

POPULATION PROJECTIONS WORKING GROUP (PPWG)
--

Short-term Migration assumptions for sub-national population projections**1. Introduction**

- 1.1 This paper provides PPWG with a summary of the investigation carried out by General Register Office for Scotland (GROS) on different methods for calculating the short-term migration assumptions for the sub-national population projections. The method used to calculate the long-term migration assumptions for the 2008-based projections had previously been agreed, and so it is not being changed.
- 1.2 The main purpose of this work is to improve the methodology for calculating the short-term net migration assumptions and to develop a method which gives plausible migration assumptions going from the most recent migration estimate to the long-term assumption for an area.
- 1.3 PPWG are invited to comment on the recommendations in section 7.

2. Background

- 2.1 GROS publishes population projections at national and local authority (council and NHS board area) level every two years. In addition, projections are published biennially for Strategic Development Plan Areas and National Parks. This investigation is focused on setting net migration assumptions for council areas but the methods would also be used for the other sub-national population projections.
- 2.2 Migration assumptions are set for the principal population projection and also for any variant projections. For the 2008-based set of projections, high and low migration variants were produced.
- 2.3 For the projections, net migration assumptions are set for each council area. An assumption is set for each of the first six years of the projection period, after a long term assumption has been set to be applied every year for the remainder of the projection period.
These assumptions cover both outwith and within Scotland migration.
- 2.4 Outwith Scotland migration is moves from Scotland to the rest of the UK and overseas. Within Scotland migration is moves within Scotland.
- 2.5 The migration assumptions for sub-national areas other than council areas are either aggregated from or constrained to council area migration assumptions.
- 2.6 The long-term migration assumptions for Scotland are derived by the Office for National Statistics (ONS) on behalf of and in consultation with GROS as well as an expert advisory group. In and out flows at Scotland level for each of the “run-in” years (six years in the latest projections) of the projection period are also set.
- 2.7 For past projections the council area outwith Scotland migration assumptions have been constrained to the Scotland level figures from ONS. The long-term in and out migration flows are constrained to agreed ONS levels, and the net migration for each

of the run-in years is constrained to the Scotland net migration figures from the national population projections. Within Scotland migration has not been constrained for past population projections.

- 2.8 The net migration assumptions for local areas are made in consultation with local authorities. For the 2008-based population projections, the initial long-term assumptions were calculated by taking five year averages of in and out migration flows between councils within Scotland and between councils and other countries. The outwith Scotland migration flow averages were scaled to match the migration assumptions used in the national projections set by ONS. After the long-term assumption had been calculated for each council area, the percentage of migrants located in each council area was calculated for the long-term assumption and also in the base year using net migration estimates for that year. The change in the percentage of migration in each council area from the base year to the long-term projection was then calculated and divided across the run-in years. The national assumption for the run-in years was then divided up for each council area.

3. Objective

- 3.1 To investigate the short-term migration assumption setting process so that the best method can be applied for the next set of population projections.
- 3.2 The method needs to be as robust as possible, and not be over sensitive to out-migration figures, large changes from the base year to the long-term migration assumption, and be able to be constrained to the ONS agreed national figures.

4. Work description

- 4.1 Methods were tested on the 2008-based data, and also for the 2004-based and 2006-based projections where the input data was readily available. As the 2004-based migration assumptions only have four run-in years this also tested whether the methods could be adapted for a different number of run-in years.
- 4.2 The explanations in this paper are mainly based on the 2008-based projection period.
- 4.3 All migration assumptions were rounded to the nearest 50 and constrained to the Scotland level figures, as was done for past published migration assumptions.
- 4.4 The following methods used the 2008-based method for calculating the long term net migration assumption:
- a. **Setting short-term migration assumptions from an average.**
This method is similar to the method used for the 2008-based projections except the five year average net migration for each council area was used as a starting point instead of the 2007/08 migration estimate. This means that less emphasis is placed on the last available migration estimate.
 - b. **Setting short-term migration assumptions from a weighted average.**
Instead of using the 2007/08 migration estimate as a starting point for the migration assumption setting process a five year weighted average was used.

The weighted averages were calculated using the migration estimates from the five years prior to the base year, with the most recent estimate given the highest weighting. The same method as used for the 2008-based projections was then adopted.

c. Using fractions to calculate short-term migration assumptions.

This method used fractions to project migration from the 2007/08 migration estimate to the long-term assumption. As there are six run-in years until the long-term assumption, sevenths were used to calculate the short-term assumptions as follows:

Year	Fraction of 2007/08 migration estimate	Fraction of long-term migration assumption
2008/09	6/7	1/7
2009/10	5/7	2/7
2010/11	4/7	3/7
2011/12	3/7	4/7
2012/13	2/7	5/7
2013/14	1/7	6/7
Long term assumption	0	1

So the weight of the input from the 2007/08 estimate decreases as you move closer to the long-term assumption.

d. Using fractions to calculate short-term migration assumptions from an average.

This method used fractions to go from a five year unscaled average migration figure to the long-term assumption. (This method is similar to the previous method.)

Year	Fraction of average migration figure	Fraction of long-term migration assumption
2008/09	6/7	1/7
2009/10	5/7	2/7
2010/11	4/7	3/7
2011/12	3/7	4/7
2012/13	2/7	5/7
2013/14	1/7	6/7
Long term assumption	0	1

e. Using fractions to calculate short-term migration assumptions from a weighted average.

Again, this method used fractions but started from a five year weighted average using data from 2003/04 to 2007/08 instead of the 2007/08 migration estimate or an simple five year average.

f. Using the in and out flows from ONS for every projection year.

This method used the in and out flows for outwith Scotland migration which ONS provide for the projection period. Similar to the method used to calculate the long-term assumptions for the 2008-based set of projections, five year average inflows and outflows for outwith Scotland migration for each council area were calculated and then constrained to the Scotland total from ONS for each projected year. For within Scotland migration, a five year average is used across the projection period. The net migration assumption for each area was calculated by adding the within and outwith Scotland inflows and subtracting the outflows.

4.5 Methods tried which do not use the 2008-based long term net migration assumptions:

g. Add a constant to make all values positive.

A constant which was larger than the largest net out-migration estimate for 2007/08 was added to each of the 2007/08 net migration estimates. The sum of these constants for each council area was added to the Scotland net migration estimate for the base year. For example, for the 2007/08 migration estimates the largest net out-migration figure was -181, therefore a constant of 200 was chosen and added to each council area net migration estimate. So, 6,400 (i.e. 32 x 200) was added to the Scotland 2007/08 migration estimate. The percentage of Scotland's migration in each council area was calculated using these new figures. The sum of the constants (i.e. 6,400) was then added to the year one net migration assumption for Scotland, and the percentages calculated were used to divide up the Scotland figure amongst the council areas. The constant was then subtracted from each of the council areas to give the year one net migration assumptions. This process was continued for each year of the projection period.

h. Weighted average.

The long-term migration assumption was calculated using a five year weighted average, with the most recent year's migration estimate having the highest weighting (i.e. 2003/04 has weighting 1, through to 2007/08 migration estimate having weighting 5). The weighted averages for in and out migration flows for the long-term assumption are scaled to the ONS agreed levels for Scotland. The unscaled five year averages were used as a starting point then the method used for the 2008-based projections was used to calculate the run-in year migration assumptions.

i. Rolling average

A five year rolling average was used across the projection period. For the 2008/09 migration assumption the migration estimates from 2003/04 to 2007/08 were used to calculate an average. For the 2009/10 migration assumption the migration estimates from 2004/05 to 2007/08 plus the migration assumptions for 2008/09 were used. This process continued, so for the long-term migration assumption (2014/15 onwards) an average of the migration assumptions from 2009/10 to 2013/14 was used. The rolling averages were then scaled to the ONS net migration figures for Scotland.

j. Scaling within Scotland migration.

For the 2008-based projections the overseas and rest of UK in and out migration averages were scaled to ONS agreed levels but the within Scotland migration was left unscaled. This method used an average of the scale factor used to scale in and out outwith Scotland migration flows to scale within Scotland migration. (The same scale factor has to be used for in and out migration flows within Scotland so that the within Scotland net migration is zero.) The scaled within and outwith Scotland flows are used to calculate the long-term assumption, and then the same method as used for the 2008-based projections was used to calculate the run-in year migration assumptions.

5. Results

- 5.1 It is difficult to measure the accuracy of a method in projecting migration as migration estimates at council area level often do not seem to follow a trend and for some areas vary significantly from year to year.
- 5.2 The method used to calculate the long-term migration assumptions for the 2008-based projections had previously been agreed, and so it is not being changed. Therefore, further analysis of short-term migration assumption setting was concentrated on methods (a-f) which used these long-term assumptions.
- 5.3 Summary table of methods:

Method	Description	Comment
a	2008-based method starting from an average	Negative figures wrongly scaled
b	2008-based method starting from a weighted average	Negative figures wrongly scaled
c	Using fractions of 2007/08 migration estimate	Negative figures wrongly scaled
d	Using fractions of a 5 year average migration estimate	Negative figures wrongly scaled
e	Using fractions of a weighted average migration estimate	Negative figures wrongly scaled
f	Using the in and the out flows from ONS for every year of projection period	No negative figures as scaling in and out flows separately

- 5.4 The assumptions produced for council areas using many of the methods were affected by negative net migration figures and the scaling required constraining the figures to the Scotland level net migration assumptions. There were also occasions where the high migration variant assumptions produced were lower than the principal net migration assumptions, or the low migration variant assumptions were higher than the principal net migration assumptions.

- 5.5 The migration assumptions calculated from an average (method a) seem viable for the principal projection but for the low and high migration variants the assumptions calculated seem questionable as sometimes the high migration variant assumptions are lower than the principal assumptions, or the low migration variant assumptions are higher than the principal assumptions. Also the difference between the principal and variant migration assumptions varies depending on the council area. For some areas the principal and low migration variant assumptions are similar and the high migration variant assumptions are a lot higher, where as for other council areas the high migration variant and principal assumptions are close and the low migration variant assumptions are much lower. For Scotland the difference between the principal and the variant migration assumptions is symmetrical and we would hope for a more symmetrical pattern for the council area migration assumptions. If the average was close to zero this had a significant effect on the migration assumptions calculated, which occurred for two council areas. The assumptions calculated for the variants using this method were very different from the migration assumptions published.
- 5.6 Looking at the migration assumptions calculated from starting with a weighted average (method b), the principal assumptions follow a similar trend to the published migration assumptions for most council areas, and there are not many occasions when the variant projections cross over with the principal projection. For some council areas, there is a large difference between the published projected migration assumptions and the assumptions calculated using this method.
- 5.7 Using fractions to calculate the migration assumptions (method c), the results for some council areas were higher across all years for the low migration variant than the principal projection. This was due to the scaling which was necessary to make the totals for the council areas match the agreed ONS migration assumption for Scotland. For the high migration variant there were a few occasions where the high migration variant assumptions were lower than the principal assumption. The high migration assumptions calculated using this method were similar to those published for the 2008-based population projections, but the low migration variant assumptions differ significantly.
- 5.8 When using fractions to calculate the migration assumptions from an average (method d) or a weighted average (method e), there were problems with the high migration variant assumptions being lower than the principal assumptions and the low migration variant assumptions being higher than the principal assumptions for a few council areas. The assumptions calculated using this method differs significantly from the published variant migration assumptions.
- 5.9 Considering in and out flows separately (method f) gave reasonable migration assumptions although they vary from those that were published for the 2008-based projections. Using this method gives fairly constant assumptions across the projection period for some council areas due to the continued use of the average migration flows for each year of the projection period. There were no occasions where the variant migration assumptions were not either side or equal to the principal assumptions.
- 5.10 The method which involved adding on a constant to make all the assumptions for the base year positive (method g) seemed to give reasonable assumptions as the

problems which occur on scaling negative numbers were eliminated. However the value of the constant chosen had a huge effect on the migration assumptions calculated since the percentage of the Scotland migration for each council area changes when the constant is changed.

6. Conclusion

- 6.1 The most robust way to get migration assumptions is to use in and out flows separately. Although they varied from the published migration assumptions for the 2008-based projections they gave more reasonable results when set in context with the variants. Since outflows and inflows were calculated and scaled separately, the process uses positive numbers and the issues that occur with scaling negative numbers are eliminated. Combining the flows to give the net migration assumption it is possible to get negative figures but as the net migration assumptions are not scaled this does not cause any problems. The assumptions for the principal projection lie within the variant migration assumptions for each council area and the projected net migration assumptions seem reasonable, and are constrained to the Scotland assumptions.
- 6.2 The other methods investigated did not cope robustly with scaling negative net migration to the national total.

7. Recommendations

- 7.1 In conclusion, the best method to use is calculating and scaling the in and out flows separately, the same as is already carried out for the long-term assumptions.
- 7.2 With this method, any past migration estimates that are considered to be unrepresentative of the migration expected for the area (i.e. outliers) can be exempt from the average calculation, and any adjustments can be made following the consultation process. The decision to treat a migration estimate as an outlier would be decided by analysing migration trends for each area and the reasons for any odd figures, in consultation with the local authorities.