ESRC Centre for Population Change

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Empirical Evaluation of Migration Forecasting Methods

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Background

- Project "Evaluation of existing migration forecasting methods and models"

- Commissioned by the Migration Advisory Committee, Home Office

- **Aims:**
    - **(1)** to evaluate the existing approaches to forecasting UK international migration;
    - **(2)** to assess the uncertainty of different forecasting methods

All the views and interpretations presented in this talk are those of the authors, and do not reflect the views of the Home Office or the Migration Advisory Committee.

Uncertain migration

- Uncertainties in migration research
  - Measurement
    - Different concepts and definitions
    - Different data collection mechanisms and incomplete reporting
  - Theories
    - Fragmented explanations offered by different disciplines
    - Very strong assumptions
  - Forecasts
    - Model specification, parameters, and covariates
    - Immanent and irreducible uncertainty about the future
  - **Individual decisions**

Uncertain forecasts

- **Example:** The 2004 EU enlargement

  - Forecasts of net migration of "around 5,000 to 13,000 individuals" from the accession countries to the UK [Dustmann et al. 2003, p. 57]

  - In reality, the true net figure was about 40,000 in 2004–12

  - Main issues with these forecasts:

    - No probability assessment of different outcomes

    - Assumption of stationarity – past migration patterns will continue

    - Reliance on macroeconomic predictors and ignoring the looming policy changes with regard to opening the labour markets
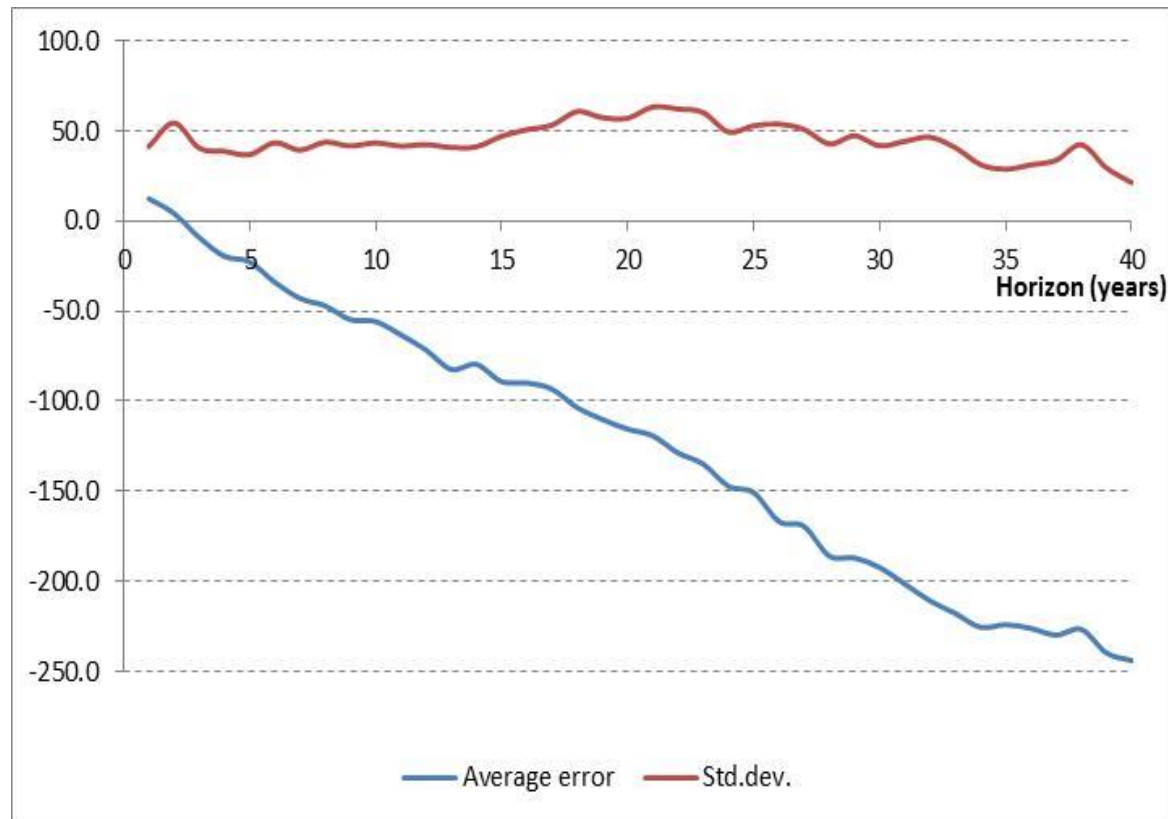
Methodological State of the Art

- Migration is **volatile and barely predictable**; too precise forecasts are doomed to fail

- Uncertainty compounded by data problems

- Various forecasting methods used in the past: extrapolation of the past data or past forecast errors, expert opinion, including explanatory economic data and demographic data, etc.
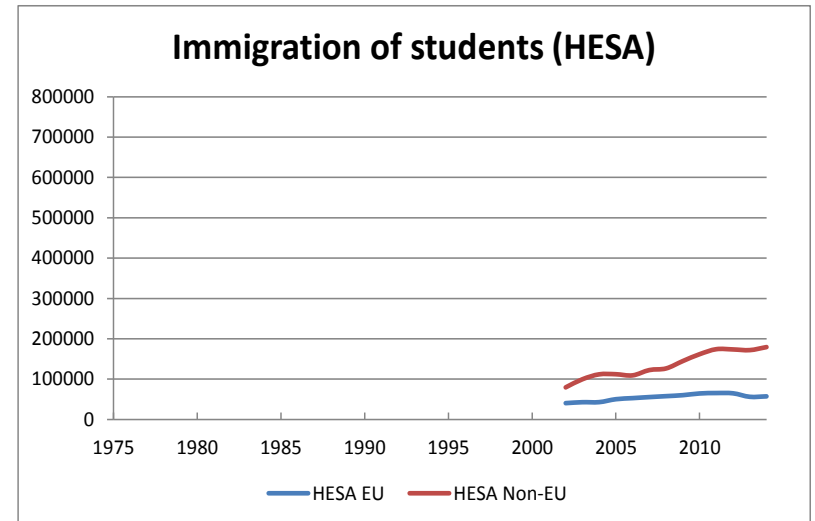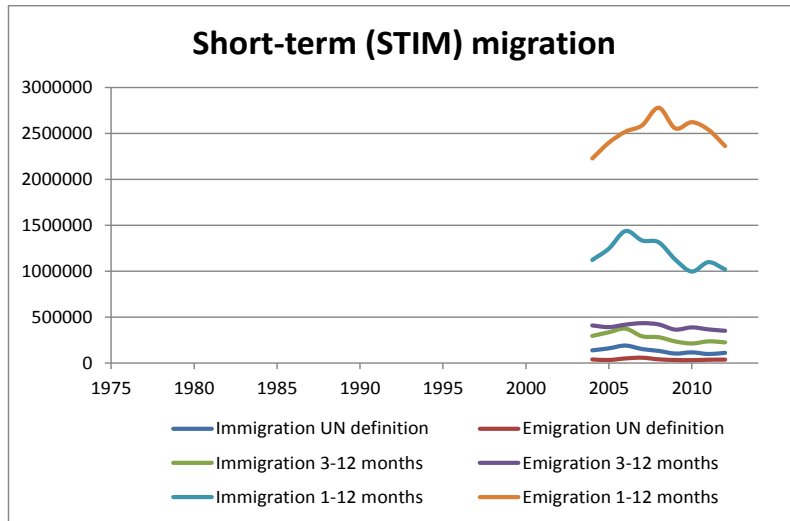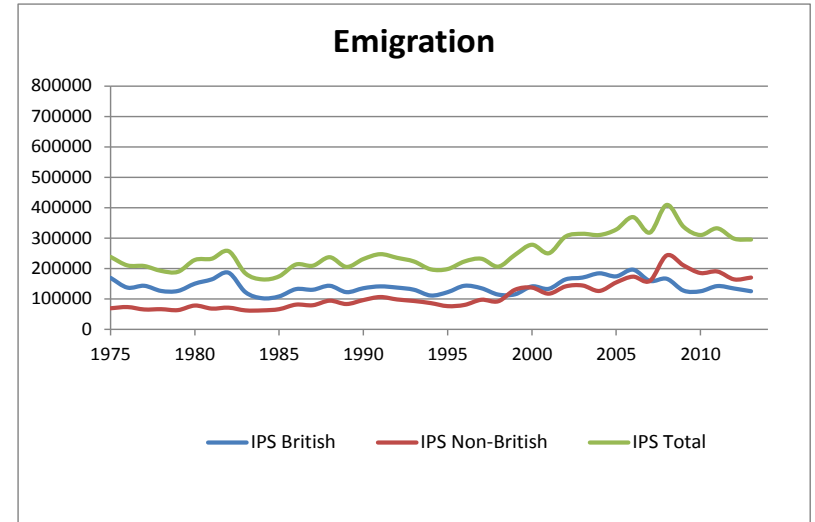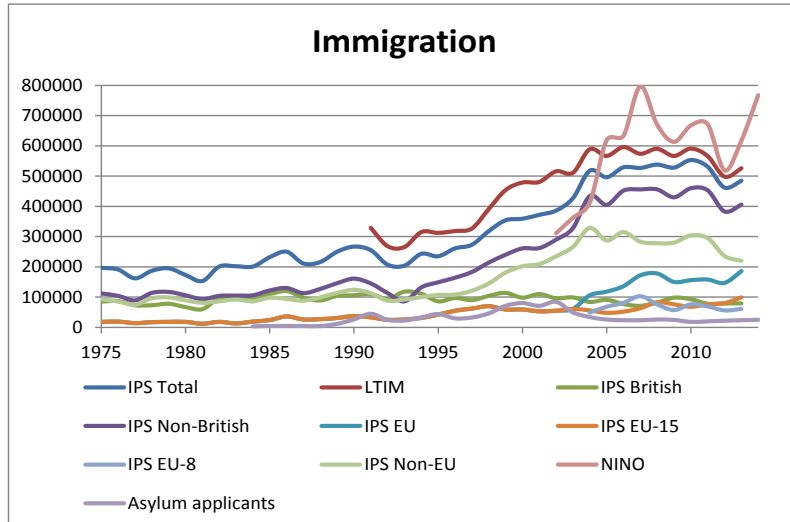
- **No method universally superior**

Extrapolation of Past Errors

Average error and its standard deviation by projection horizon, NPP 1970-based to 2012-based

Source: Government Actuary's Department / ONS

Data

Immigration

Legend: IPS Total, LTIM, IPS British, IPS Non-British, IPS EU, IPS EU-15, IPS EU-8, IPS Non-EU, NINO, Asylum applicants

Emigration

Legend: IPS British, IPS Non-British, IPS Total

Short-term (STIM) migration

Legend: Immigration UN definition, Emigration UN definition, Immigration 3-12 months, Emigration 3-12 months, Immigration 1-12 months, Emigration 1-12 months

Immigration of students (HESA)

Legend: HESA EU, HESA Non-EU

Source: ONS; HESA; Home Office (various years)

Assessment Framework

- Insight into forecast uncertainty offers decision makers additional information beyond single (deterministic) variants

- Empirical assessment by comparing the results of various models for different migration flows against the past trends

- **Two crucial challenges:**
  - Synthesis of this information
  - Communication to the users

Assessment Framework

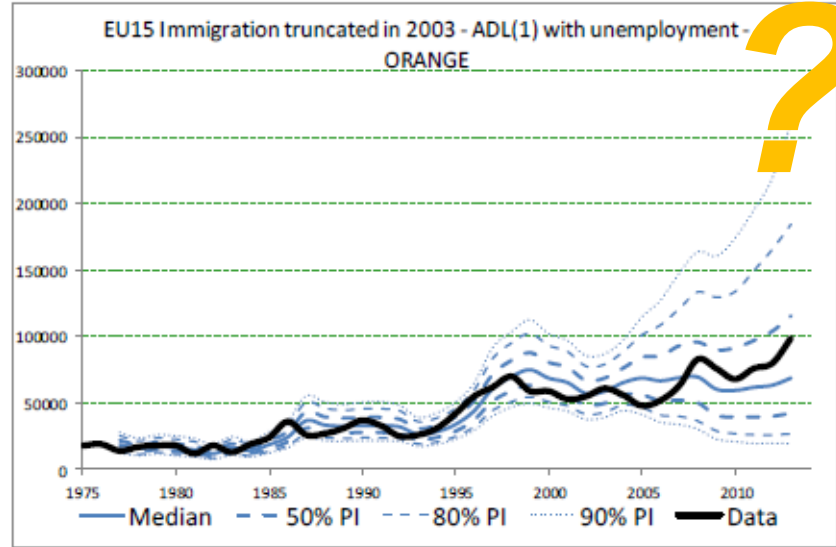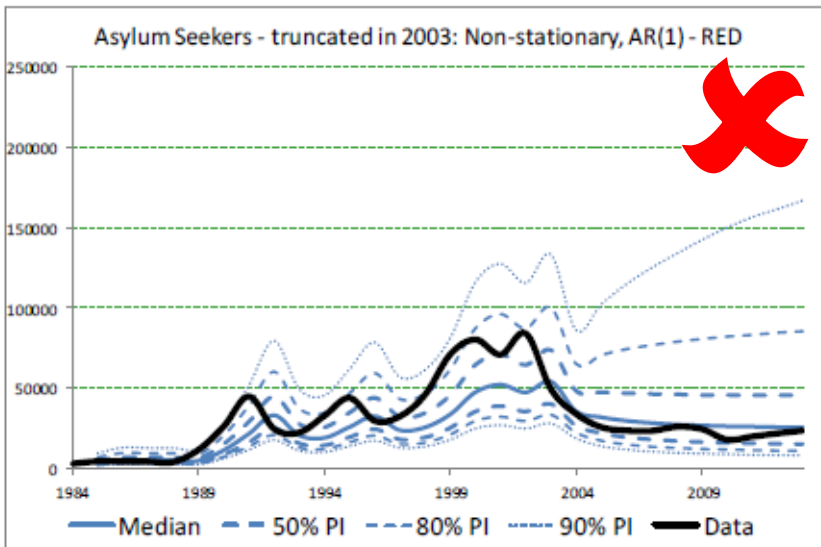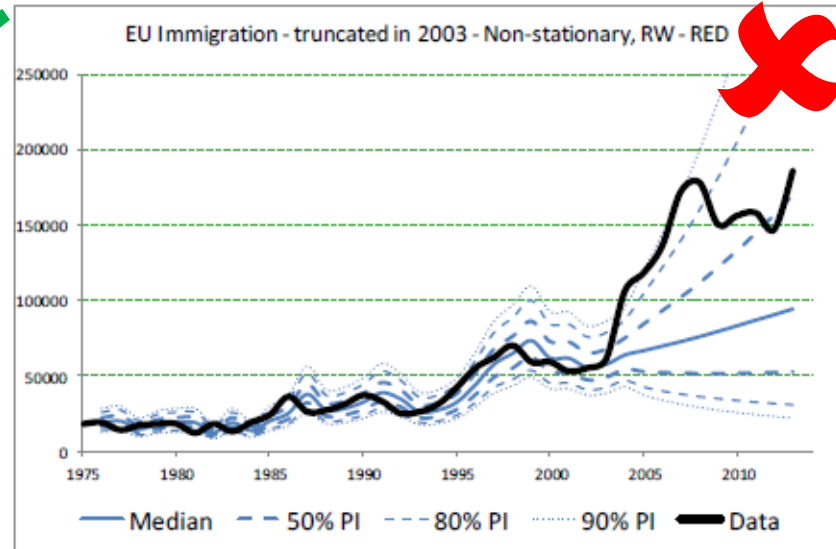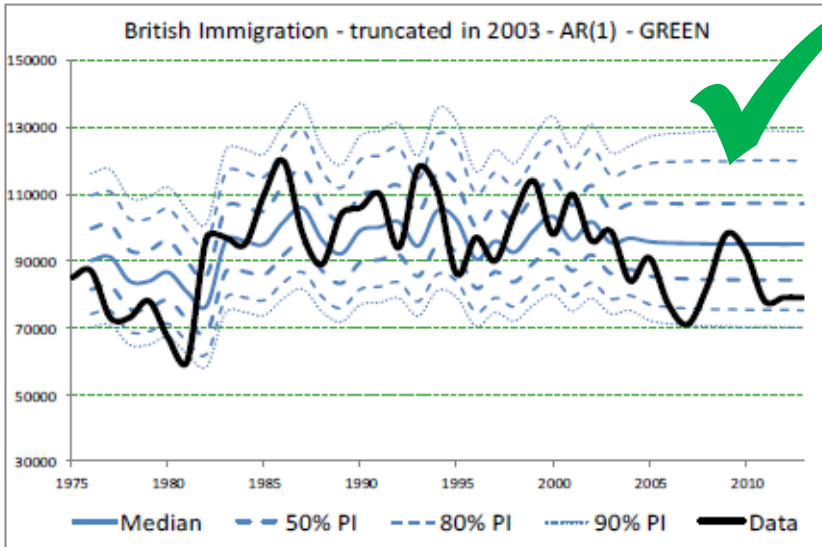| Class	Data sources	Methods vs. models	Empirical results
   	• Good match to a given definition • Small random errors • Small biases	• Method readily applicable to available data	• Low errors ex post • Generally well-calibrated
   	• Reasonable match to a given definition • Medium errors • Medium biases	• Some issues (e.g. small samples), but surmountable given additional input	• Medium errors ex post • Some problems with calibration
   	• Poor match to a given definition • Large errors • Large biases	• Method not applicable to available data	• High errors ex post • Uncertainty not calibrated

Methods and Models

- Several methods looked at, chiefly time series and extrapolation of past errors

- A range of data sources with different features: **(non)stationarity, series length**

- Analysis of errors and calibration

  - Mean Percentage Error (bias)

  - Empirical coverage of 50% and 80% intervals

  - Exercise on series truncated in 2003 and 2008

Methods and Models

- Problems with theory-based forecasting
  - Migration theories are to weak and too fragmented to be useful
  - The future of migration determinants themselves can be very uncertain
  - Estimation of relationships between covariates and migration: another source of error
  - Result: If all these problems are combined, the forecast is almost pure uncertainty

Selected results

British Immigration - truncated in 2003 - AR(1) - GREEN

EU Immigration - truncated in 2003 - Non-stationary, RW - RED

Asylum Seekers - truncated in 2003: Non-stationary, AR(1) - RED

EU15 Immigration truncated in 2003 - ADL(1) with unemployment - ORANGE

Selected results

- **No single model is conclusively superior**

- Results are not surprising: better forecasts for the more stable data series (e.g. flows of the UK nationals), less susceptible to shocks or policy changes

- Models assuming stationarity not to be used for non-stationary data series (and vice versa)

- Additional information – expert judgement, for example in Bayesian models – can help

Migration – Risk Management Matrix

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

* Existing policy controls

General Remarks

- Paradigm change in forecasting: from determinism to acknowledging uncertainty

- Focus not on methods, but on possible impacts and consequences of decisions

- Various sources of uncertainty need to be acknowledged and combined in the analysis

See a letter on "Probabilistic population forecasts for informed decision making", forthcoming in *Journal of Official Statistics* (Bijak et al. 2015)

Open Challenges

- Convince the users and producers of forecasts about the **added value** of uncertainty analysis

- **Bespoke approaches**: forecasts tailored to specific needs of different users and audiences

- Tailoring predictions and eliciting the relevant information requires **interaction with users**

- More **methodological research**: calibrating tails of distributions, developing methods for forecasts for specific decisions

Key Messages – General

- Migration cannot be forecast without error

- Imperative to emphasise uncertainty involved in all migration forecasts

- The probability of a single forecast being correct is extremely low: this needs to be made explicit to decision-makers and the general public

- Migration can be affected by a wide range of events, including 'shocks', which, although unlikely, can have potential impact on migration

Key Messages – Methodology

- **Multiple layers:** data, models, combinations of the two, and their empirical performance

- Communication challenge addressed by applying a traffic-lights system

- **First adding uncertainty, then reducing it**

- The framework cannot be applied to single deterministic scenarios: not possible to assess calibration

Recommendations

A three-step approach is recommended:

1. Assess the **nature of the migration flow** being forecast (stationary, volatile...)

2. Evaluate the **available data** (quality, accuracy, possible biases)

3. Design a **bespoke forecasting model,** reflecting both the character of the given migration flow and the data

For more details…

Full report: https://www.gov.uk/government/publications/evaluation-of-existing-migration-forecasting-methods-and-models

Probabilistic forecasting letter in *Journal of Official Statistics* 31(4), 537–544: http://www.degruyter.com/view/j/jos.2015.31.issue-4/jos-2015-0033/jos-2015-0033.xml

Thank you!

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