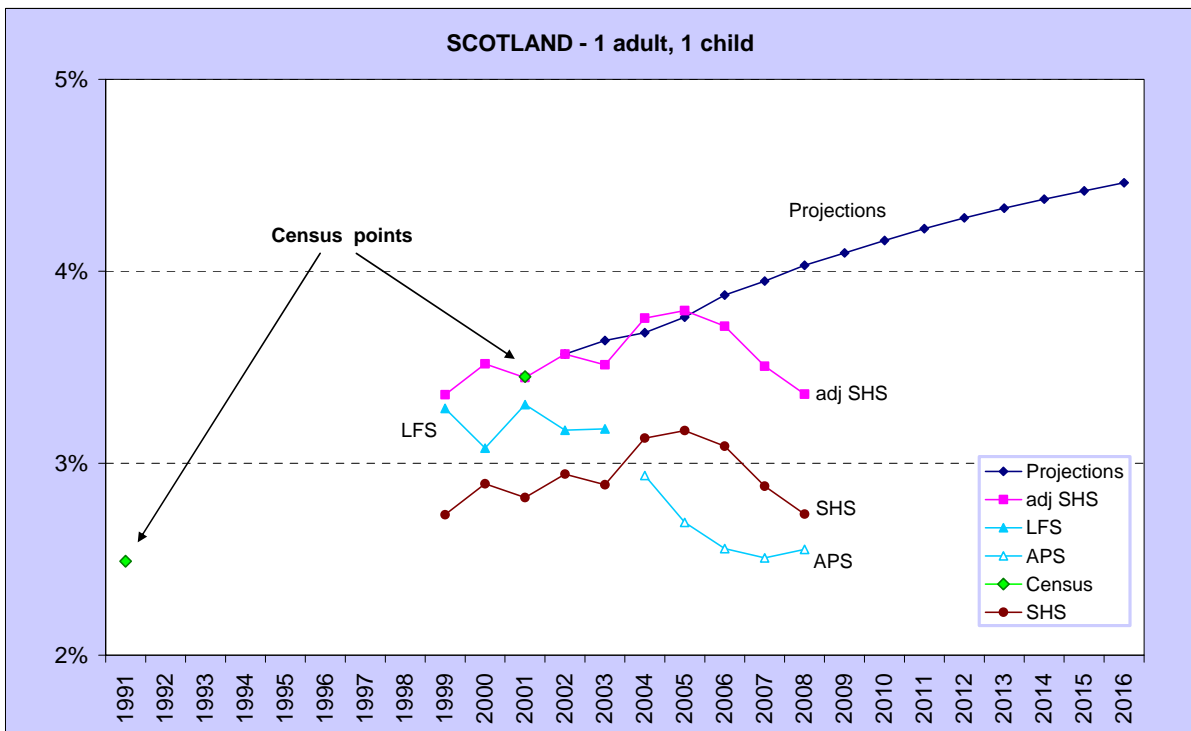
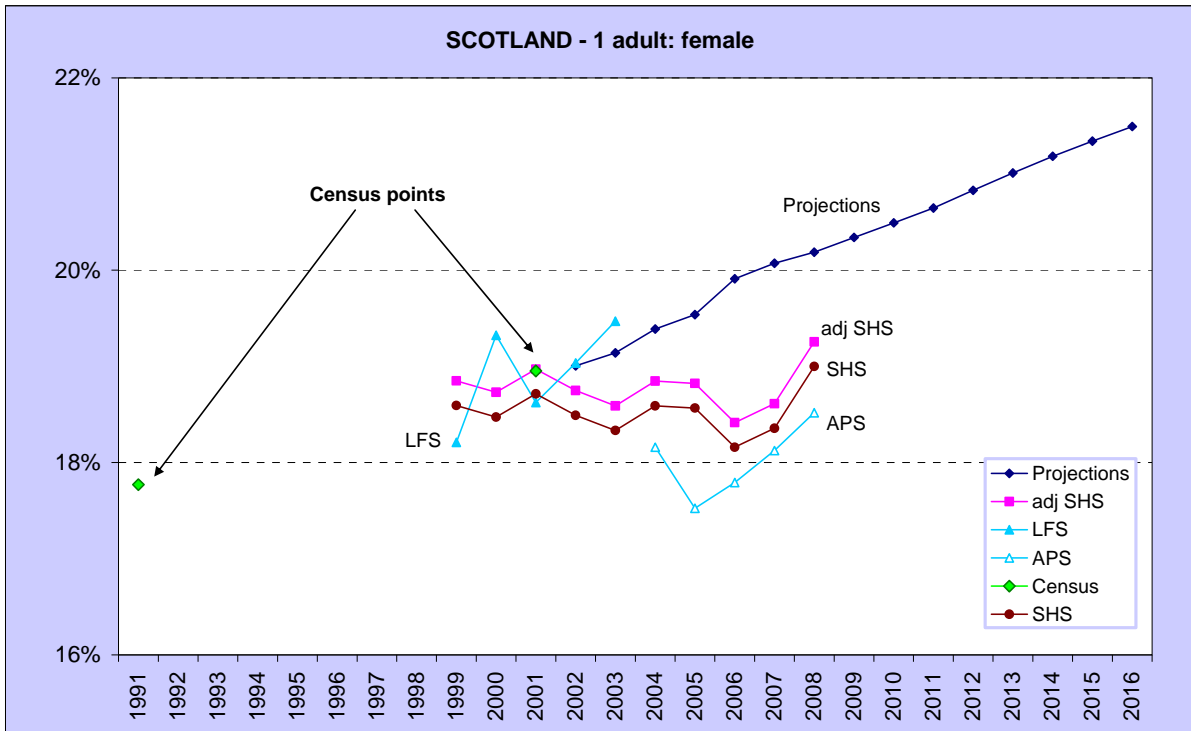
#### 4. Comparing survey data to census data and household projections

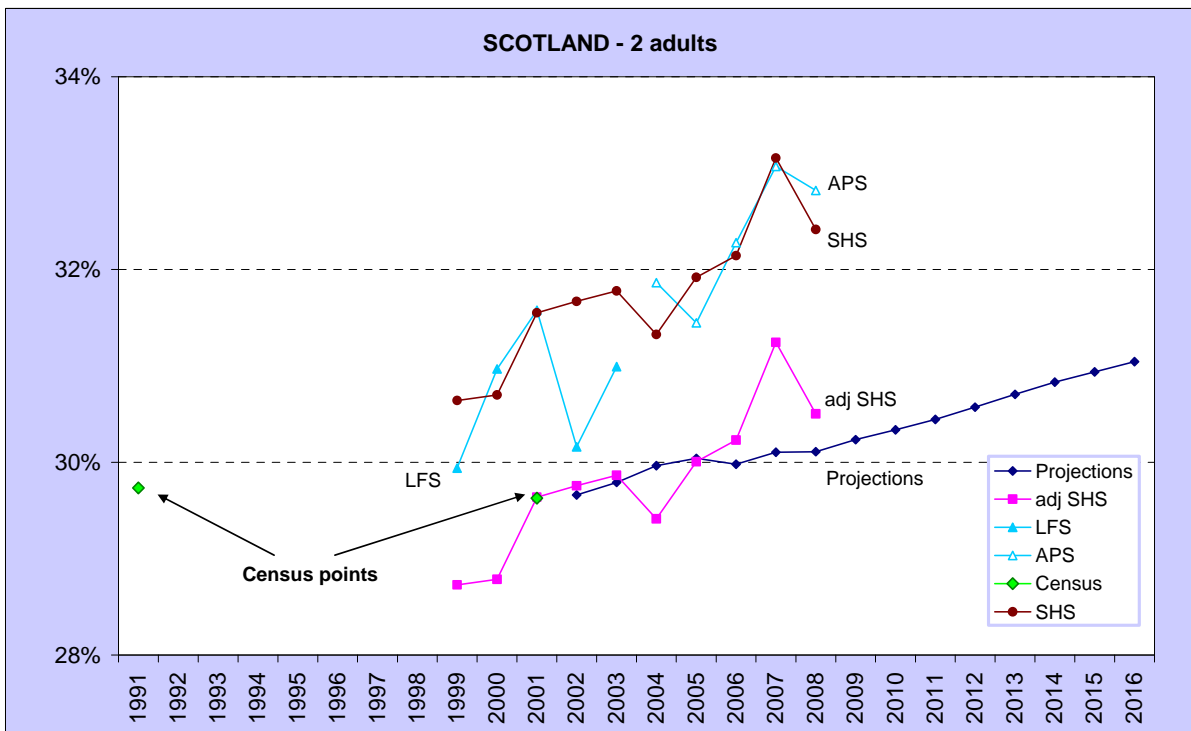
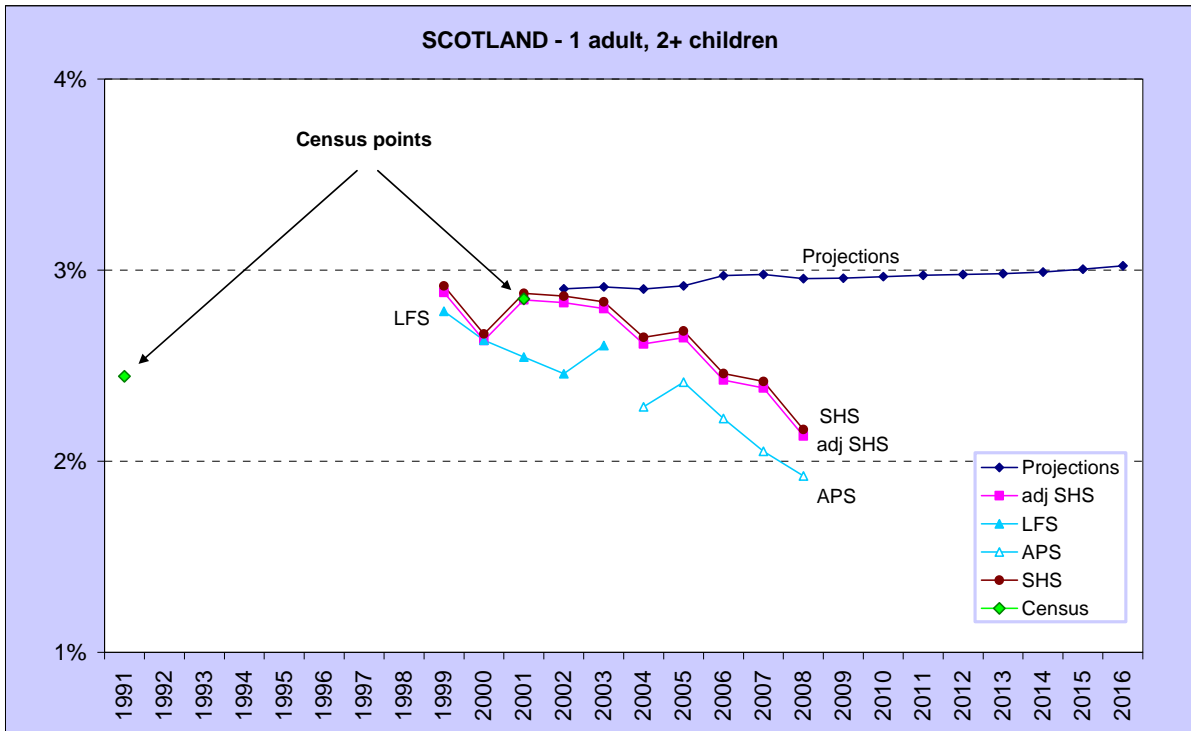
4.1 The following charts compare projected census proportions of household types with those from survey data. The scales on the vertical axes vary between each graph so that differences can be seen more clearly. However this may make differences seem more exaggerated, for example, in the chart for 1 adult, 1 child where the vertical axis increases in increments of 1%.

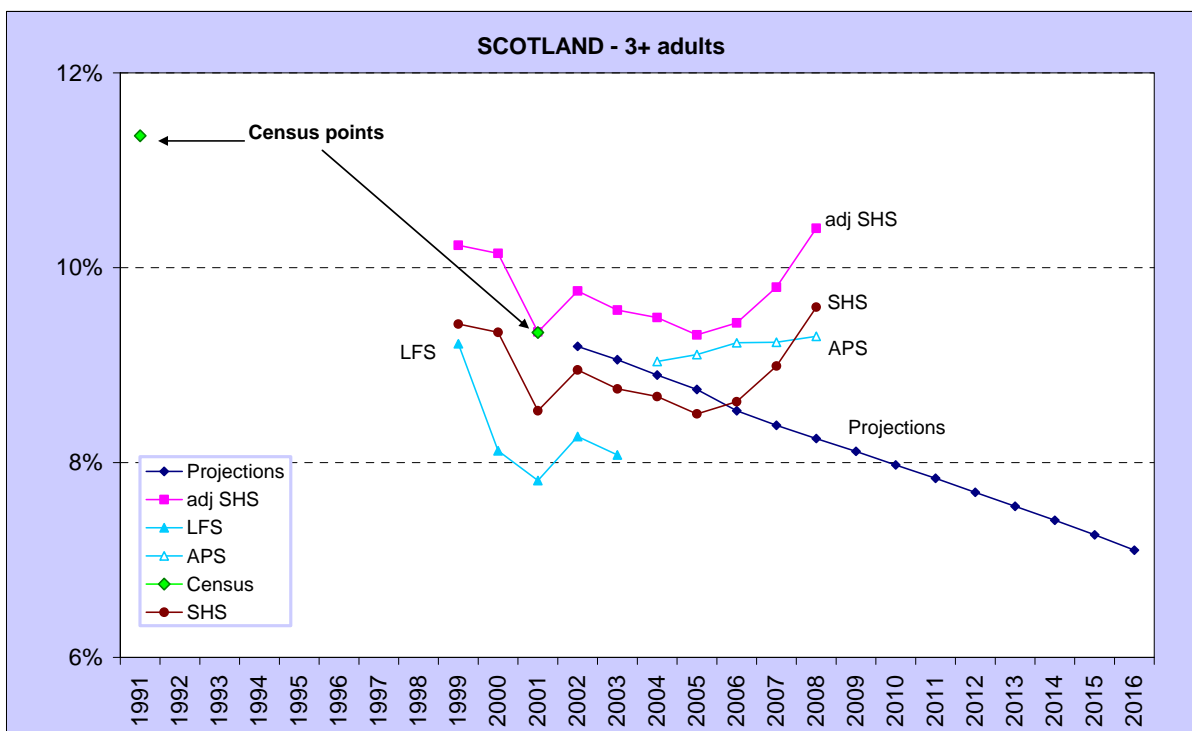
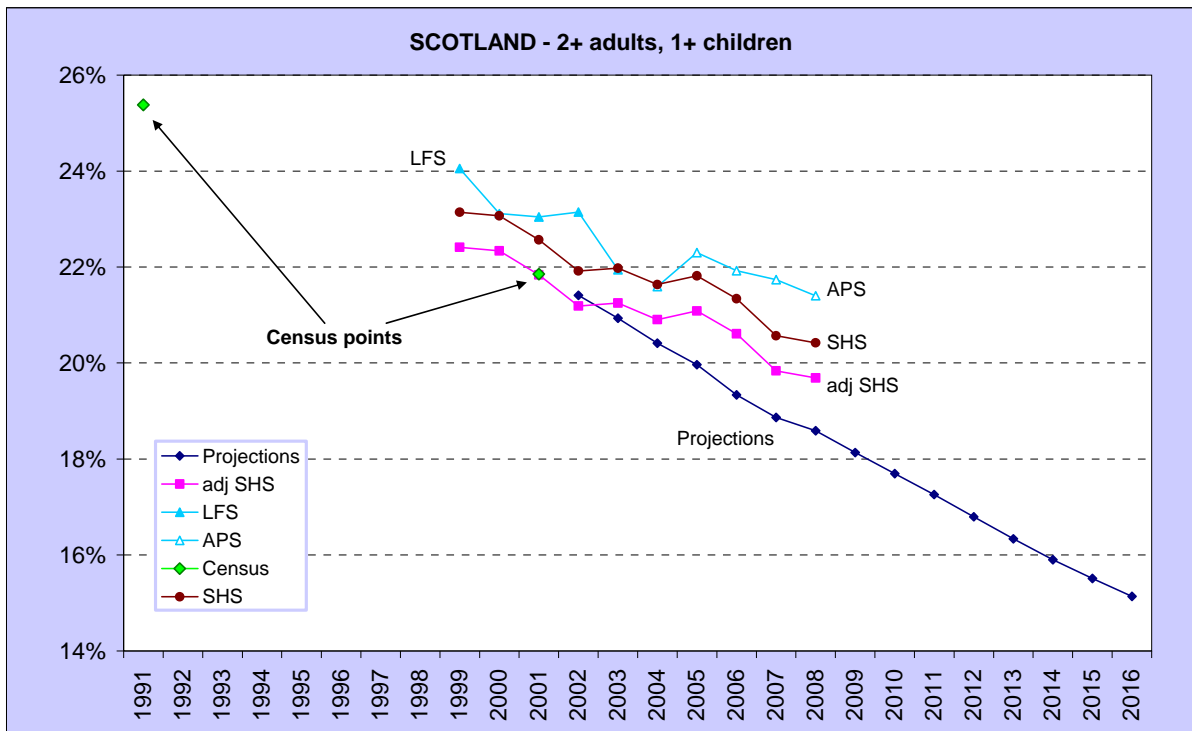
4.2 Note that the Annual Population Survey (APS) incorporates what was known as the Labour Force Survey (LFS). From March 2003, the APS sample in Scotland was boosted from 8,000 households in the LFS to around 23,000 in the APS hence the break in the line graph between 2003 and 2004.

4.3 The line “adj SHS” in the following charts is the graph for Scottish Household Survey (SHS) data corrected to 2001 proportions.





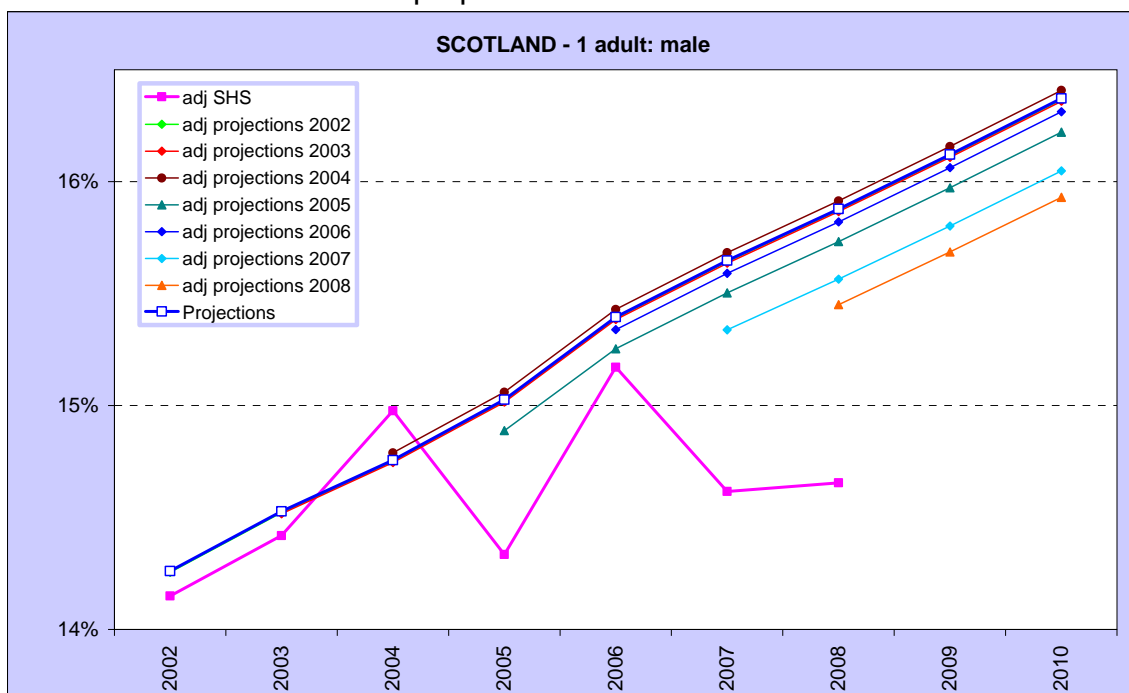




4.4 From the charts it appears that, for 2006 onwards, survey data consistently reports lower proportions for single adult households but higher proportions for multiple adult households when compared to census projections.

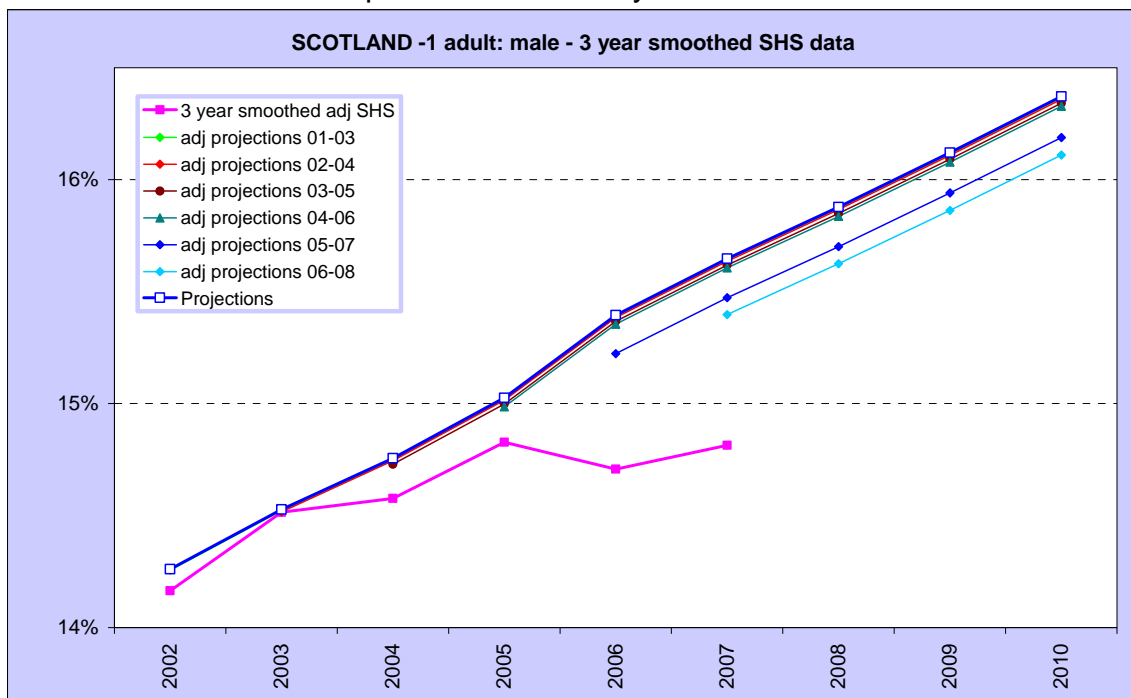
## 5. Exploratory analysis

- 5.1 In the Communities and Local Government (CLG) household projections for England, adjustments are made to household representative rates by using smoothed quarterly LFS data. The LFS is a sample survey and as such is subject to a margin of error. In the CLG research report "[Testing methodological changes to the household projections model](#)" it was suggested that increased weights be given to the LFS relative to the census. To reflect uncertainty over accuracy the maximum weight of 50% was agreed on but linked to the time since the last census. For example, for 2008-based projections, the LFS data receives a 35% weight derived as the maximum weight (50%) multiplied by the time in years elapsed since the 2001 census divided by the maximum number of years between censuses (7/10). This recommendation was based on a combination of a methodological review, interviews and statistical testing and is subject to further research. In the absence of any other strategy the weighting method favoured in England may be a useful starting point.
- 5.2 The chart shown here shows the percentage of households that are projected to contain 1 adult male from 2002 to 2010. The line "Projections" is the projected proportion of 1 adult households from combined 2002-based, 2004-based, 2006-based and 2008-based household projections. These have been combined so that, for example, the 2002 and 2003 proportions have been sourced from 2002-based household projections. Similarly 2004 and 2005 proportions are sourced from 2004-based household projections etc. Proportions for 2008 onwards are from the 2008-based household projections.
- 5.3 The series of adjusted projections 2002 to 2008 (labelled "adj projections") have been weighted to the corresponding adjusted SHS point for the base year using weights as described in the paragraph above. The projections for future years are also adjusted by the same proportion to preserve trends. Only SHS data has been used as this is the only survey data that can be corrected to 2001 census proportions.





5.4 Since the sample size for the SHS is relatively small it might have been expected that results will be variable. This can be seen in the previous chart. One way to overcome this is to smooth the adjusted SHS data. The following chart shows the same process but with 3 year smoothed SHS data.



5.5 The 3 year smoothed average for 2007 is calculated as the average of years 2006, 2007 and 2008 to give a smoothed average. Smoothed averages for other years are calculated in a similar way. In the chart above the 2007 proportion for unsmoothed SHS data is 15.34% whereas the smoothed SHS proportion for 2007 is 15.40%

## 6. Calculation of household projections adjusted to SHS survey proportions

- 6.1 The exploratory analysis in the previous section gives an indication of how the relative proportions of household types may be varied by calibrating to SHS survey data. However, these changes in proportions will also affect the numbers of households projected to 2033. The method used to calibrate to SHS survey data is described here.
- 6.2 For each household type the smoothed 2007 SHS data point for 2006-2008 was calculated. This SHS data point was given a weight of 30% and combined with the 2007 projected proportion from 1991 and 2001 census points. 2008 data was then adjusted proportionately.
- 6.3 It may make this clearer to look at an example. The table shown here contains data for the proportion of one adult male households.

1 adult: male	2006	2007	2008
SHS adjusted to 2001 census	0.151709142	0.146162413	0.146550372

The 3 year smoothed average for 2007 is calculated as the average of years 2006, 2007 and 2008 to give a smoothed average of 0.148140643.

The smoothed average is then combined with the proportions from published projections in the ratio 30%:70% to give the adjusted proportion.

( $0.3 \times 0.148140643 + 0.7 \times 0.156475551 = 0.153975078$ )

1 adult: male	2006	2007	2008
Published projections	0.153952571	0.156475551	0.158781769
3 year smoothed SHS		0.148140643	
adjusted proportion		0.153975078	0.156244444

The 2008 figure is then adjusted in line with the adjustment for 2007 and is calculated as

$$\frac{0.153975078}{0.156475551} \times 0.158781769 = 0.156244444$$

- 6.4 In a similar way the adjusted proportions for all household types were calculated giving the following results. These proportions were then constrained so that they sum to 1.

2008	proportions	constrained proportions
1 adult: male	0.156244444	0.156275219
1 adult: female	0.197921405	0.197960389
2 adults	0.302751541	0.302811173
1 adult, 1 child	0.039018492	0.039026177
1 adult, 2+ children	0.027578034	0.027583466
2+ adults, 1+ children	0.189405980	0.189443287
3+ adults	0.086883175	0.086900288
	0.999803072	1.000000000

- 6.5 In the table shown here, the column "projected number of households", shows the figures for 2008 that were calculated from projected census proportions. These figures can be compared against those using the SHS constrained proportions. SHS adjusted numbers of households are calculated as the constrained proportions of the total households.

2008 household types	projected numbers of households	shs constrained proportions	shs adjusted numbers of households	difference	% difference
1 person male	368,873	0.156275219	365,373	-3,501	-0.9%
1 person female	469,485	0.197960389	462,833	-6,652	-1.4%
1 adult, 1 child	92,945	0.039026177	91,243	-1,702	-1.8%
2 person all adult	707,283	0.302811173	707,975	692	0.1%
1 adult 2+ children	67,594	0.027583466	64,490	-3,103	-4.6%
2+ adult 1+ children	437,196	0.189443287	442,920	5,724	1.3%
3+ person all adult	194,632	0.086900288	203,174	8,542	4.4%
Total households	2,338,007				

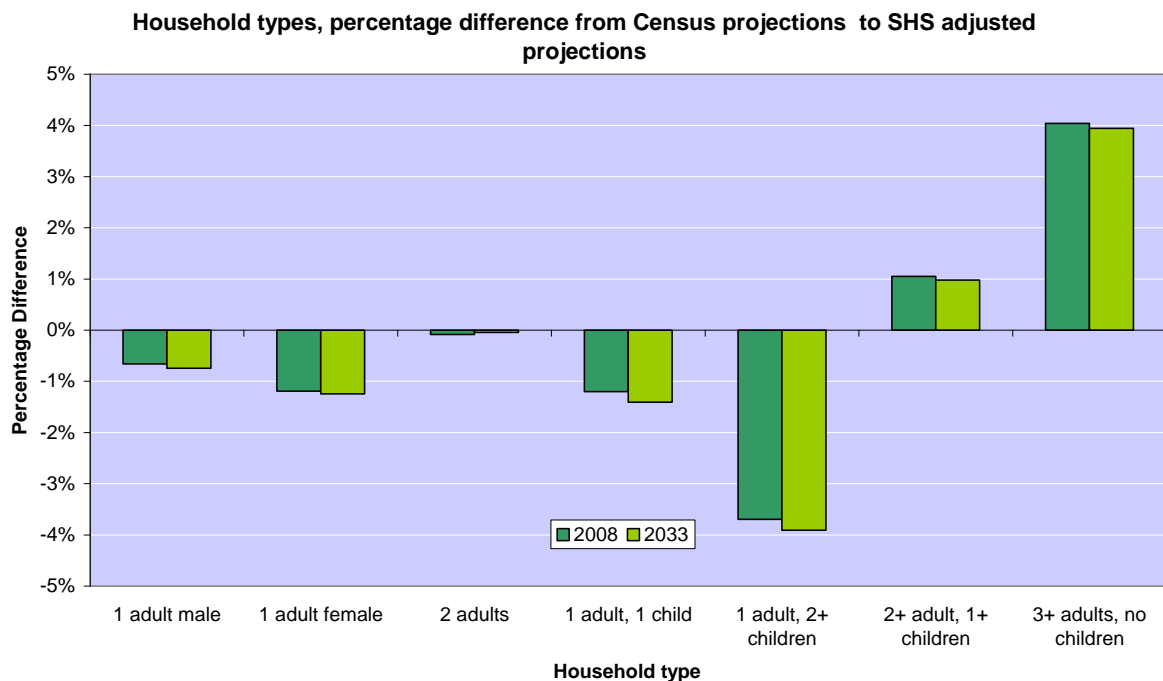
- 6.6 SHS adjusted numbers of households are lower for single adult households but higher for multi adult households.
- 6.7 The projected numbers of households across all age groups and local authorities are now constrained to agree with those produced for Scotland using the SHS constrained proportions for 2008. In addition, projections for future years to 2033 are also constrained by the same factor. No change was made to the numbers of "Non-heads".
- 6.8 [Annex 1](#) is a diagram of processing for the household projections system and the shaded boxes show where the additional steps to constrain to SHS proportions have been inserted. The remaining steps in the household projections methodology are unchanged.
- 6.9 Minimum adult adjustments were made to Aberdeen City, Dundee City, Edinburgh City and Orkney Islands. There were no minimum child adjustments.

## 7. Comparing results

7.1 The results obtained from SHS adjusted projections can be compared with the original unadjusted 2008-based projections.

### 7.2 Comparison by household type

Household size	Household type	2008		2033	
		unadjusted	shs adjusted	unadjusted	shs adjusted
One person households	1 adult male	370,160	367,720	578,060	573,760
	1 adult female	470,630	465,020	675,940	667,510
Two person households	2 adults	701,910	701,310	865,670	865,300
	1 adult, 1 child	93,980	92,860	146,410	144,360
3+ person households	1 adult, 2+ children	68,900	66,350	91,450	87,880
	2+ adult 1+ children	433,420	437,980	314,970	318,060
	3+ person all adult	192,250	200,010	140,000	145,530
<b>All households</b>		<b>2,331,250</b>	<b>2,331,250</b>	<b>2,812,500</b>	<b>2,802,400</b>



SHS adjusted projections are lower for single adult households but higher for multi-adult households.

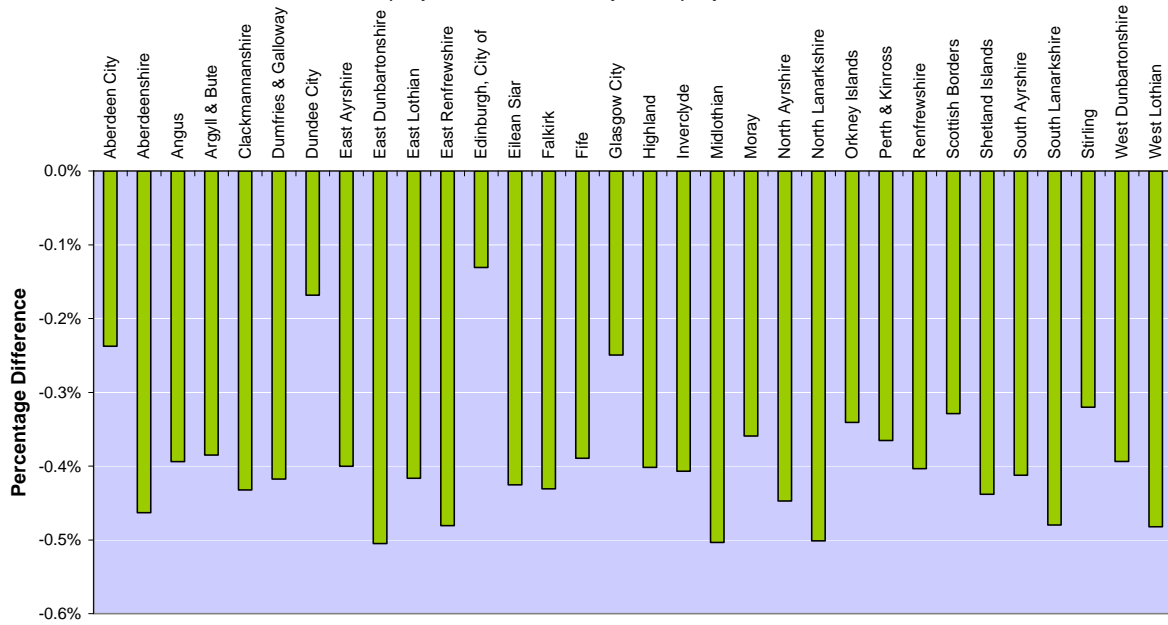
### 7.3 Comparison by Local Authority

The 2008 figures for Local Authorities are identical for the original Census projections and SHS adjusted projections. This is because figures are constrained to Local Authority 2008 household estimates. However, by 2033 the numbers of households for SHS adjusted projections are all lower than the original Census projections. The percentage difference varies between local authorities due to differing proportions of types of household in each authority.

Local authority	2033		% difference
	Census Projections	SHS adjusted	
<b>Scotland</b>	<b>2,812,517</b>	<b>2,802,399</b>	-0.36%
Aberdeen City	122,067	121,777	-0.24%
Aberdeenshire	137,167	136,532	-0.46%
Angus	59,070	58,838	-0.39%
Argyll & Bute	42,901	42,736	-0.39%
Clackmannanshire	31,920	31,782	-0.43%
Dumfries & Galloway	74,413	74,102	-0.42%
Dundee City	72,285	72,163	-0.17%
East Ayrshire	59,003	58,767	-0.40%
East Dunbartonshire	43,352	43,133	-0.50%
East Lothian	58,798	58,553	-0.42%
East Renfrewshire	37,668	37,487	-0.48%
Edinburgh, City of	293,151	292,768	-0.13%
Eilean Siar	13,403	13,346	-0.43%
Falkirk	86,414	86,042	-0.43%
Fife	197,861	197,090	-0.39%
Glasgow City	334,100	333,268	-0.25%
Highland	129,791	129,270	-0.40%
Inverclyde	34,614	34,473	-0.41%
Midlothian	39,563	39,364	-0.50%
Moray	43,482	43,326	-0.36%
North Ayrshire	66,809	66,511	-0.45%
North Lanarkshire	168,235	167,392	-0.50%
Orkney Islands	11,981	11,940	-0.34%
Perth & Kinross	89,035	88,710	-0.37%
Renfrewshire	82,792	82,457	-0.40%
Scottish Borders	64,878	64,664	-0.33%
Shetland Islands	11,143	11,095	-0.44%
South Ayrshire	55,392	55,164	-0.41%
South Lanarkshire	165,979	165,183	-0.48%
Stirling	45,095	44,951	-0.32%
West Dunbartonshire	43,058	42,888	-0.39%
West Lothian	97,095	96,627	-0.48%

The biggest percentage differences of -0.50% are in East Dunbartonshire, Midlothian and North Lanarkshire, whereas there is only a difference of -0.13% for the City of Edinburgh.

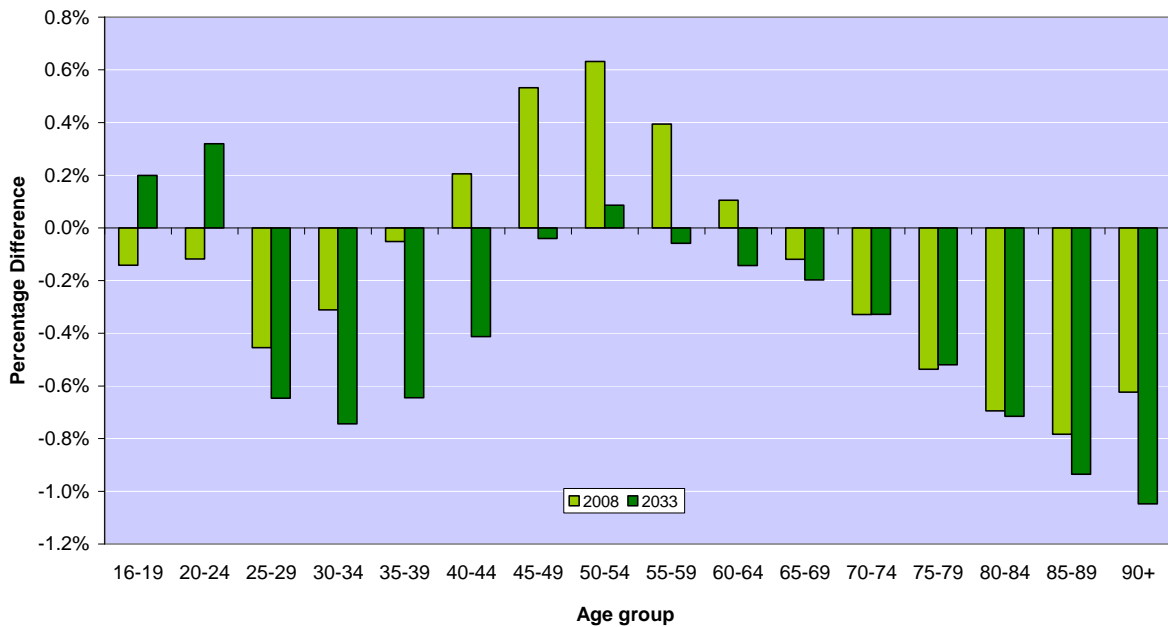
Household projections by local authority area, percentage difference in 2033 from Census projections to SHS adjusted projections



### 7.4 Comparison by age of head of household

The chart here shows percentage differences in households headed by people of differing age groups. Percentage differences are a function of the proportions of different household types in each age group.

Age group of head of household, percentage difference from Census projections to SHS adjusted projections



## 8. Conclusion

- 8.1 Adjusting the 2008-based projections to SHS proportions has reduced the total number of households projected up to 2033 from 2,812,500 to 2,804,400, a reduction of 0.4 per cent. SHS adjusted projections reduce the total number of households in all local authorities by varying amounts. There are also reductions in smaller households but increases in larger households.

**Note:** HARG members are asked to comment on the analysis presented here and consider whether it is be appropriate to make adjustments to future household projections using survey data.

GROS: Household estimates and projections branch  
March 2011

**Annex 1 – Diagram of processing**

