

## Fertility convergence values

- Overall good performance for European fertility patterns of Schmertmann model
- Convergence distribution:
  - $\alpha = 14$  years (age reached)
  - Peak of fertility  $P = 31$  years of age
  - Half-fall after the peak  $H = 37$  years of age
  - TFR = 1.85 live births per woman
  - MAC = 30.5 years
- Neglected the bulge in the fertility rates at younger ages in few countries

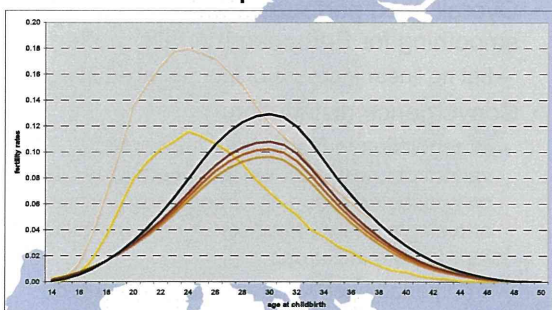
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## Fertility assumptions

- Schmertmann modelling for each country on latest available year(s), adjusted to the observed TFR
- Linear interpolation between latest modelled rates and the convergence values
- SRB=1.062 equal across countries and years (males = 515, females = 485)

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## Example: Austria

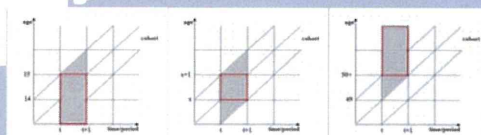


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## From PC to AP fertility rates

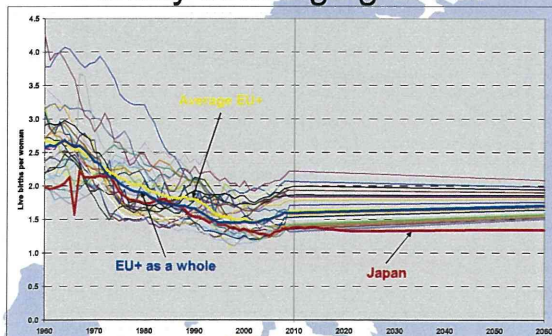
- Eurostat TFR is computed from AP rates
- Then:

$$\hat{f}_x^{AP} = \begin{cases} 0.5 \cdot (f_{x-1}^{PC} + f_x^{PC}) & x = 14, \dots, 49 \\ f_{x-1}^{PC} & x = 50 + \end{cases}$$



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## Fertility converging trends



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## What the literature says about fertility

- General postponement of childbearing should come to an end => expected recovery of TFR
- Some scholars warn about the "low-fertility trap"
- Excerpt from Goldstein *et al.* (2009)

– "The prominent forecasting agencies such as the United Nations and Eurostat are likely to be right in their medium variant assumption that TFR levels in most countries will rise to 1.5 or above in the decades ahead. The fear of an accelerated downward spiral of fertility, articulated on numerous occasions over the last decade, seems unsubstantiated." Population and Development Review 35(4) p.691

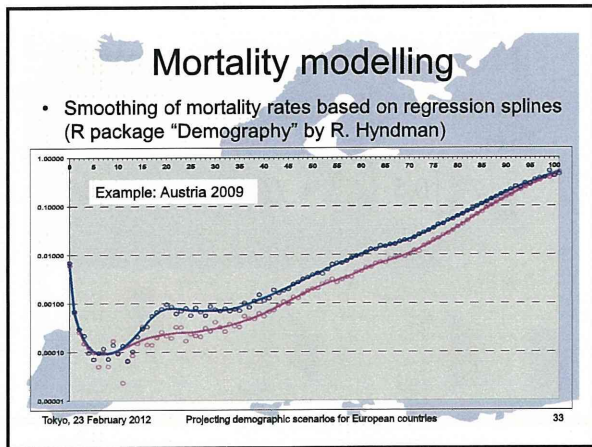
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## Mortality scenario in summary

- Mortality improvements will continue, but at slowing pace, as they can be expected almost completely only from older ages
- Smaller gender differences (in work, lifestyles, etc.) will bring a reduction of mortality of sex differentials
- Mortality differentials between countries tend to become smaller, thanks to the diffusion (easier within EU/EFTA countries) of advanced medical treatments, healthier lifestyles, etc.

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## Mortality convergence values

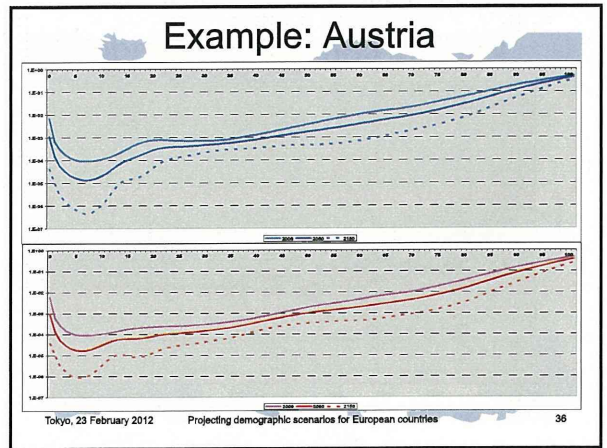
- Overall good performance of spline smoothing for European mortality patterns
  - but no linear increase of  $\log(mx)$  at adult ages
- Convergence distribution:
  - extrapolation to the far future using BMS variant of Lee-Carter model (Booth *et al.* 2002) on a selected group of 12 countries (merged in one single entity), representing the mortality forerunners in Europe
  - data period used for the model: 1977-2005

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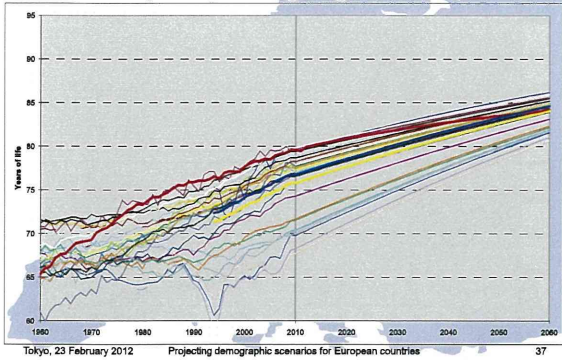
## Mortality assumptions

- Splines modelling for each country on latest available year(s)
- Control for closeness of  $e_0$  and  $e_65$  estimates from smoothed rates with actual ones (jump at the start year).
- Exponential interpolation between smoothed rates and the convergence values
- (Control for) reduction of sex differentials

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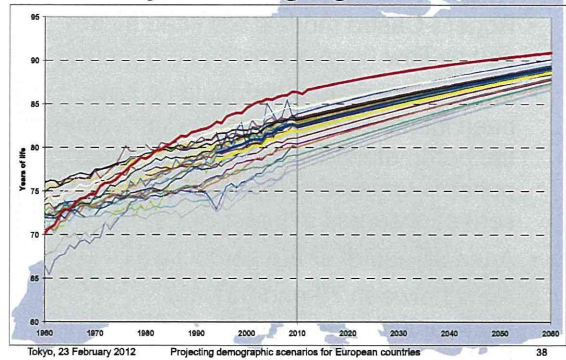


### Mortality converging trends: e0M



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### Mortality converging trends: e0F



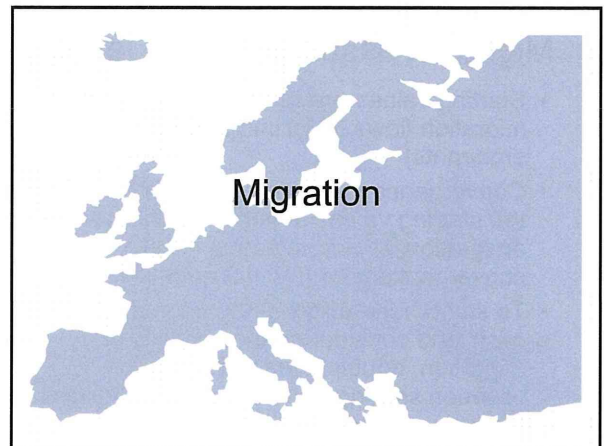
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### What the literature says about mortality

- General agreement on continuing mortality improvements
- Various stages of health transition to explain convergences/divergences in mortality (Vallin and Meslé 2002)
- Central-eastern European countries recovering from unfavourable trends (e.g. Meslé 2004)

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### Migration



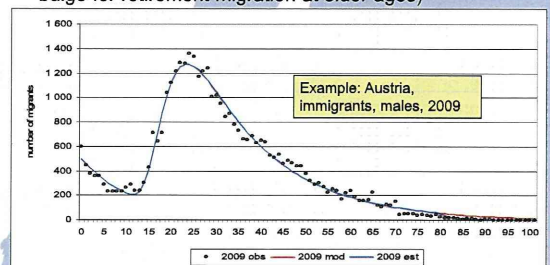
### Migration scenario in summary

- The ageing and the possible shrinking of the European populations call for an increasing number of immigrants
- However, an increasing demographic contribution of migrants in shrinking population may lead to challenging social developments
- Other areas of the world may come up in the future which may divert migratory flows
- Net migration levels tend then to decrease over time (although rates may keep stable or increase), but adjustments are added in case of shrinking population in working age

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### Migration modelling

- Rogers-Castro (1981) model with 7 parameters (i.e., no bulge for retirement migration at older ages)



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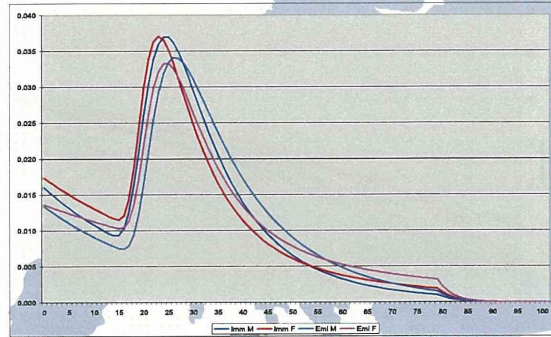
## Migration convergence values

- Rogers-Castro models are fitted by sex and by flow (immigrants and emigrants)
- The 4 convergence distributions have been identified taking the median values of the parameters estimated over 46 age patterns for each component (184 data series) observed in latest years
- Ages 95 and over are set to zero
- Ages between 79 and 95+ are exponentially interpolated

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## Normalized migrants age patterns



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## Migration assumptions on levels

- Starting values are the latest observed migration flows (total immigrants and emigrants)
- Convergence values are the average of the starting values of immigration and emigration => net migration is zero in the convergence year (but not each level!)
- To smooth the effect of the economic crisis and considering the volatility of migration, double linear interpolation between starting and convergence values

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## The double linear interpolation

- For each country, an intermediate point is defined as average of migration levels observed in the latest years (2002-2009)
- The intermediate point, through which values have to pass, is set in 2020
- Values 2010-2019 are obtained by linear interpolation between starting and intermediate values, and 2021-2060 between intermediate and convergence values

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## Exceptions...

- Eastern Europe countries
  - Those with negative intermediate values in 2020 would have negative net migration all over the projections period
  - For 6 countries the convergence has been anticipated to 2035, then from that year on net migration is zero and not negative
- High migration inflows countries
  - Some countries would have a relatively high cumulative net migration at the end of the period
  - For 10 countries the intermediate point has thus been reduced of one third.

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## Further assumptions on levels

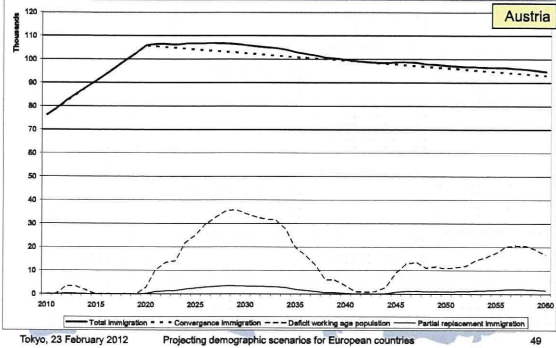
- The total immigration and emigration flows as from the convergence assumption are equally divided by sex
- A partial replacement migration may be then added:
  - First run of the projections and control of the projected working age population so obtained
  - If pop 15-64 shrinks, then 10% of that reduction is added to immigration (no emigration involved)
- The final levels of migration are finally the sum of the convergence and replacement components, which may well be not linear over time

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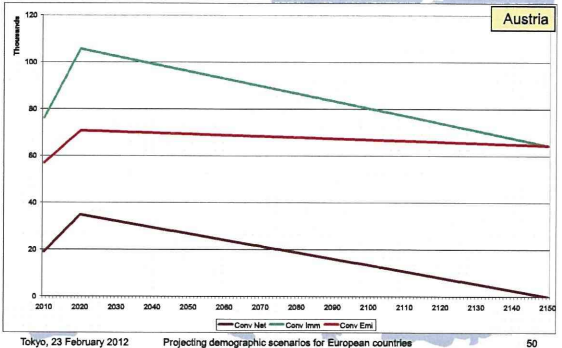
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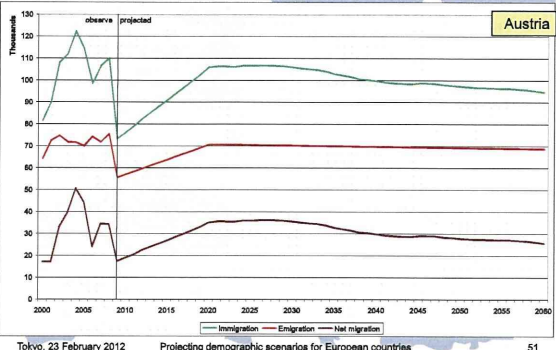
### Example immigration components



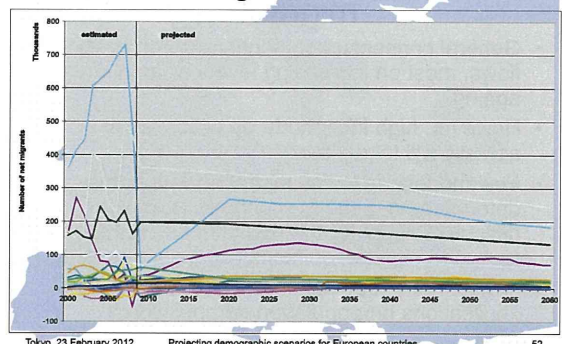
### Example convergence flows



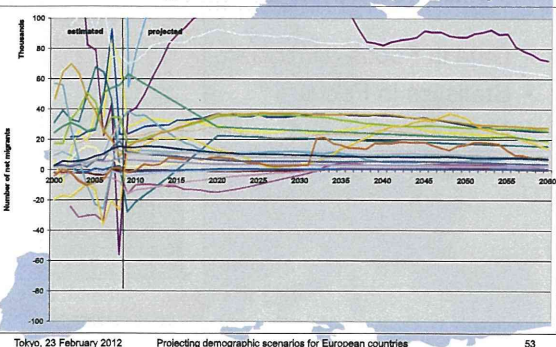
### Example total flows



### Net migration levels

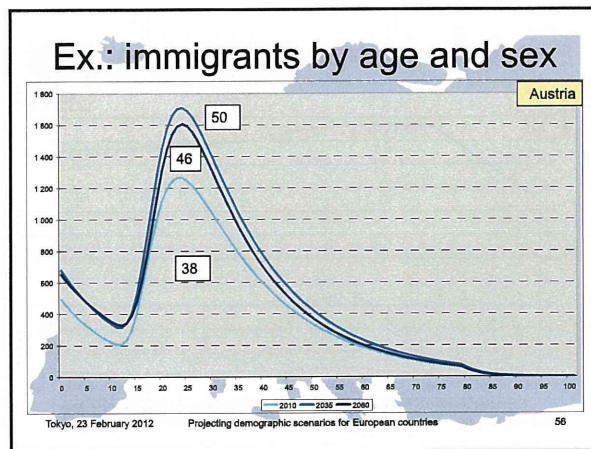
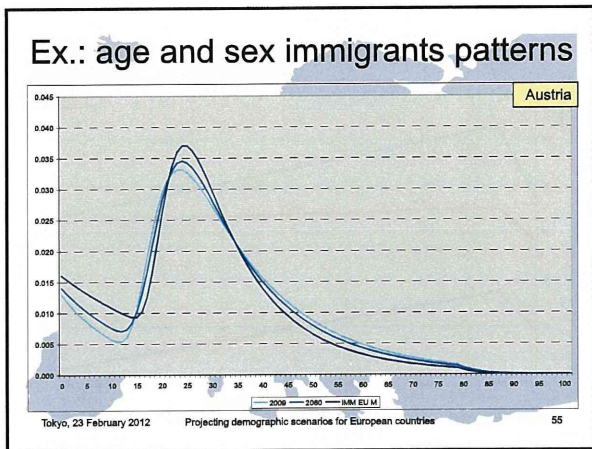


### Net migration levels (zoom)



### Migration assumptions by age

- Rogers-Castro modelling for each country on latest available year(s) using non-linear estimation in Excel
- Linear interpolation between normalized models and the convergence values
- Age- and sex-specific values are finally proportionally changed to match the given level of the sex-specific flow (immigrants or emigrants)



- ### What the literature says about migration
- General consensus on continuing immigration flows, most on increasing levels as solution to ageing
  - However, high incertitude on which levels actually will take place
  - Few models try to link migration with some determinants (usually economic ones), but difficult to apply for the medium/long term, or formalise experts' opinions (Bayesian models)
  - Almost none (but Coleman 2006) looks at the implications on population composition
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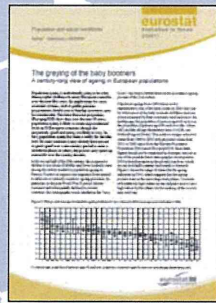
- ### Technicalities in summary
- The long-term scenario is based on the idea of convergence
  - There are almost no short/medium-term trends
  - The events are period-cohort based (but no cohort analysis)
  - Fertility and mortality assumptions are formulated in terms of age- and sex-specific rates and not as aggregated indicators
  - Migration assumptions are formulated in total numbers for each flow (in and out)
  - Age- and sex-specific distributions change year by year over the projections period
- 
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- ### Projections data dissemination
- Main results freely available in Eurobase
  - Further detailed data upon request (for free)
- 
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- ### Publications on projections
- **Data in Focus (Nowcast)**
  - **Statistics in Focus**
  - **Methodologies and Working Papers**
- 
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## Publications on projections

- Data in Focus
- **Statistics in Focus**
- Methodologies and Working Papers



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## Publications on projections

- Data in Focus
- Statistics in Focus
- **Methodologies and Working Papers**
  - Proceedings of the Eurostat/UNECE Work Session on Demographic Projections
  - “Fewer, older and multicultural? Projections of the EU populations by national/foreign background”
  - “Eurostat Population Projections 2010-based (EUROPOP2010): methodology and main results of the Convergence scenario” (*forthcoming*)

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## Some references

- Booth, Maindonald and Smith (2002): "Applying Lee-Carter under conditions of variable mortality decline". *Population Studies*, 56:325-336.
- Lanzieri (2009): "EUROPOP2008: a set of population projections for the European Union". Paper for the XXVI IUSSP International Conference, Marrakech.
- Rogers A. and L.J. Castro (1981): "Model Migration Schedules". IIASA Research Report RR-81-03, Laxenburg (AT).
- Schmertmann (2003): "A system of model fertility schedules with graphically intuitive parameters". *Demographic Research* 9(5):81-110.
- van Imhoff and Keilman (1992): "LIPRO 2.0: An Application of a Dynamic Demographic Projection Model to Household Structure in the Netherland". NIDI-CBGS publication n.23. Swets&Zeitlinger Publisher.

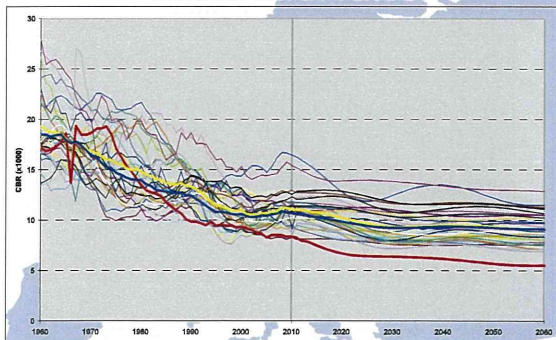
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## Selected outcomes of EuroPOP2010

## Crude birth rates

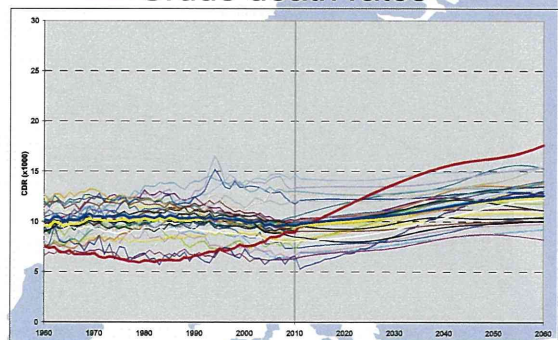


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## Crude death rates

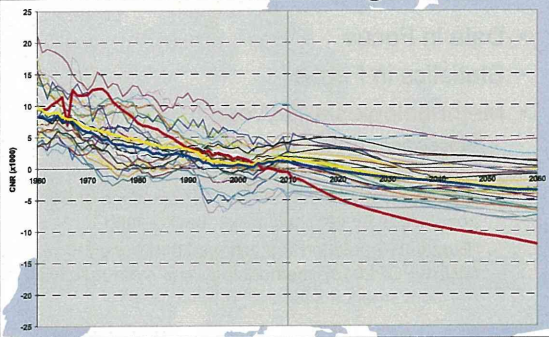


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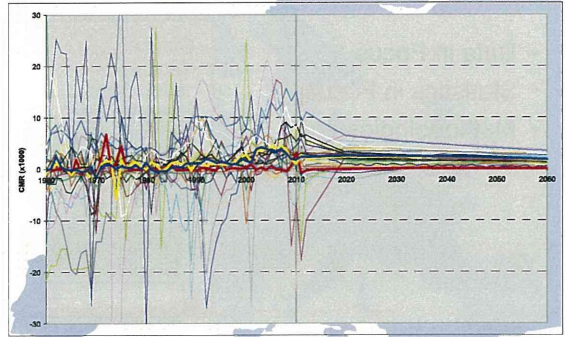
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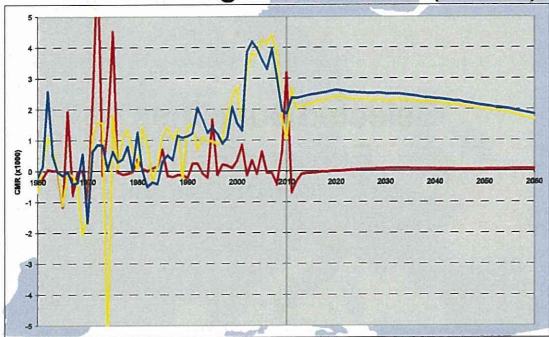
### Crude natural change rates



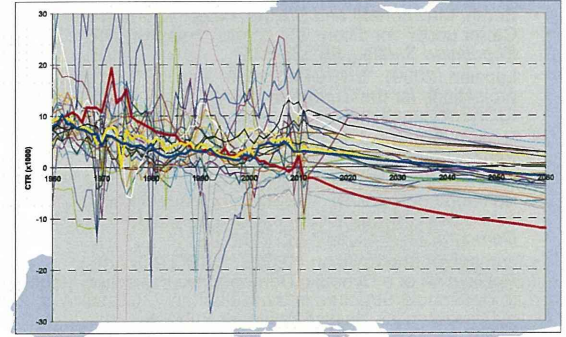
### Crude net migration rates



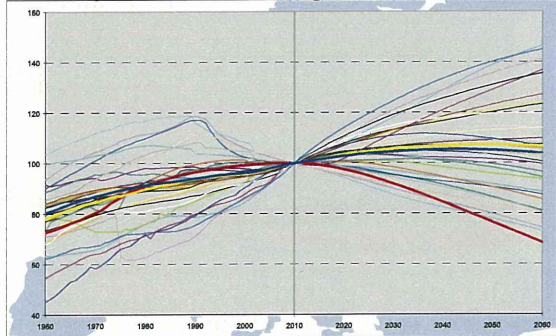
### Crude net migration rates (zoom)



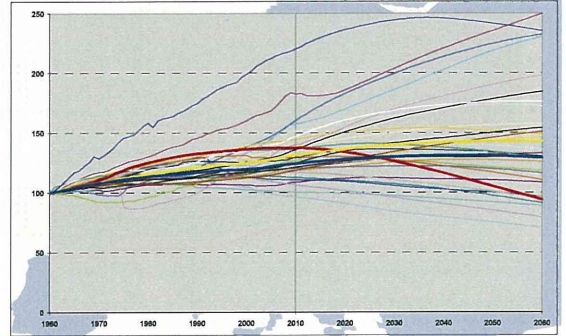
### Crude total change rates



### Population change from 2010

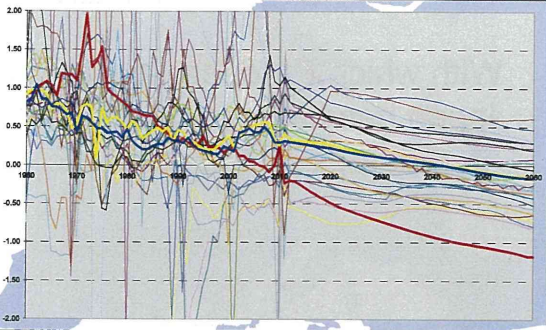


### Population change from 1960



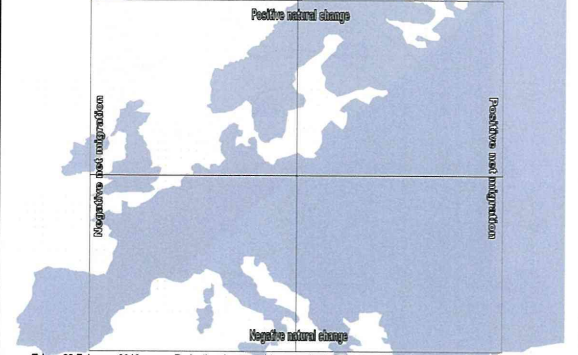


### Population relative change



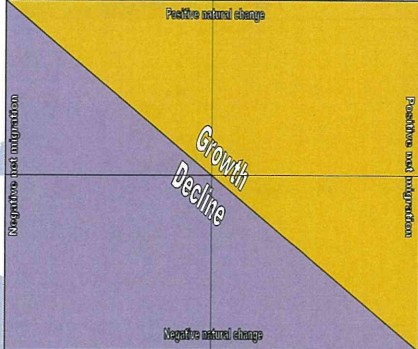
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### The drivers of change



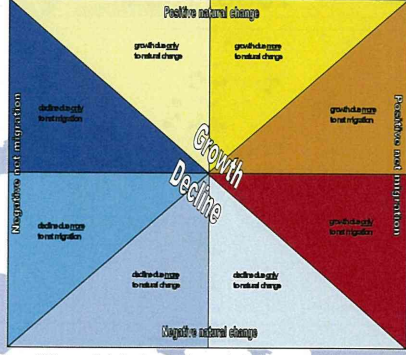
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### Growth or decline



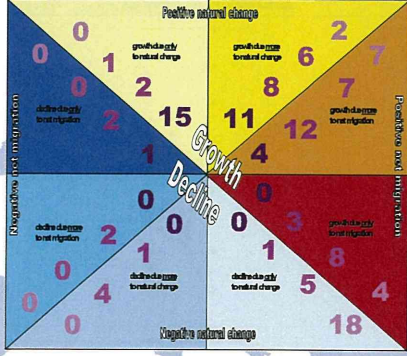
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### The relative strength



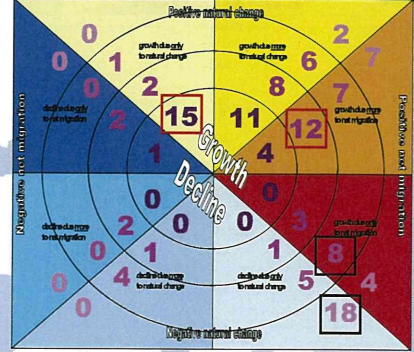
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### Changes in 4x25=100 years

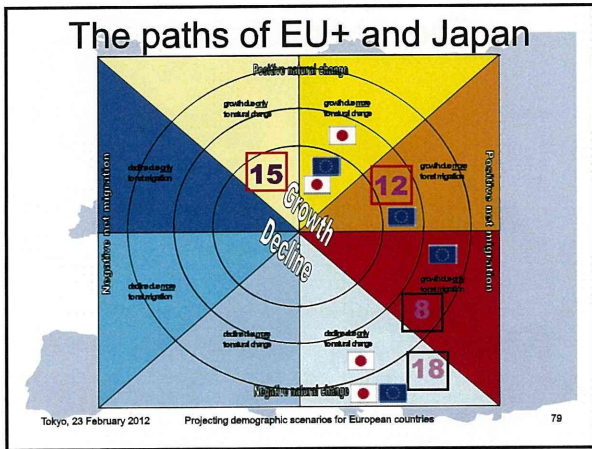


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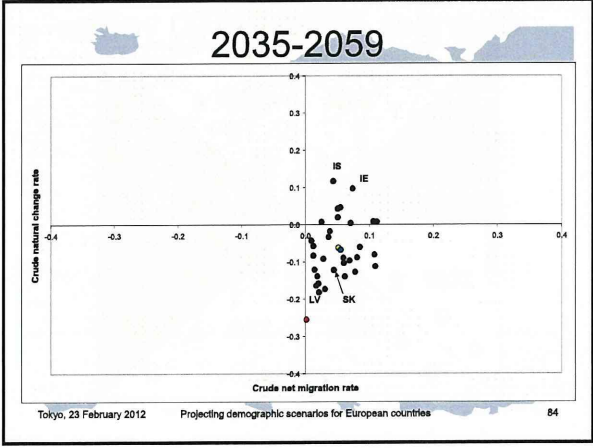
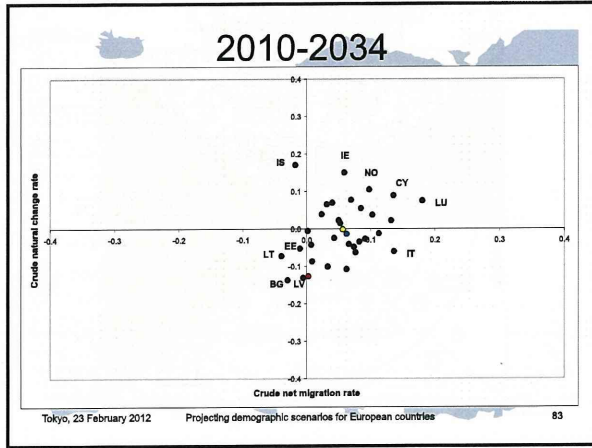
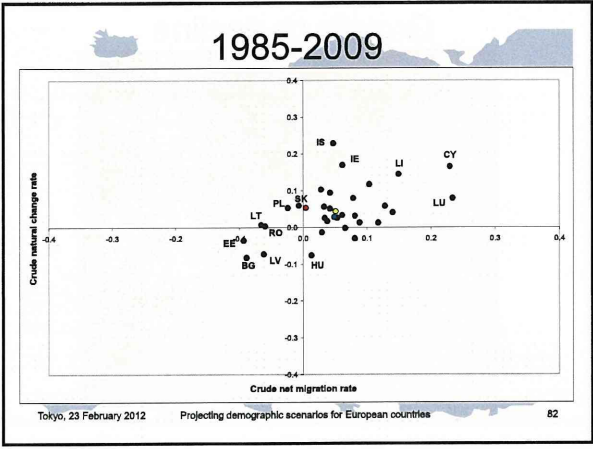
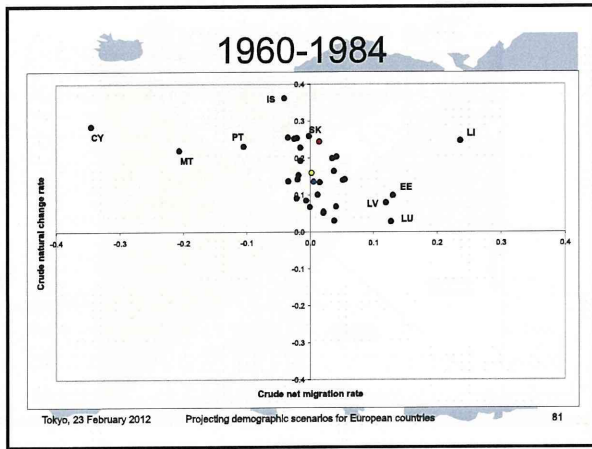
### "Dendrometry"

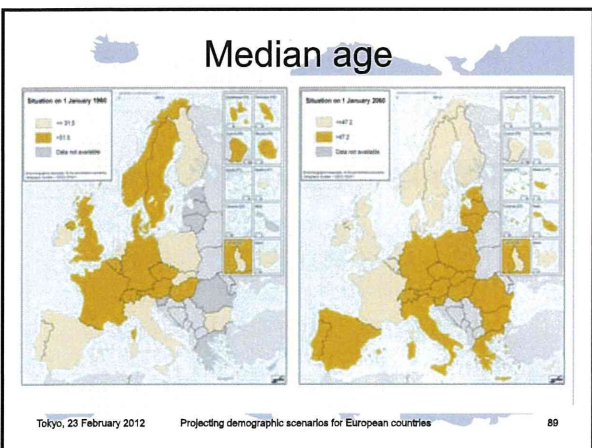
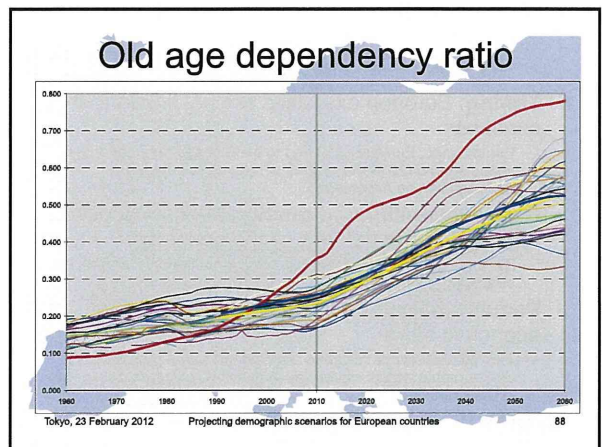
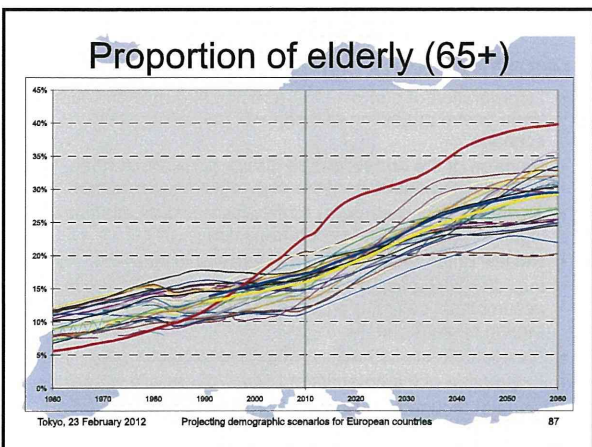
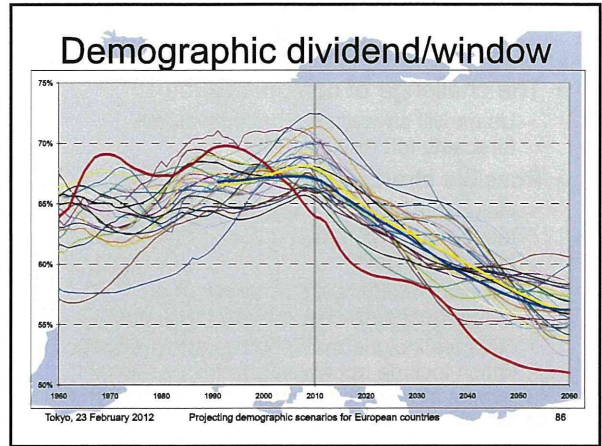


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With which European country Japan has higher similarity as for the population change?





## Projections vs. forecasts

- The challenge of communication
  - Users will always take projections as forecasts (cf. Keyfitz 1972)
- Possible strategies:
  - Release of several **variants** possibly with no label of main/central/medium, or stochastic confidence limits
  - Release of different **scenarios** (e.g., convergence, trends, current rates, etc.)
  - Release/include real (short-term) **forecasts**, which include approved policies or relevant events already known to occur.

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## What can you find in EuroPOP?

- EUROPOP are:
  - ...a vision for the far future
  - ...a “no-policy-change” scenario
  - ...based on simple and intuitive assumptions coherent with (selected) demographic literature
  - ...scrutinised in depth by national experts
  - ...independent
  - ...comparable across countries
  - ...available (in detail) for free to everybody
- EUROPOP are NOT:
  - ...population forecasts
  - ...short-term projections
  - ...the only possible demographic scenario

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## Reasons for “NOT being”

- **Timing:** EuroPOP exercises are not linked to the censuses.
  - For instance, EuroPOP2010 had to be released during the new census round (2011 in Europe), where major population revisions can be expected.
- **Data availability and quality:** trends modelling requires proper data for all the countries.
  - Because of their official use, it is almost mandatory EuroPOP to be based on official data.
- **Peculiar historical moment:** impact of the economic crisis
  - The financial/economic crisis ongoing in Europe may have a demographic impact which was impossible to assess at the time of the exercise.

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## The way ahead: research work for future (?) exercises

- Incorporation of a **short-term** forecast and **medium-term** trend-based projection components in the **long-term** scenario
- Revision of the **convergence** distributions and further analysis on plausibility of the convergence assumption.
- Testing of new **method(s)** for fertility, mortality (shifting logistic model) and migration projections
- Review of the methodology for **regional** level
- Inclusion of the **interplay** of fertility with main factors in the assumptions setting (=> derived projections: labour force, foreign background, etc.)
- Assessment of stochastic methods for **uncertainty**
- Exploration of the potential of MIC-MAC (**micro-macro**)
- General thoughts on **feedback mechanisms**

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## To conclude: where all this is done?



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Thanks for your attention!

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(until end March 2012!)

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(from April 2012 on)

# 外国人人口の受入れによる将来人口の変化と社会保障への影響に関する研究概要

わが国ではこれまで、少子・高齢化問題の解決策としての外国人人口受入れに関する本格的な定量分析が十分に行われてきたとは言い難い状況にあるが、外国人人口受入れによる将来人口の変化について、複数の前提条件の下に仮想的シミュレーションを行って定量的評価を行うとともに、その社会保障へのインパクトを分析しておくことは極めて重要であり、このような課題に対して、人口学的分析を中心とした総合的研究を行う。

## 外国人人口受入れに関する前提および将来の出生・死亡動向の研究

- ・ 当初の移入者受入れについての複数の政策と、移入者のプロフィール、および、当初の移入者が誘発するさらなる移入者について検討
- ・ 現状ベースでの出生・死亡等の人口動態特性に関する精緻な動向分析に基づき、移入者の増加が外国人・日本人それぞれの人口動態に与える影響について評価

## モデル構築とこれに基づく将来人口の仮想的シミュレーション

- ・ 外国人受入れに関する前提およびこれに連動する人口動態の変化を反映する人口学的なモデルについて、欧米での研究例などを参考にしつつ構築
- ・ 構築されたモデルと人口の仮想的シミュレーションと融合させ、外国人人口受入れに関する複数の前提に基づく将来の仮想的シミュレーションを実行し、定量的に評価

## 将来人口の変化が社会保障に及ぼす影響の評価

- ・ 将来人口の年齢構造等の変化が、医療・年金・介護などの社会保障各制度にどのように影響するのか人口構造指標などを用いて評価
- ・ 移民のミクロ的影響に関する先行研究のレビューと考察
- ・ 社会保障面での変化が経済全体へ及ぼす影響を分析する上での問題点等について調査

複数の前提に基づく移入者のプロフィール

日本人・外国人別の出生・死亡等の人口動態特性の動向分析

外国人受入れ及びこれに連動する人口動態の変化を反映する人口学的モデル

人口の仮想的シミュレーションによる将来人口の定量的評価

人口構造指標などを用いた社会保障制度への影響評価

期待される効果

### 将来人口シミュレーションの技術向上

外国人受入れに関する各種前提に基づく当初の移入者や彼らが誘発する移入者のプロフィール、また、これらの前提変化に対応した出生・死亡動向などについてのモデル構築は、将来人口シミュレーションに関する総合的技術向上をもたらす、人口学分野においてこのような研究成果が幅広く引用され、活用される

### 将来プラン策定の基礎資料

外国人受入れに関する各種前提に基づく将来人口の仮想的シミュレーションから、将来の人口規模や、高齢化率などの年齢構造指標などの定量的な評価結果が得られ、これらは、様々な将来プランの策定に直接反映可能な資料となると期待される

### 社会保障制度の企画立案

将来人口の変化が社会保障制度に及ぼす影響評価は、年金・医療・介護等の社会保障制度の企画立案に直接反映可能な成果となると期待される

