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Empirical Evaluation of Migration Forecasting Methods

Note by the ESRC Centre for Population Change, United Kingdom[1]

Summary

The aim of the work reported in this note has been to assess the uncertainty in forecasting models of migration for the United Kingdom (UK), by comparing the forecasts produced by different models against actual migration trends observed in the past. The performance of different models was tested for two periods with migration 'shocks': the 2004 enlargement of the European Union, and the 2009 economic crisis. The magnitude and calibration of prediction errors were assessed.

All the models produced considerable uncertainty when tested against the observed data. The more successful forecasts were obtained for the more stable migration flows, such as those of UK nationals, which are less susceptible to unpredictable shocks or policy changes. In other situations, the applicability of any models was either limited, or completely inappropriate.

The results indicate that no model can be considered as conclusively superior. In particular, no model was able to predict migration well if the underlying data series were short, or in the presence of 'shocks'. Still, even in such cases, some models performed better than others: models that did not assume stability of trends, when none was to be expected, at least described the forecast uncertainty more accurately, and hence more honestly.

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I. Introduction

1. The work reported in this note was commissioned by the United Kingdom (UK) Home Office, and was conducted by the ESRC Centre Population Change, University of Southampton. Its main aim has been to assess the uncertainty in forecasting models of migration for the UK, by comparing the forecasts produced by different models against actual migration trends observed in the past.

2. The aim of our work was to assess the degree of uncertainty in migration forecasting models – or how likely the different forecasts were to be correct. This was done by comparing the results of various models for different migration flows against actual trends observed in the past. The performance of different forecasting models were tested for two periods with visible migration 'shocks': the 2004 enlargement of the European Union, and the 2009 economic crisis. The forecasts have been assessed according to the magnitude of errors, and their calibration – how well they describe the predicted uncertainty in comparison with the real data.

II. Background

3. There are many social, economic and political drivers which can impact migration flows, making forecasting migration an extremely difficult task (Bijak 2010). In particular, migration is very susceptible to shock events which are, by their very nature, hard to predict, such as economic cycles, military conflict and policy changes. Changes in migration flows can be subject to extreme short-term fluctuations, thereby making migration forecasts prone to very high levels of error (see also Keilman 2007, 2008; Shaw 2007).

4. In the past, migration forecasting has been attempted using a wide array of methods (Bijak 2010), with the central focus frequently on one or more of the following: extrapolation of past data, the opinion of experts in the field, and the inclusion of additional explanatory information, such as economic data and demographic characteristics. No method is considered to be universally superior, and the applicability of each method depends on the particular definition of migration under scrutiny, as well as the features of the data, such as how much data are available, how far into the future one is trying to forecast, and the stability (stationarity) of the underlying trends.

5. The inherent uncertainty about future migration flows is further compounded by the problems with the quality of collected migration data upon which forecasts rely. Data sources can differ in the coverage of specific migrant groups, the accuracy of measurement and even in the definition of migration itself (Raymer et al. 2013; Disney et al. 2015). Moreover, there exists no perfect and overarching migration theory that can be used for forecasting purposes (Arango 2000). Even if credible theoretical explanations of past migration flows do exist, their principles tend to be difficult to extrapolate into the future.

6. The main source of data used by the Office for National Statistics (ONS) to measure migration in the UK is the International Passenger Survey (IPS). The IPS has several important limitations. Due to the sampling of respondents adopted in the survey, breaking the data down, for example to look in detail at look at migrants from and to

specific countries of origin or destination, can give high margins of error. There can also be some bias in the numbers, related to the way the data are collected, and the long-term IPS estimates are based on the questions about the intended (rather than actual) length of stay in the UK or abroad. In this work, besides the IPS, we have also looked at the Home Office statistics on the inflow of asylum seekers, as well as shorter series on new National Insurance Numbers (NINo) from the Department of Work and Pensions, and data on international students from the Higher Education Statistics Authority.

7. To evaluate the empirical performance of different predictive models, four model groups were considered: (i) extrapolation of time series using various ARIMA models; (ii) Bayesian models (ARIMA) with expert prior information; (iii) econometric models with covariates (ADL); and (iv) extrapolation of time series through propagation of historical forecast errors. Overall, 198 different combinations of models and data series were examined, both for the series truncated in 2003 and in 2008 – before the 'shocks' related to the EU enlargement and economic downturn, respectively. The magnitude of errors was assessed through mean percentage errors, and the calibration was done for 50-per cent and 80-per cent predictive intervals (for details, see Disney et al. 2015).

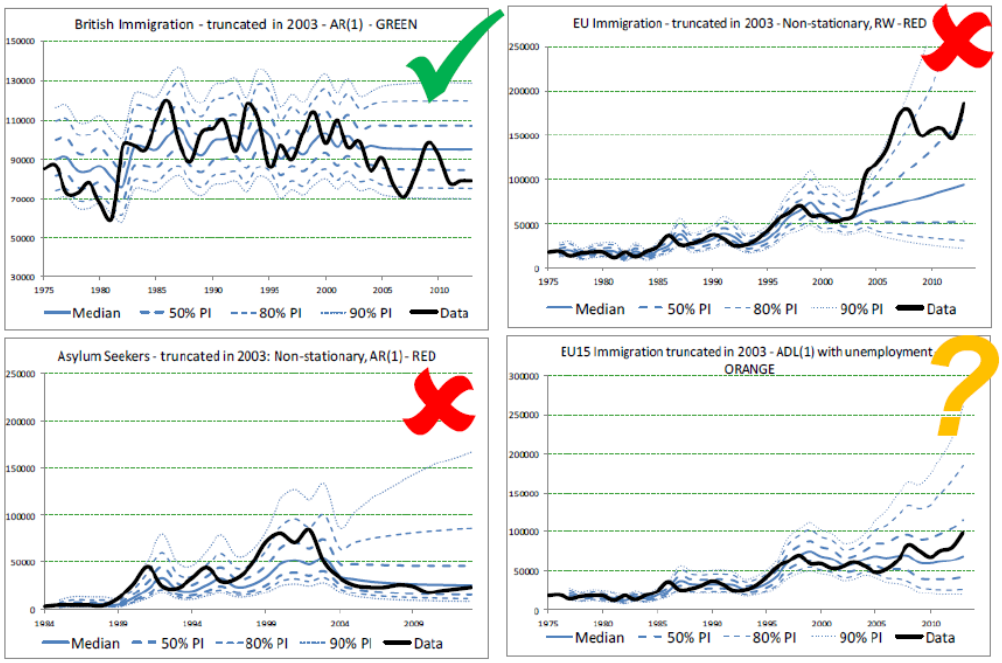
III. Results Highlights

8. All the models produced considerable uncertainty when tested against the observed data. The more successful forecasts were obtained for the more stable migration flows, such as those of UK nationals, which are less susceptible to unpredictable shocks or policy changes. In other situations, the applicability of any models was either limited, or completely inappropriate. Examples of the results obtained for a range of situations – from low errors and good calibration (✓), through higher, yet still tolerable errors and calibration (**?**), to large errors and/or poor calibration (✖) – are offered in Figure 1.

9. All the models examined in our work produced considerable uncertainty when tested against past data. For example, for migration from the new EU member states the more reliable models predicted that there was a 50 per cent chance that the average annual immigration between 2004 and 2013 would range from 100 to 200 thousand people; in reality, this proved to be just above 150,000. Some models produced smaller errors and consequently were deemed to have performed better than others. Notably, the more successful forecasts were observed when predicting more stable migration flows such as the migration of UK nationals, which are less susceptible to unpredictable shocks or policy changes.

10. In other situations, the applicability of various models was either limited, or completely inappropriate, with large errors and the actual observations remaining far outside the prediction intervals. In particular, no model was able to predict migration well if the underlying data series were short, or in the presence of 'shocks'. Still, even in such cases, some models performed better than others. When the migration process was expected to be unstable, models that did not assume stability (stationarity) of trends at least described the forecast uncertainty more accurately, and hence produced more honest results.

Figure 1: Results of the model assessment exercise, with series truncated in 2003, with examples of: stationary series; non- stationary series; presence of a structural break in 2003; and econometric models with 'perfect foresight' on their covariates



Source: Disney et al. (2015, p. 36) Authors' calculations; Data from the Office for National Statistics and Home Office

IV. Conclusion

11. From the analysis, there is no particular model that can be considered as conclusively superior. Instead, we recommend that future analysis utilise a three-step approach to migration forecasting: (1) assess the nature of the migration flow being forecast, (2) evaluate the available data, and (3) design a bespoke forecasting model given the data and the nature of the migration flow under study. Instead of trying to do the impossible and design the 'best possible' migration forecasting method, further work in this area should focus on the ways of describing the uncertainty of forecasts, and translating it into policy advice and decisions.

12. It is imperative that all migration forecasts emphasise the uncertainty involved in the predictions. This is necessary to transparently acknowledge that migration cannot be forecasted without substantial error, whilst also providing an account for the possible size of these errors. Different ways of showing the range of errors are possible, by the means of probabilities for various ranges of possible outcomes.

13. As the probability of a single forecast being correct is extremely low, it is vital that the uncertainty around migration forecasts is made explicit to decision-makers and the general public. Emphasising the uncertainty also allows decision-makers to correctly represent the fact that migration can be affected by a wide range of events, including 'shocks', all of which need to be taken into account as, although they are quite unlikely, their potential impact on migratory flows could be large.

14. More research needs to be done on early warning systems designed to detect the signs of changes in migration trends in response to various indicators or policies. Their outcomes could be presented and analysed using the risk management tools – combining the potential policy impacts with uncertainty of the underlying processes – to facilitate making prudent and robust decisions. An example of a risk management matrix concerning different migration flows is provided in Table 1, with the red and yellow areas being those of particular policy focus.

Table 1: A stylised example of a risk management matrix related to migration forecasts, from the point of view of possible policy impacts

Uncertainty (risk) / Impact	Low	Medium	High
Low		Long-term migration of UK nationals*	Short-term non-EU migration
Medium		Long-term migration of other EU nationals: old EU (Western Europe)* Long-term migration of non-EU nationals	Long-term migration of other EU nationals: Central & Eastern Europe* Short-term EU migration* Student migration
High		Visas issued, by type	**Refugees and asylum seekers**

Source: Disney et al. (2015, p 44)

Notes: Asterisks (*) denote flows, for which not too many policy controls exist. No migration flows are characterised by low uncertainty.

15. Another area for further exploration is the use of formal statistical decision analysis to support migration-related policies and decisions made under the conditions of uncertainty. Finally, the assessment of the data carried out within the project confirmed the presence of inaccuracies and biases associated with each of the data sources under study. There is a need to harmonise data to a common "true flow" before forecasting, which remains an important part of future research recommendations.

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References

Arango, J. (2000) Explaining Migration: A Critical View. International Social Science Journal, 52(165): 283–296.

Bijak, J. (2010) Forecasting international migration in Europe: A Bayesian view. Springer Series on Demographic Methods and Population Analysis, vol. 24. Dordrecht: Springer.

Disney, G., Wiśniowski, A., Forster, J.J., Smith, P.W.F., and Bijak, J. (2015) Evaluation of existing migration forecasting methods and models. Report to the Migration Advisory Committee. Southampton: Centre for Population Change.

Keilman N (2007) UK national population projections in perspective: How successful compared to those in other European countries? *Population Trends*, 129: 20–30.

Keilman N (2008) European Demographic Forecasts Have Not Become More Accurate Over the Past 25 Years. *Population and Development Review* 34(1): 137–153.

Raymer, J., Wiśniowski, A., Forster, J.J., Smith, P.W.F. and Bijak, J. (2013) Integrated modeling of European migration. Journal of the American Statistical Association, 108(503): 801–819.

Shaw C (2007) Fifty years of United Kingdom national population projections: How accurate have they been? *Population Trends*, 128: 8–23.