

# Method for incorporating cross border migration rates into the UK National Population Projections

## Introduction

A [review](#) of the migration assumptions setting method for the National Population Projections was conducted by the Economic and Social Research Council (ESRC) Centre for Population Change (CPC) in 2012. The review made a number of recommendations for improvements to the method and split these into phases. The majority of the Phase 1 recommendations, which involved a general streamlining and updating of the method, were [implemented for the 2012-based projections](#). However, one of the recommendations, namely the use of migration rates for certain migrant flows, could not be incorporated due to incompatibility with the existing Excel based projections system.

Subsequently, a project was undertaken to set up a new SAS-based projections system for the 2014-based projections, so a parallel project to incorporate migration rates into this was also started. The project aimed to formulate a robust method for setting and applying the cross border (intra-UK) migration assumptions as rates rather than fixed numbers of migrants.

International migration flows were not covered by the project due to the added complexities of calculating and applying rates for populations outside of the UK.

## Reason for introducing rates

Introducing migration rates into the projections is a continuation of the work to implement the recommendations from the ESRC review and is another step towards fully aligning the ONS projections with the most up to date academic ideas.

The ESRC review set out the main benefits of using migration rates rather than fixed numbers of migrants [here](#). The main advantage is that the process is clearly related to the population at risk, allowing the migrant flows to change on the basis of the underlying population size and age structure. This means that the projections cannot produce implausible values, such as negative population stocks, when projected fixed levels of emigration are greater than the initial population size.

This is a particular issue for Northern Ireland where there is a high level of cross border migration of 18-19 year olds out of Northern Ireland but an often decreasing projected population in this age group. If fixed migrant numbers are assumed on the basis of past trends regardless of the underlying population size, this can lead to the migration rate of 18-19 year olds out of Northern Ireland increasing over the course of the projection. This issue required a specific ad hoc adjustment to be made to the 2010-based projections, but the use of rates would mitigate this.

## The existing method

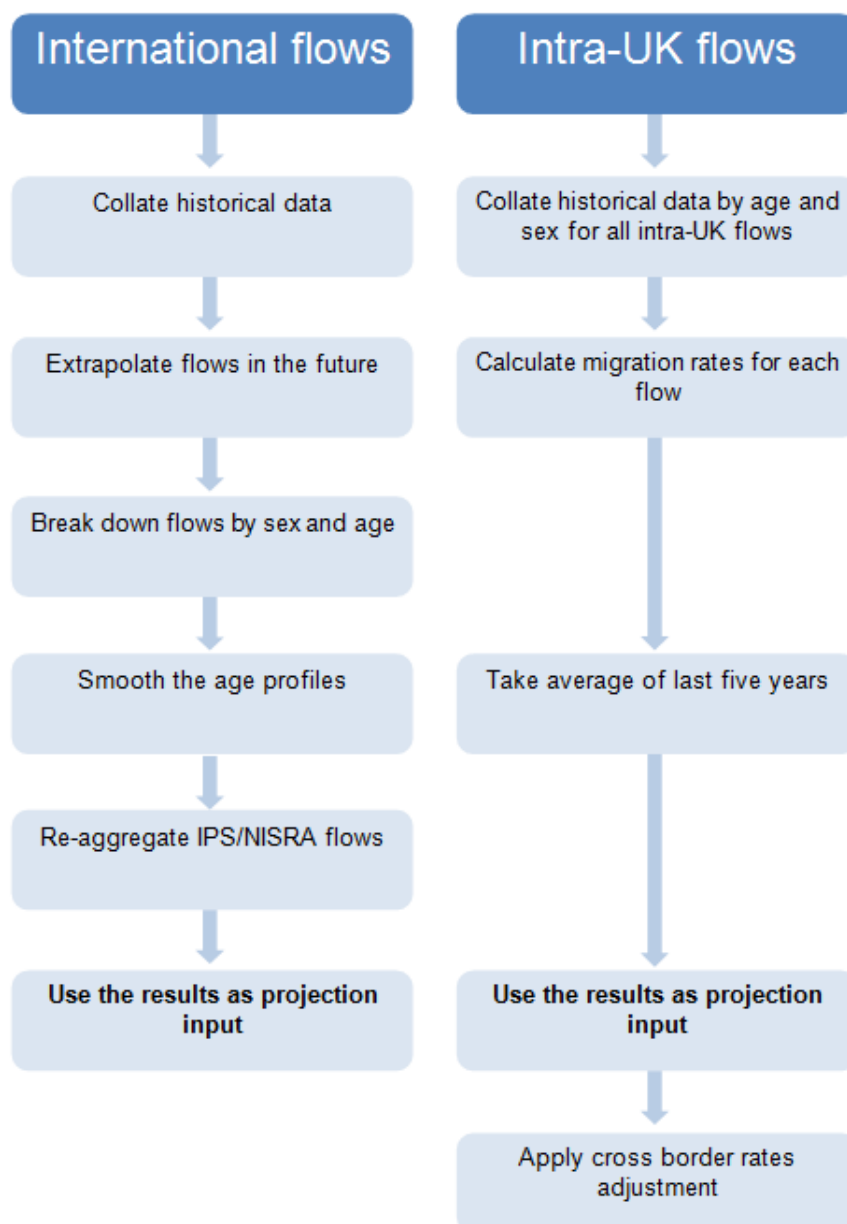
The existing assumptions setting method, as used for the 2012-based National Population Projections, is set out [here](#). Migrant numbers for each migration flow (e.g. international, asylum seeker and cross border) are modelled and extrapolated into the future. The resulting migration assumptions are set as fixed numbers of migrants for each individual flow and the different flows are then combined to give overall in, out and net migrants by single year of age and sex for each UK country. The net figures feed into the projection system and are added onto/taken away from the relevant populations during each year of the projection.

## The new method

Assumptions for international migrants and asylum seekers will be set in the existing way, while a new rates-based method will be used for the cross border (intra-UK) flows only.

The new process is summarised in figure 1.

**Figure 1. Simplified process flow of the new assumptions setting method**



The new cross border migration assumptions setting process is based on a “multiregional constant outmigration rates” methodology as described by Wilson and Rees, 2005<sup>1</sup>. The process is as follows:

1. Annual age and sex-specific migration rates for each cross border flow are calculated for a specific historical reference period (e.g. 2010-2014), where migration rate = number of migrants at end of year/population of country of origin at start of year.

A reference period of the last five years has been selected in order to reflect recent trends and because the availability of age-specific data adjusted to account for the under-recording of student migrants is limited.

<sup>1</sup> Wilson, T. and P. Rees. 2005. Recent developments in population projection methodology: A review, *Population, Space and Place*, 11 (337–360).

Migrant numbers for each flow are obtained from the NHS Central Register, Northern Ireland Statistics and Research Agency (NISRA) and National Records Scotland (NRS) for a specified reference period.

The cross border flows are represented in the matrix shown in table 1.

**Table 1. Matrix of intra-UK cross border flows**

	Destination			
Origin	England	Scotland	Wales	Northern Ireland
England	-	England to Scotland	England to Wales	England to NI
Scotland	Scotland to England	-	Scotland to Wales	Scotland to NI
Wales	Wales to England	Wales to Scotland	-	Wales to NI
Northern Ireland	NI to England	NI to Scotland	NI to Wales	-

The denominator for the rates, which represents the population at risk of migrating, is the population estimate for the country of origin at the beginning of the year in question. This is, strictly speaking, not a true rate since the denominator does not exactly represent the population at risk of migration, but the use of this simplified 'pseudo-rate' enables straightforward application of the rates during the projections process.

2. An unweighted average of the annual rates from the reference period is calculated for each flow and age-sex group.
3. The averaged rates are fed into the projections system and are applied to the relevant population at the start of each projection year, with the resulting migrant numbers added onto/taken away from the relevant country populations in the same way as is done for the fixed numbers flows. The rates are held constant over the projection period, although an optional adjustment can be applied at the beginning of each year before migrant numbers are calculated in order to take the population of the destination country into account.

### Optional rates adjustment

While the constant rates method has a number of advantages compared with the previous fixed numbers method, there are some drawbacks, which have been described by [Statistics Canada](#).

The main issue is that this method effectively makes the assumption that migration is only dependent on the population of the region of origin even though, by definition, there are two regions involved in any migration event. Plane (1993)<sup>2</sup> has described how interregional out migration rates are linked to the population in the region of destination as well as the region of origin because fast growing regions have a tendency to attract migrants from slower growing regions for various economic and sociological reasons. A more realistic migration model would therefore ideally include the size of the region of destination as well as the region of origin.

<sup>2</sup> Plane, D.A. (1993). Requiem for the fixed-transition probability migrant, *Geographical Analysis*, 25 (211-223).

When only the region of origin is taken into account, migration out of fast growing regions will always increase at a faster rate than that from slow growing regions. This can lead to net migration rates to the different regions changing significantly from those observed in the reference period. Net migration to slow growing regions will increase over time because in migration will grow faster than out migration. The opposite effect will be seen for fast growing regions where net migration will decrease because out migration will grow faster than in migration.

The consequence of this is that a constant outmigration rates method tends to lead to faster growth in the slowest-growing regions at the expense of the fastest-growing regions, effectively balancing growth of all the regions/countries in the system as the projection progresses. This can be argued to run counter to the implicit assumption made by the UK National Population Projections that the projections represent the situation if past trends were to continue.

To mitigate this issue, Statistics Canada formulated an adjustment to take the region of destination into account in the interregional outmigration rates for the [Population Projections for Canada \(2013 to 2063\), Provinces and Territories \(2013 to 2038\)](#). This meant that net migration rates to each region over the course of the projection were stabilised and therefore more closely resembled those in the reference period. More detail can be found in Annex 1.

This adjustment has been coded into the new SAS-based projections system for the UK and can be applied to each age-specific rate when running the projections. An on/off switch allows the results from the adjusted rates to be compared with the unadjusted ones. The NPP committee will decide whether to apply the adjustment when agreeing the migration assumptions.

## **Variant assumptions**

The standard high and low migration variants will be produced by varying the international in and out flow assumptions only and using the principal assumptions for all other flows. Variant cross border rates assumptions will not be used because varying the rates adds an extra level of complexity to both the variant assumptions and the outputs, and there is no evidence that this would actually better meet user needs. Bespoke cross border rates variants may be produced if users can demonstrate a specific requirement to represent a particular scenario by, for example, using a different length of historical time series for the rates reference period.

## **Contact**

ONS welcomes feedback on the new methodology.

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## Annex 1: The rates adjustment

The Statistics Canada adjustment<sup>3</sup> works by modifying the provincial out-migration rates according to the relative population sizes of the regions to balance the migration flows. For each year of the projection, the outmigration rates are adjusted on the basis of the average outmigration rates, the population sizes from the reference period and the basis of the population sizes at the beginning of the year to be projected.

The equation is as follows:

$$m_{ij}^{t,t+1} = m_{ij}^{ref} \frac{P_j^t / \sum_k P_k^t}{P_j^{ref} / \sum_k P_k^{ref}}$$

Where:

$m_{ij}^{t,t+1}$  is the new adjusted rate for the flow and year in question

$m_{ij}^{ref}$  is the averaged rate from the reference period

$P_j^t$  is the size of the population of the region of destination at the beginning of the projection year

$\sum_k P_k^t$  is the sum of the populations of all the regions in the system at the beginning of the projection year

$P_j^{ref}$  is the average size of the population of the region of destination from the reference period

$\sum_k P_k^{ref}$  is the sum of the average sizes of the populations of all regions from the reference period

The adjustment can be applied to the UK, with the UK countries being analogous to the Canadian provinces. The effect is that if the receiving country makes up a smaller proportion of the UK than it did in the reference period, the migration rate to it for the year in question will be scaled down slightly. Conversely, if the receiving country makes up a larger proportion of the UK than it did in the reference period, the migration rate to it for the year in question will be scaled up slightly.

This basically assumes, in line with Plane (1993), that faster growing countries will become more attractive destinations for in-migrants as well as naturally producing more out-migrants due to their greater population size. The eventual outcome of this is that net migration levels between countries are kept more stable than without the adjustment.

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<sup>3</sup> Population Projections for Canada (2013 to 2063), Provinces and Territories (2013 to 2038): Technical Report on Methodology and Assumptions, Chapter 8. URL: <http://www.statcan.gc.ca/pub/91-620-x/2014001/chap08-eng.htm#wb-tphp>