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Forecasting Scottish Migration in the Context of the 2014 Constitutional Change Debate

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ABSTRACT

Migration to and from Scotland might be affected by the outcome of the 2014 Scottish referendum on the constitutional future of the United Kingdom. This potential change in migration has not been thoroughly analysed to date. The aim of this paper is thus to present a set of predictions of the possible effects of Scottish independence on internal and international migration. In particular, different sources of uncertainty of future migration flows are examined. The presented forecasts are based on the available historical data on migration flows, as well as on the opinions of a panel of experts on future migration trends. Bayesian statistical inference is used to combine different sources of uncertainty in a coherent manner. The results indicate that there is substantial uncertainty about future migration to and from Scotland, which increases with the forecast horizon. The most uncertain flow is international immigration to Scotland. Emigration from Scotland is more likely than not to increase in the near future, whereas migration between Scotland and the rest of the UK is expected to remain at similar levels to the present, irrespective of the outcome of the 2014 independence referendum. © 2014 The Authors. *Population, Space and Place* Published by John Wiley & Sons Ltd.

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INTRODUCTION

In the context of the 2014 Scottish referendum on the constitutional future of the United Kingdom (UK), the aim of this paper is to forecast how Scottish independence might impact migration in Scotland, both within the boundaries of the current UK, as well as internationally. Four migration flows concerning Scotland are considered: in-migration from and out-migration to the rest of the UK, as well as immigration from and emigration to all other countries. The presented forecasts of migration are based on two key sources: the historical statistical data on Scottish migration and a Delphi survey amongst 12 experts, concerning the future migration trends. The forecasts, with a horizon of 2021, demonstrate the high uncertainty of future Scottish migration. Selected results of the Delphi survey are also discussed.

Migration is the most uncertain – and barely predictable – component of the population change; hence, forecasting it requires a careful assessment of the uncertainty (e.g. Bijak, 2010; Bijak & Wiśniowski, 2010; Abel *et al*., 2013). The uncertainty of migration predictions comes from several sources. First, unlike in the case of vital events, the concepts and definitions of a *migration* and of a *migrant* are vague and do not allow for efficient measurement (Poulain *et al*., 2006; Kupiszewska & Nowok, 2008; Raymer *et al*., 2013; Wiśniowski *et al*., 2013). Second, while the reasons for migration can vary greatly amongst migrants, the existing theoretical explanations are too specific and too fragmented to be helpful in predicting migration. Finally, migration itself is susceptible to many unpredictable factors, such as political and economic crises or policy changes (Bijak, 2010).

These uncertainties notwithstanding, forecasts of migration are required for informed policy-making, as well as for understanding reasons and consequences of migration (e.g. Alho & Spencer, 1985, 2005; Bijak, 2010). This information is especially vital before the Scottish independence referendum that is scheduled on 18 September 2014. Depending on the outcome of this referendum, Scottish Government's policy towards migration may diverge to a greater or lesser extent from the policy currently implemented by the government of the entire UK.

This paper makes three main contributions to the debate on the impact of possible constitutional change in the UK on Scottish migration. First, an explicit analysis of the uncertainty associated with migration forecasts is offered in terms of probability distributions, which goes beyond the standard variant approach used by the official statistics. Second, the assessment of the uncertainty utilises historical data, as well as formally elicited quantifiable expert opinion. Third, forecasts of migration processes, and of the result of the Scottish independence referendum, the latter based on a series of opinion poll data, are combined in a bespoke manner in a unique and topical area of application.

In terms of methodology, and especially with respect to the coherent quantification of uncertainty, the work presented in this paper is based on Bayesian statistics. The essence of Bayesian inference, based on joint probability distributions of all random quantities under study, is that it offers a natural framework for incorporating various sources of uncertainty in forecasts. These sources may include the following: natural variability of the process under study, measurement errors, uncertainty about the forecasting model and its parameters, ambiguities of the expert opinion, and the inevitable and irreducible uncertainty of the future (Bijak, 2010; Bijak & Wiśniowski, 2010; Gelman *et al*., 2013).

This paper is structured as follows. In the next section, the background of the study is described, with a focus on two aspects: a brief summary of the current political debate on migration in Scotland, followed by a discussion of problems related to migration measurement in the policy context. In the section on Methodology, the forecasting method is presented, including a discussion of the Delphi study amongst experts on future migration in Scotland. In the section on Results, the forecasts of Scottish migration are reported. Lastly, the section on Discussion and policy implications offers a summary of findings and recommendations for policymakers.

BACKGROUND

Constitutional Context

Following the re-establishment of a Scottish Parliament in 1997, some of the political control has been repatriated from London to Edinburgh. Scotland now has the power to make laws in so-called Devolved Matters, such as education, justice, health, economic development, or internal transport. On the other hand, responsibility for the Reserved Matters rests with the Parliament of the UK in Westminster. The Reserved Matters include, amongst others, defence, foreign policy, benefits, oil, gas and electricity, and immigration (Scottish Parliament, 2014).

The 2014 independence referendum will ask Scottish residents whether Scotland should be an independent country. As set out in the Scottish Government (2013) White Paper *Scotland's Future*, if the majority of voters answer positively, from 24 March 2016, Scotland will be able to decide about all Reserved Matters, while the monarch of the UK will remain the head of state.

Being an important element of the Reserved Matters, the migration policy for Scotland is decided centrally in Westminster for the entire UK. According to the Scottish Government (2013), immigration policy of the UK Government is too restrictive and thus hampers population and economic growth in Scotland. For example, since the late 1990s, there was a steady increase in immigration from overseas and decline in out-migration to the rest of the UK. However, in 2012, the net migration flow to Scotland dropped from 27,000 to 12,700 persons, which was a result of an increase in emigration overseas and reduction of immigration. Details on the differences between the UK and Scottish Government policy stance on migration, and between the public attitudes to immigration in Scotland and elsewhere in the UK, are discussed in McCollum *et al*. (2014).

In Scotland, migration is a very important component of the overall population growth (NRS, 2014). The issues of population ageing

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and potential decline, especially concerning the working age groups, are on top of the Scottish Government's agenda and at the core of their economic strategy (Wilson & Rees, 2003; Rolfe & Metcalf, 2009). Currently, there is an official target for population growth in Scotland, which is envisaged to match that of the EU 15 countries by 2017 (Scottish Government, 2013: 140). Migration is clearly one of the key variables that have impact on the population growth target. Still, the key component of Scottish migration is related to flows to and from the rest of the UK, with levels of international migration being of slightly lower magnitude.

Migration Measurement Issues

Generally, measurement of migration in Scotland, as well as in the entire UK, is difficult because of the limitations of the data collection mechanisms used. Information on international migration is obtained from the International Passenger Survey (IPS), whereas the data on internal migration come from the National Health Service Central Register of patients. While the former can be inadequate because of the sampling and non-sampling errors of the survey, the latter can be biased by the under-registration or delayed registration of migrants (Singleton *et al*., 2010; Raymer *et al*., 2011, 2012). As is acknowledged by Rolfe and Metcalf (2009), these limitations pose a serious obstacle for preparing population estimates and projections, which serve as the evidence base for policymaking.

The population estimates and projections for Scotland are prepared by the National Records of Scotland (NRS). The projections are scenario based, that is, various assumptions are made about the future mortality rates, fertility rates, and net migration volumes, which are subsequently used as input in the cohort-component model of population dynamics (NRS, 2014). There is a principal (base) scenario, as well as low and high variants for each of the three components of population change. The base scenario is interpreted as reflecting a likely and plausible trajectory of the future population change, whereas the low and high ones correspond to some realistic lower and upper bounds. For net migration, the levels are assumed to converge to +7,000 (low variant), +15,500 (base variant), or +24,000 (high variant) by mid-2018 and remain constant thereafter. Additional scenarios explore effects of changes in the components on the projection outcomes, for example, by assuming zero net migration.

The official projections prepared by the NRS suffer from two major shortcomings: (a) there is no specification or assessment of the likelihood of any of the scenarios, and (b) the assumptions relate to net migration, rather than separately to inflows and outflows. This approach is known to conflate the flows in both directions, which may be largely independent from each other, and to obscure the resulting age distributions (Rogers, 1990). While in this paper the overall methodology of population projections is not addressed, the proposed method allows for overcoming these two limitations. In particular, by forecasting the international, as well as intra-UK migration flows separately, the method is capable of surmounting the shortcomings of the net migration approach. Moreover, the suggested methodology is also capable of integrating various sources of uncertainty in the forecasts and explicitly describing the future migration in probabilistic terms.

METHODOLOGY

Expert Knowledge Elicitation

As mentioned in the Introduction, the forecasts of Scottish migration are based on several pieces of information. The first one – expert opinion – has been obtained by means of a two-round Delphi survey (e.g. Armstrong, 1985; Rowe & Wright, 1999, 2001). The survey has been carried out between June and August 2013, amongst 12 migration experts. It was aided by an online Multidisciplinary Assessment of Technology Centre for Healthcare (MATCH) Uncertainty Elicitation Tool (Morris *et al*., 2014). The questionnaire was designed following the general advice on elicitation given by Kadane and Wolfson (1998), O'Hagan (1998), and O'Hagan *et al*. (2006), as well as recent applications of the Delphi survey for migration modelling and forecasting in Bijak and Wiśniowski (2010), Abel *et al*. (2013), Raymer *et al*. (2013), and Wiśniowski *et al*. (2013).

The questionnaire used in this work consisted of a preamble, which introduced the project aims and explained elicitation methodology, followed by five specific questions and an open question

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for providing comments or suggestions by the respondents. The first question was related to the subjective probability of gaining independence by Scotland. The next question related to in-migration from the rest of the UK to Scotland in two scenarios: gaining independence or remaining in the UK. The experts were asked to state if the selected components of migration (i.e. students, young workers, families with children, and retirees) would increase, decrease, or remain at the same level, and invited to 'bet' on the level of the total number of migrants in 2021 for each of the scenarios, by using the online elicitation tool. 'Betting' consisted in placing a desired number of 'chips' on a given range of the level of future migration. Experts were also informed about the level of migration observed in 2011.

The next three questions on, respectively, out-migration from Scotland to the rest of the UK, international immigration to Scotland, and international emigration out of Scotland were constructed in a similar fashion. The 'bets' on the level of migration were further transformed into the probability distributions for the expected levels of migration in 2021, by using the built-in features within the MATCH elicitation tool. In general, online betting proved to provide a very efficient and intuitive way of eliciting the uncertainty of experts about the future levels of migration. The two-round design of the survey allowed for a possibility of convergence of the views of particular experts. However, this largely did not take place in the study.

Bayesian Time Series Forecasting

The forecasts of migration flows are based on a combination of expert knowledge and statistical trend data, brought together under a common Bayesian framework for forecasting and describing the associated uncertainty. To produce the forecasts, annual, historical, and officially reported end-of-year data on migration from 1975 to 2011 have been used. The data were obtained from the National Records of Scotland and supplemented by information from the Office for National Statistics for the rest of the UK. The data series are presented in Figures 2 and 3 in the section on Results, alongside the forecasts. The results from the forecasting model should be analysed bearing in mind the shortcomings of the data discussed in the section on Background.

The forecasting model has been constructed similarly as in Abel *et al*. (2013), following the methodological work by Bijak (2010) and Bijak and Wiśniowski (2010). First, expert views related to the level of migration in the forecast horizon year $H = 2021$ have been transformed into the prior distribution in the following ways. Let the level of expected migration in 2021 be denoted by v, which is obtained as a mixture probability distribution over all experts, $i = 1, \ldots, n$, for $n = 12$. For each expert i, a log-normal distribution $f_i(v)$ has been constructed using the results obtained from the online MATCH elicitation tool. Subsequently, the individual densities have been combined into a single prior distribution, π:

$$\pi(v) = \frac{1}{n}\sum_{i=1}^{n} f_i(v). \tag{1}$$

Further, let y_t, $t = 1975, \ldots, T$, where $T = 2011$, denote a natural logarithm of a given migration flow in year t. To produce forecasts, a simple autoregressive model of order 1 has been used, whereby

$$\begin{aligned} &y_t \sim N\left(\mu + \varphi\left(y_{t-1} - \mu\right), \tau\right) \text{ for } t = 1976, \ldots, T \\ &y_t \sim N\left(\mu^* + \varphi\left(y_{t-1} - \mu^*\right), \tau\right) \text{ for } t = T+1, \ldots, H \\ &\varphi \sim N(0, 0.1), \quad \mu \sim N(0, 0.0001), \\ &\tau \sim N(0, 0.0001)\mathrm{I}(\tau > 0). \end{aligned} \tag{2}$$

In the previously mentioned specification, μ is a mean of the flow (on a logarithmic scale), φ is an autoregressive parameter, τ is a precision (inverse of a variance), and the notation $\mathrm{I}(\tau > 0)$ represents a probability distribution that has been truncated to include positive values only. The precision parameter reflects the variability of the data y_t, $t = 1975, \ldots, T$, which is propagated in the forecasts for $t = T+1, \ldots, H$, where $H = 2021$ is the forecast horizon. This uncertainty is distinct from the uncertainty about the expected level of migration in 2021 expressed by the experts and reflected by the prior density in Equation (1).

The uncertainty of the resulting forecasts has to include uncertainty embedded in the historical data, uncertainty of the experts about future migration, and the uncertainty about possible outcomes of the 2014 independence referendum and its impact on migration. In order to reflect that in an appropriate manner, the forecasts and

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their uncertainty have been averaged over various scenarios. The hierarchy of scenarios for all four directions of flows is presented in Figure 1.

For each of the flows, two mutually exclusive scenarios have been considered:

(i) Scotland does not gain independence and the constitutional status quo remains, or
(ii) Scotland gains independence.
Further, for the independence scenario, four different paths of expected migration flows have been proposed:

(a) gradual change from the current level to the level foreseen by the experts;
(b) a sudden change to expected levels in 2016 – the year of actual gaining of independence according to the White Paper *Scotland's Future* (Scottish Government, 2013);
(c) a gradual change towards the expected 2021 levels, starting from 2016; and
(d) gradual change right from the referendum year (2014).
These scenarios are represented by different specifications of the μ^* parameter in Equation (2).

Because the likelihoods for all averaged models are exactly the same and there is no strong prior information about which variant path (a–d) is more plausible, the posterior weights have been assumed equal for all of them. The two main scenarios, in turn, have been weighted by the predicted probability of particular referendum outcomes, with two mutually exclusive possibilities: independence (with probability p) and remaining in the UK (with probability $1 - p$). The referendum predictions were obtained from combining the expert survey with the results of various opinion polls carried out in 2013, disregarding the 'unknown' or 'undecided' answers.

For the logit-transformed share of the poll respondents who declared voting for the independence, an autoregressive model has been constructed. The results of the poll were obtained from the UK Polling Report website.[1] The use of prediction market data has also been considered, but the best-suited market, which used to trade in contracts related to the Scottish independence, Intrade.com, stopped trading in March 2013, which would render the relevant data too outdated.

The subjective opinion elicited from the experts was used only as prior information, which subsequently was modified by the available historical data on migration and the results of the opinion polls. The prior input has been especially important in averaging of the forecasts uncertainty, as the outcome of the referendum remains unknown up to date. However, migration data play a key role in shaping the uncertainty of future migration trends, which has proved to be much more influential than the referendum result. Prior distributions for the remaining model parameters (i.e. μ, φ, and τ) are very weakly informative and have hardly any impact on the posterior distributions.

RESULTS

The results of the Delphi survey indicate that the impact of Scottish independence on migration may largely depend on the group of migrants in question, with the migration of students and young workers being potentially the most

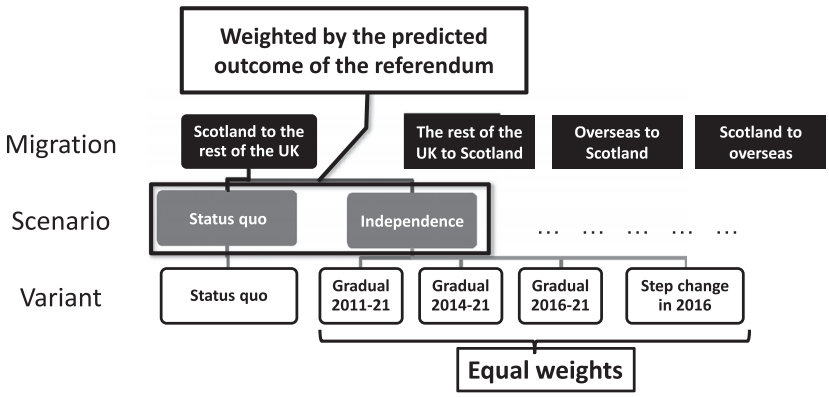

Figure 1. Conceptual framework of the scenarios hierarchy.

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sensitive to constitutional change. The dominant directions of the expert answers for particular migration flows, migrant groups under the two scenarios, are summarised in Table 1.

The expert answers revealed relatively higher uncertainty – and a wider spread of views – under the scenario of Scottish independence. The subjective probabilities of independence were also obtained from the panel of experts. Here, the majority of the panel felt that there was a rather small likelihood of full Scottish sovereignty being achieved following the referendum. In general, the expert uncertainty about future migration has been found to be a crucial component of the overall forecast errors. Fuller details of the Delphi survey amongst experts can be found in Shang *et al*. (2014).

The forecasts of the four directions of Scottish migration are shown in Figure 2, separately for the two scenarios: status quo (left column) and independence (right column). In general, the forecasts seem to be moderately sensitive to the expert information about the potential impact of the referendum outcome. More substantial differences can be noticed for in-migration from the rest of the UK to Scotland (panel A in Figure 2) and emigration from Scotland to the rest of the world (panel D in Figure 2). The averaged forecasts for the four directions of flows, weighted by the predicted probability of independence, are, in turn, presented in Figure 3. They take into account the historical data, expert opinion on the level of migration in 2021, and the uncertainty about the referendum outcome. The overall uncertainty of forecasts presented in Figure 3 is thus weighted across both scenarios – status quo and independence – and, for the latter, across the four assumed variant paths.

For in-migration from the rest of the UK to Scotland, the results suggest that it will generally remain at similar levels as observed in the past. The uncertainty of the forecasts indicates that this migration flow is more likely to decrease than increase, which seems to be even more plausible under the independence scenario. As far as out-migration from Scotland to the rest of the UK is concerned, it is expected that it will also remain at similar levels to those observed in the 1990s and 2000s, although with a slight tendency to increase. Here, it is also expected that the outcome of the independence referendum will have hardly any impact on the level of flows.

Immigration flows to Scotland from the rest of the world are characterised by substantial uncertainty. On average, however, future immigration is likely to remain at similar levels to those observed in the 2000s. Nevertheless, there exists a non-negligible probability of large inflows. Further, immigration from overseas does not seem to be much affected by the referendum outcome. This finding is likely due to the fact that the effect of the referendum has been largely subsumed within the generally high unpredictability for this direction of flows.

Finally, for emigration flows from Scotland to the rest of the world, the referendum outcome is not expected to be a major driver of mobility. It is forecasted, although, that emigration flows will

Table 1. Summary of expert views on the changes in migration components.

	Students		Young workers		Families with children		Retirees	
	Independence	Status quo	Independence	Status quo	Independence	Status quo	Independence	Status quo
In-migration from the rest of the UK	↓	~	↓	↑	↓	~	↓	↑/~
Out-migration to the rest of the UK	↓	~	↑	~	?	~	↓	~
International immigration	↑	↑/~	↑	~	↓	~	↑	~
International emigration	↑/~	~	↑	~	~	~	~	~

Notes: '↓' denotes that a majority of experts expect a migration component to decrease, '↑' – to increase, '~' – to remain unchanged, and '?' indicates that the experts were undecided. Source: Shang *et al*. (2014).

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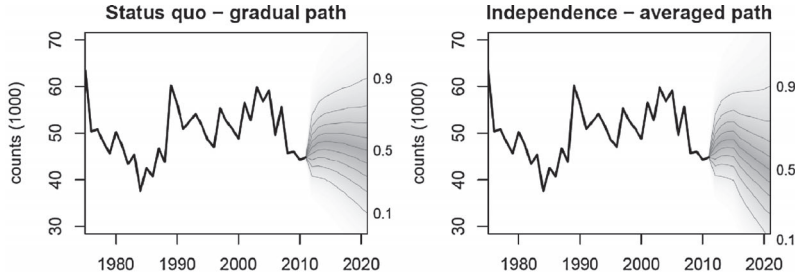
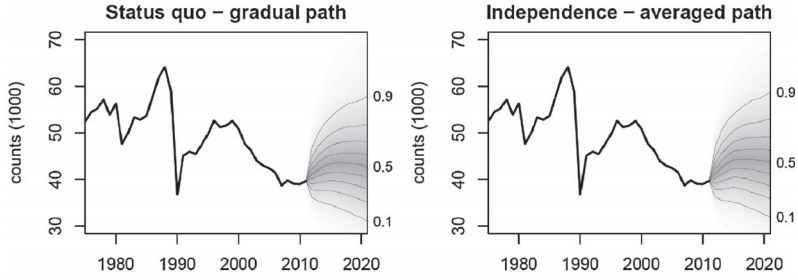
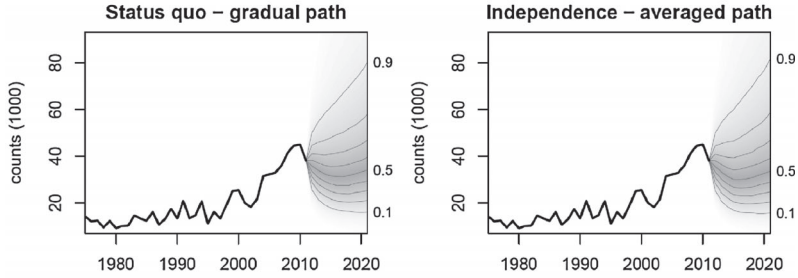
A) In-migration from the rest of the UK to Scotland, data for 1975–2011 (solid line) and forecasts for 2012–2021 (grey shadings), in thousands



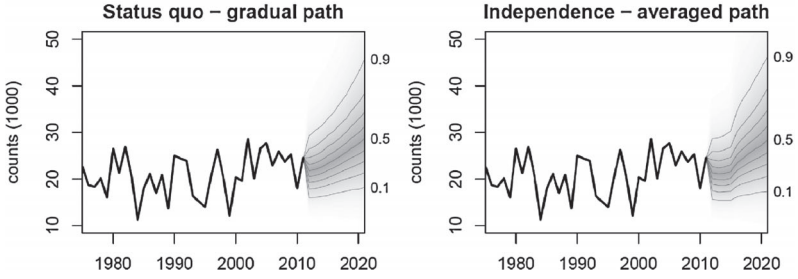
B) Out-migration from Scotland to the rest of the UK, data for 1975–2011 (solid line) and forecasts for 2012–2021 (grey shadings), in thousands



C) Immigration from the rest of the world to Scotland, data for 1975–2011 (solid line) and forecasts for 2012–2021 (grey shadings), in thousands



D) Emigration from Scotland to the rest of the world, data for 1975–2011 (solid line) and forecasts for 2012–2021 (grey shadings), in thousands



Source: own computations; migration data from the ONS and NRS

Note: Grey lines in the forecasts represent deciles (0.1 probability bands) of the uncertainty of predictions, and the shades of grey represent plausibility of a given migration path to fall into a given range– the lighter the colour, the less plausible a given path is.

Figure 2. Forecasts of Scottish migration under two scenarios: status quo (left column) and independence (right column).

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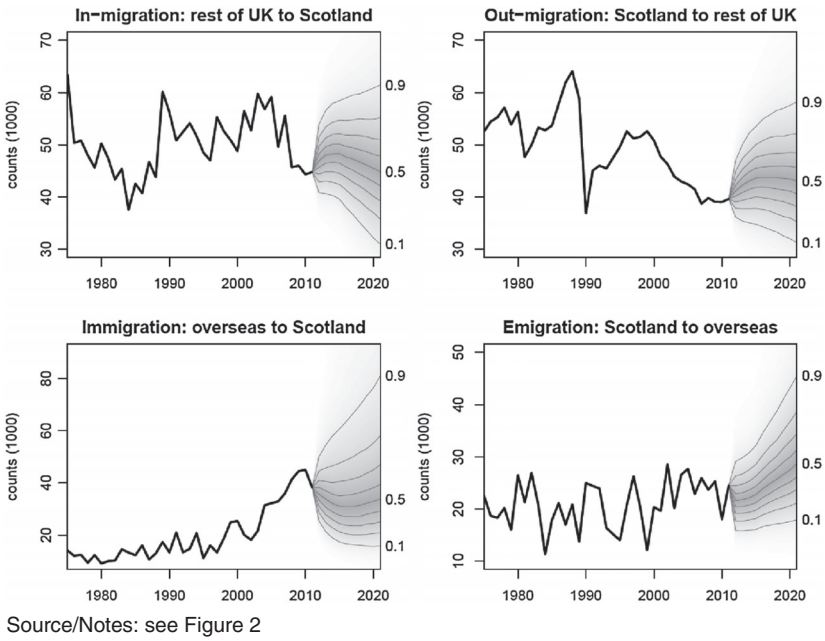

Figure 3. Migration into and out of Scotland, data for 1975–2011 (solid line) and averaged forecasts for 2012–2021 (grey shadings), in thousands.

likely increase towards the horizon of 2021, compared with the historically observed levels.

DISCUSSION AND POLICY IMPLICATIONS

The predictions of Scottish migration presented in this paper are based on the results of the Bayesian forecasting model and take into account the available historical data, expert views, and predictions of the outcome of the referendum on independence, based on the opinion poll data. The analysis reveals high uncertainty about both internal and international migration in Scotland. On the one hand, as discussed in McCollum *et al*. (2014), independent Scotland may try to attract more migrants from abroad. On the other hand, the inflow will likely be balanced by an increase in emigration. Migration exchange with the rest of the UK is expected to remain at similar levels as those observed in the past two decades.

This last finding can be explained by the fact that, according to the Scottish Government (2013: 14), Scotland is expected to remain in the Common Travel Area (CTA) with the rest of the UK. Then, the agreements about travelling without systematic passport and immigration control between Scotland and the rest of the UK will remain intact. However, this may lead to a situation when Scotland is used as a 'backdoor' to the rest of the UK by those migrants, whose direct entry is limited. For this reason, even in the case of independence, new Scottish immigration policy may not diverge greatly from the current rather restrictive approach implemented by the UK Government.

Still, since the Scottish Government, in its White Paper on *Scotland's Future*, has identified immigration as one of the key drivers of population and economic growth, the considerations explored in this paper are clearly important for decision-making surrounding migration policy. If constitutional change allows the Scottish Government to set up and implement its own migration policy, it is expected to follow a less-restrictive approach to immigration than the current UK policy. However, this policy would plausibly have to take into account the views of the UK Government and its own approach towards immigrants, mainly because of the CTA arrangements (for further discussion, refer to Meehan, 2014).

In terms of the forecasting methodology, the main contribution of this paper is twofold. First, the forecasting method integrates uncertainty from the data, expert views, and various scenarios of future migration depending on the

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outcome of the constitutional referendum. This approach is recommended as an alternative to the official scenario-based projections, as whole probability distributions offer the forecast users more information in comparison to variant scenarios. Second, it has been demonstrated that a Delphi survey, aided by online elicitation tools, can be utilised to obtain useful information on the expert uncertainty concerning future migration flows. The MATCH elicitation tool (Morris *et al*., 2014) has proven to be very helpful in quantifying the expert uncertainty, although some experts initially required additional explanation of the 'betting' method. In that respect, for future applications, it is also recommended that more emphasis is put on eliciting the explanations and justifications for the views expressed in quantitative terms. It needs to be stressed that the results of the survey are not used in the forecasting process on their own but are used within the Bayesian approach to augment the available quantitative data.

More general challenges that remain open to future research include disaggregating flows by the broad group of origin countries (such as EU and non-EU), or by age and sex, and investigating how the outcome of the referendum may impact these specific groups. However, what may obstruct the analysis is the high sampling error in the disaggregated data originating from the IPS. Here, a solution could be using alternative sources of data, such as in the Integrated Model for European Migration project (Raymer *et al*., 2013; Wiśniowski, 2013). Moreover, forecasting disaggregated variables would plausibly require detailed subjective opinion, about which experts might be very uncertain. Another option is to explore a broader class of forecasting models and carry out Bayesian model averaging for them (Bijak, 2010; Abel *et al*., 2013).

The limitations and possibilities for further research notwithstanding, the key lesson from the current piece of work is that the potential impact of the constitutional change on Scottish migration is not of primary importance for the future migration flows into and out of Scotland. When compared with the overall forecasting uncertainty of the underlying migration processes, the uncertainty of the referendum result did not prove to be very consequential. Hence, irrespective of the referendum outcome, any political and policy strategies and decisions dealing with the future of Scottish migration will need to take the large uncertainty of migration forecasts into account.

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NOTE

(1) Available at http://ukpollingreport.co.uk/scottish-independence-referendum (accessed on 31 January 2014).

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