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# The use of expert information in migration forecasting

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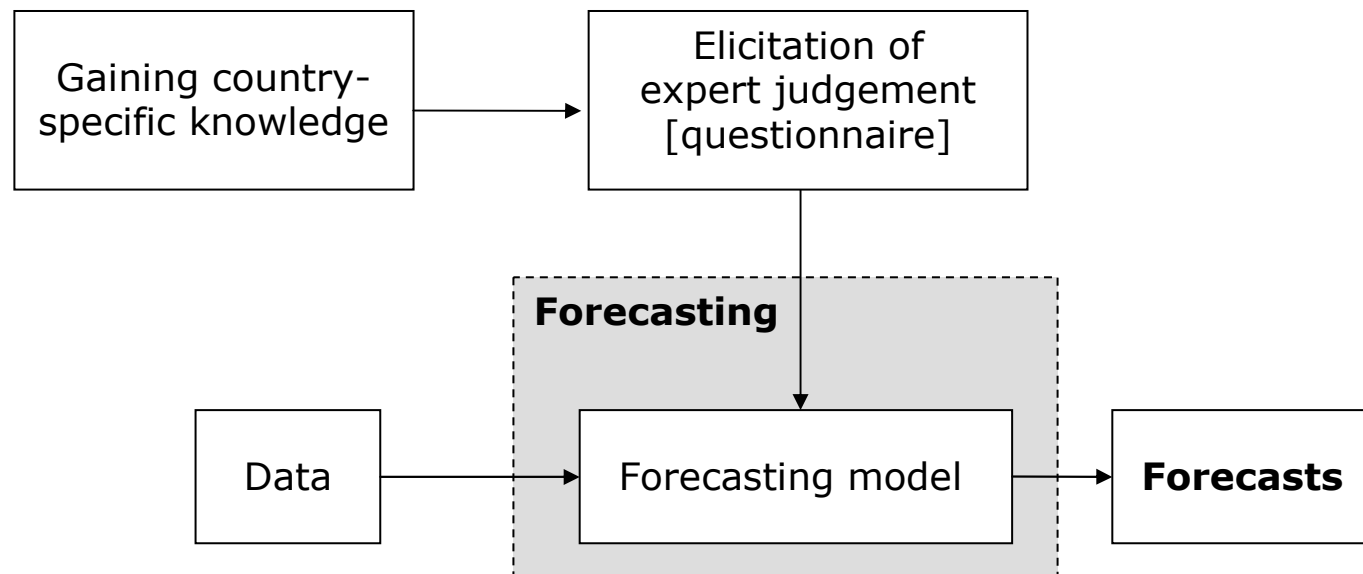
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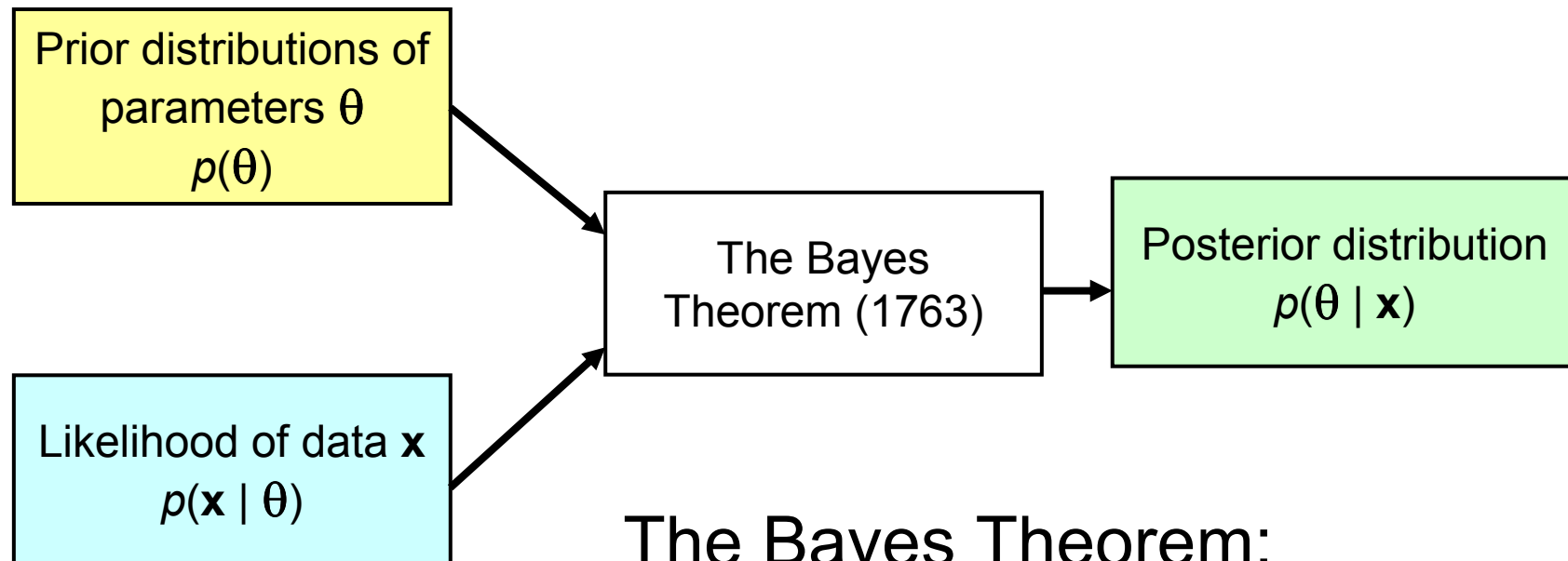
- Work carried out in the EU-funded project “IDEA” (*“Mediterranean and Eastern European Countries as new immigration destinations in the EU”*)
- **Main objective:** to prepare forecasts of immigration to eight European countries for 2007–2025
- **Methodology:** making use of both qualitative and quantitative information, formally combined and represented using the Bayesian perspective

- **Data:** total registered long-term immigrant flows
- **Sources:** Eurostat, UN Statistics Division, statistical offices of countries, Council of Europe
- **Problems:**
  - Different definitions of migrants, changes over time
  - Short time series or missing observations
- **Result:** lack of direct comparability between countries, country-specific perspective adopted

## Combining the qualitative expert knowledge with quantitative data in order to produce forecasts



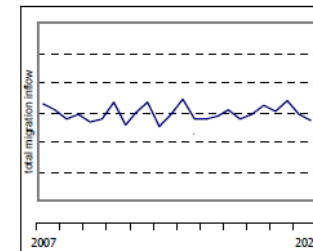
## The Bayesian approach



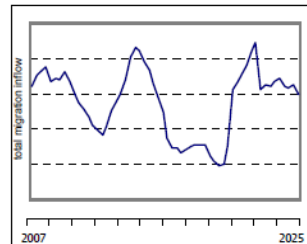
The Bayes Theorem:  
$$p(\theta|\mathbf{x}) = p(\theta) p(\mathbf{x}|\theta) / p(\mathbf{x})$$

- **Forecasting models:**

- Autoregression AR(1) with trend

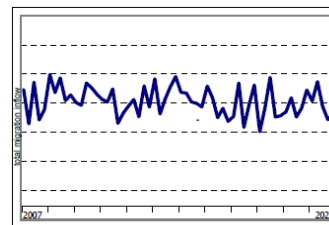


- Random walk

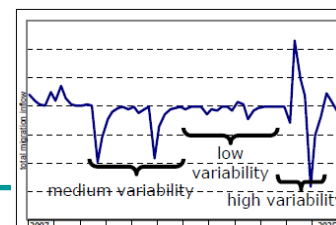


- **Two variants:**

- Constant variance



- Stochastic variance



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# Role of expert information

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- Short time series  $\Rightarrow$  prior information matters
- Our intuitions:
  - Migration processes hardly predictable
  - Low precision of the error term is a key assumption
  - Migration is rather non-stationary (random walk?)
  - Variability of migration may change over time
- **Approach:** combine data with the expert judgement, elicited using a Delphi survey

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# Delphi survey

- Delphi method – survey technique of obtaining information or opinion concerning the future
  - Respondents are experts in a given field
  - Respondents remain anonymous and independent
  - Opinions are obtained iteratively
  - Experts are informed about aggregate results of the preceding round of the survey in order to be able to reach an informed consensus
  - The answers can be statistically aggregated

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# Delphi survey: Questionnaire

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- **Aim:** to formulate questions so that they are clear to the respondents, but still formal enough
  - However, in our case the survey was addressed predominantly to non-statisticians
  - Attempted solution: visualisations of options
  - **Taboo words:** probability, random variable, distribution, stationarity, variance, quantile...
  - Very important and interdisciplinary part of the work: designing and testing of the questionnaire

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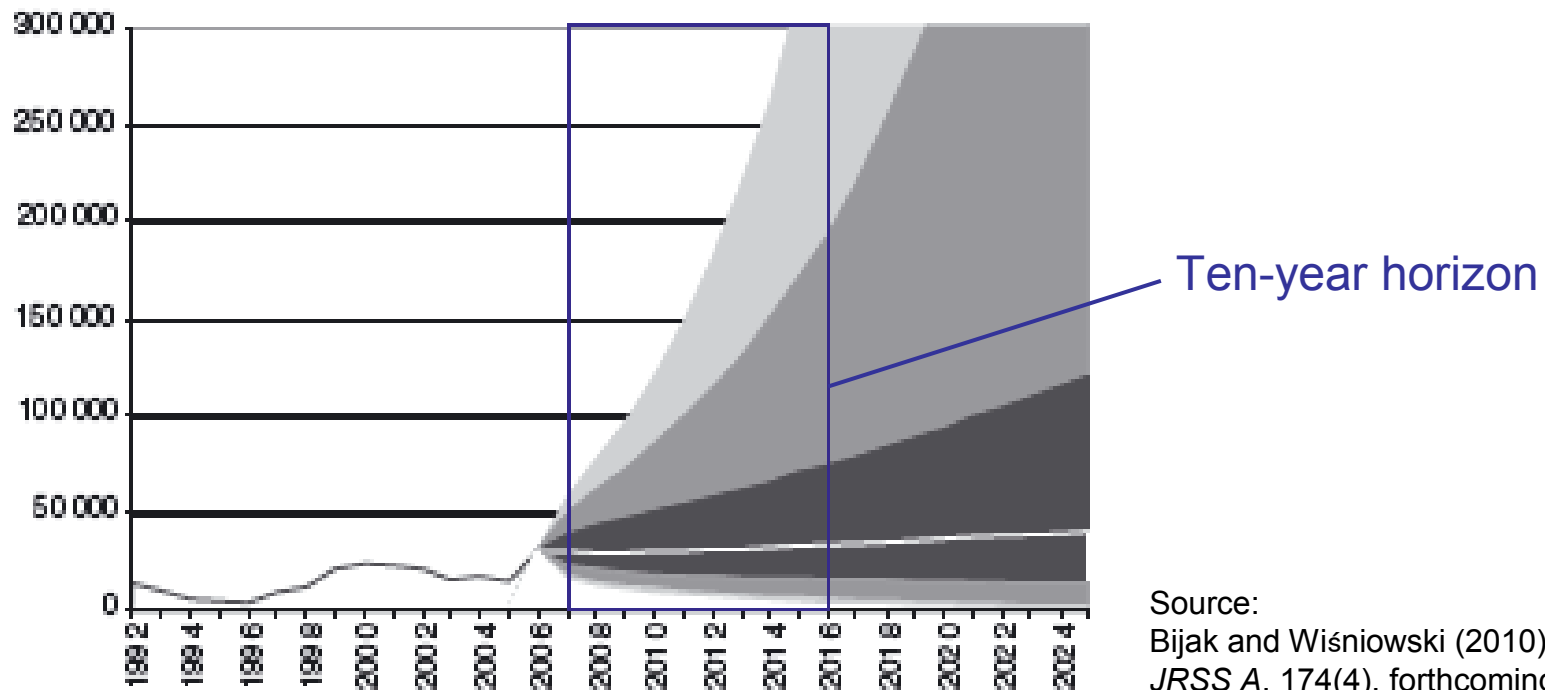
# Selected results: Forecasts

- General results:
  - Data gave strong preference to non-stationary models
  - Expert judgement generally increased the uncertainty
  - The findings support the intuition about a hardly predictable nature of migration
- Implications:
  - Uncertainty of forecasts increasing over time
  - Policy changes expected to have lasting effects
  - ‘Neat’ and ‘orderly’ predictions hardly possible

# Selected results: Forecasts

- Example: Portugal

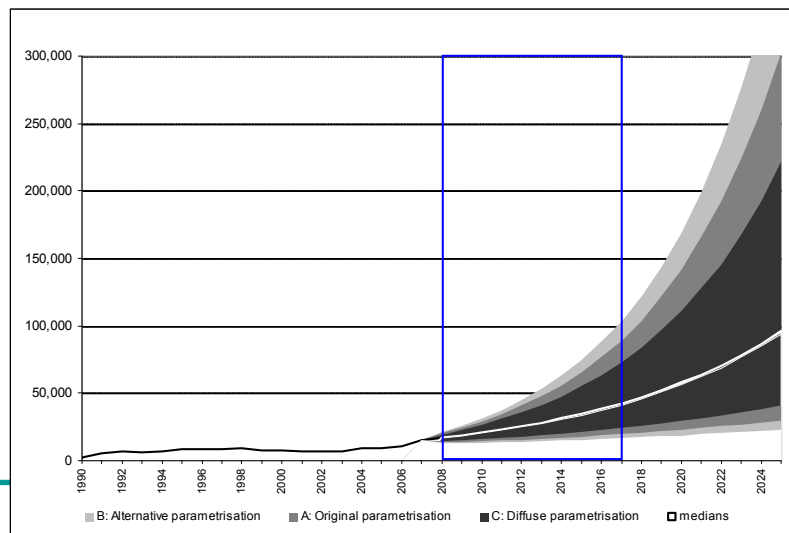
Immigration to Portugal: ■ 50%, ■ 80% and ■ 90% predictive intervals



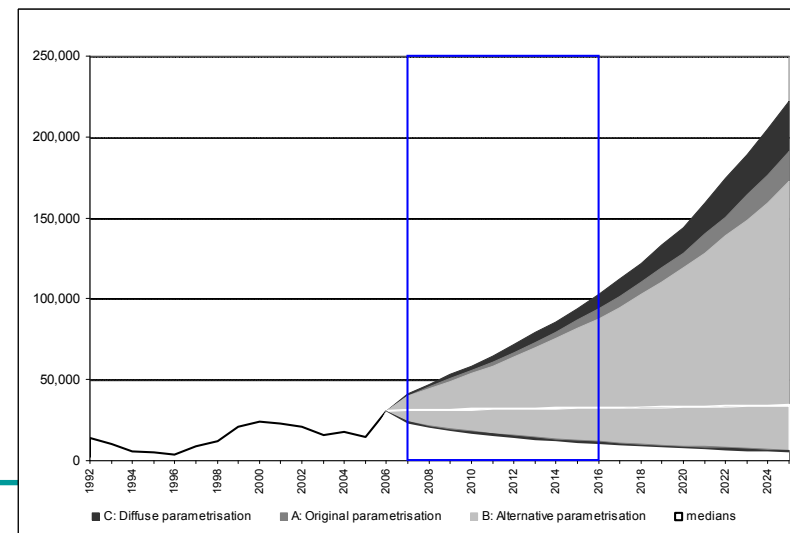
# Selected results: Sensitivity

- Hardly any sensitivity was found to the selection of the forecasting model (random walk, again...)
- For some countries, the forecasts were sensitive to assumptions on the variance of the error term

Poland



Portugal



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## Conclusions: Main Findings

- Likely non-stationary (random walk) and thus hardly predictable character of immigration
- Expert judgement has impact on characteristics, but not so much on the nature of migration
- Migration uncertainty assessments should be taken into account by the decision makers
- For forecast horizons over 10 years, uncertainty span becomes too high to be useful

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## Conclusions: Methodology

- **Methodology:** combined features of Bayesian statistics and the Delphi survey in a difficult application field (migration forecasting)
- **Also:** bringing together the qualitative and the quantitative analysis (both languages still need a more common vocabulary...)
- **Delphi survey:** a way to elicit expert knowledge whilst allowing for informed convergence of heterogeneous opinions

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For more details...



J. Bijak, A. Wiśniowski (2010) Bayesian forecasting of immigration to selected European countries by using expert knowledge. *Journal of the Royal Statistical Society A*, 173(4). [forthcoming]

**Project website:** <http://www.idea6fp.uw.edu.pl>

**Thank you!**

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*All opinions, errors and omissions are those of the authors only.*

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