Autoridad Independiente de Responsabilidad Fiscal

Demographic forecasts: an integrated approach

November 2018

Why does AIReF need demographic forecasts?:

- **AIReF must analyse the long-term sustainability of public finances**
  - The population and its structure is one of the main factors in the long-term dynamics of the main expenditure components: pensions, healthcare, education and social services, among others.
- **Legislation assigns AIReF special responsibility in the monitoring of the financial situation of Social Security in the short, medium and long term**

→ The expenditure associated with ageing represents one of the major risks for the sustainability of public finances in the long term

Why make our own demographic forecasts?

Identified limitations of existing approaches:

- **The INE (National Statistics Institute) or Eurostat do not make forecasts, but *projections***
  - They do not incorporate uncertainty, which is necessary for the assessment of the budgetary and sustainability forecasts that AIReF makes
  - Analysts use them as if they were baseline forecasts of a probability distribution

→ This can generate a bias in the analysis and in the forecasts of expenditure linked to aging (pensions, healthcare, dependence, etc.)

Why make our own demographic forecasts?:

Identified limitations existing approaches:

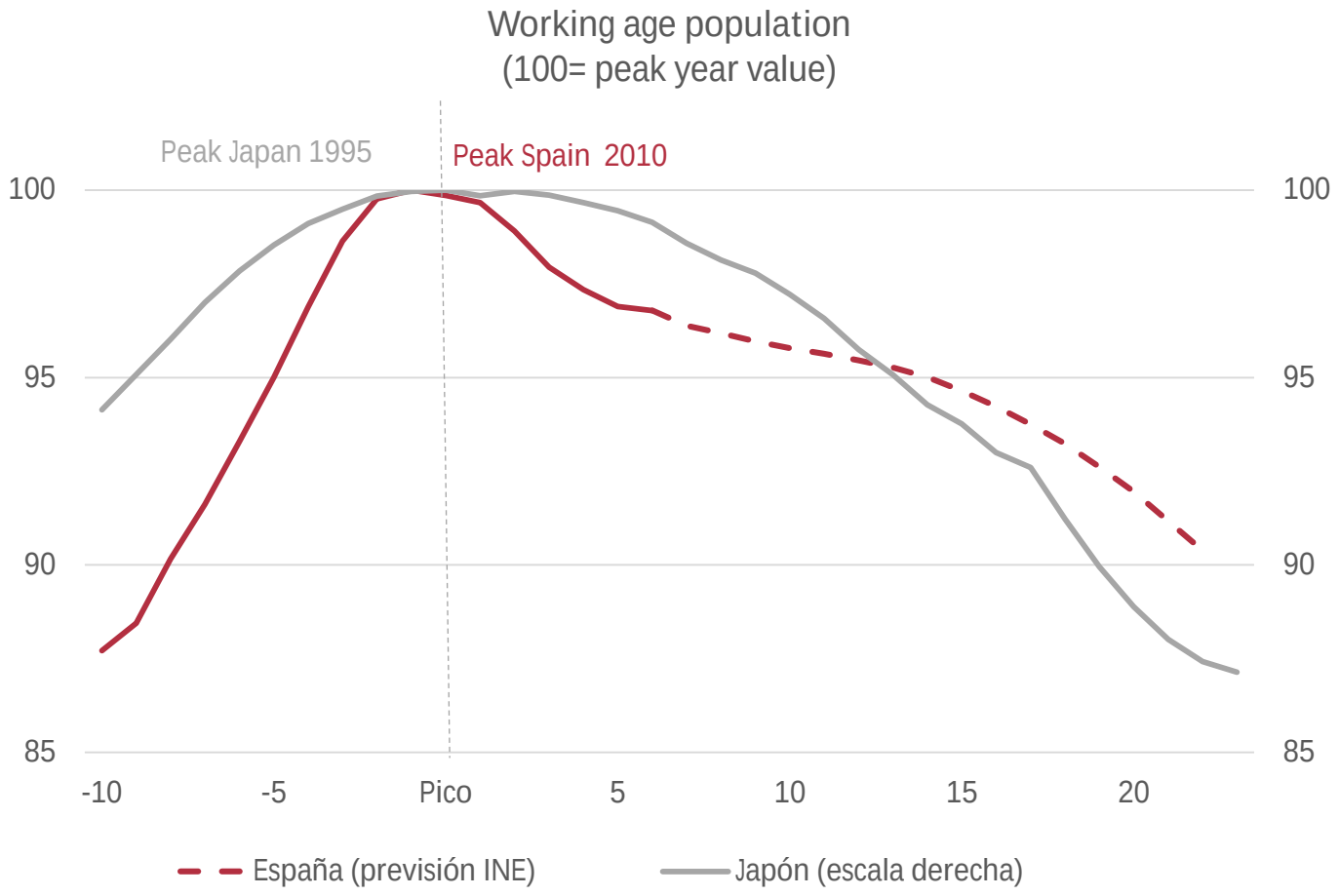
- **They are based exclusively on the extrapolation of the demographic structure and recent trends**
- **There is no coherent picture of the backbones of the long-term forecasts:** demography, labour market, productivity, etc.

They are not consistent with a long-term economic narrative that takes into account the historical evolution and international experience…

…and they are subject to strong fluctuations, mainly due to unsophisticated modeling of the migratory element

Do we believe in a *japanization* of the Spanish economy?:

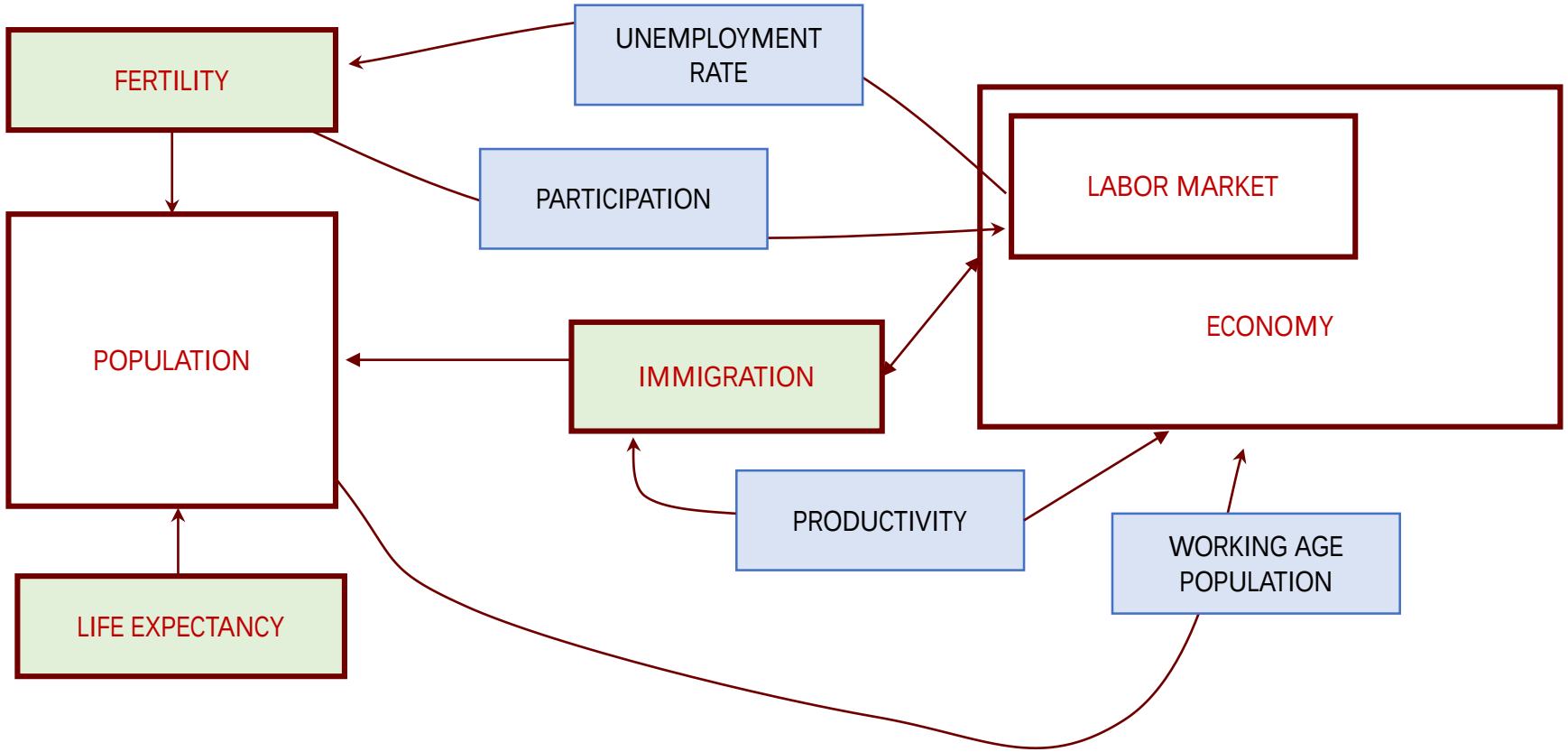
- **INE (<u>pre October 15th</u>) projections to 2050 imply a poorer economy through a sharp drop in the working age population**



How to make our own demographic forecasts?:

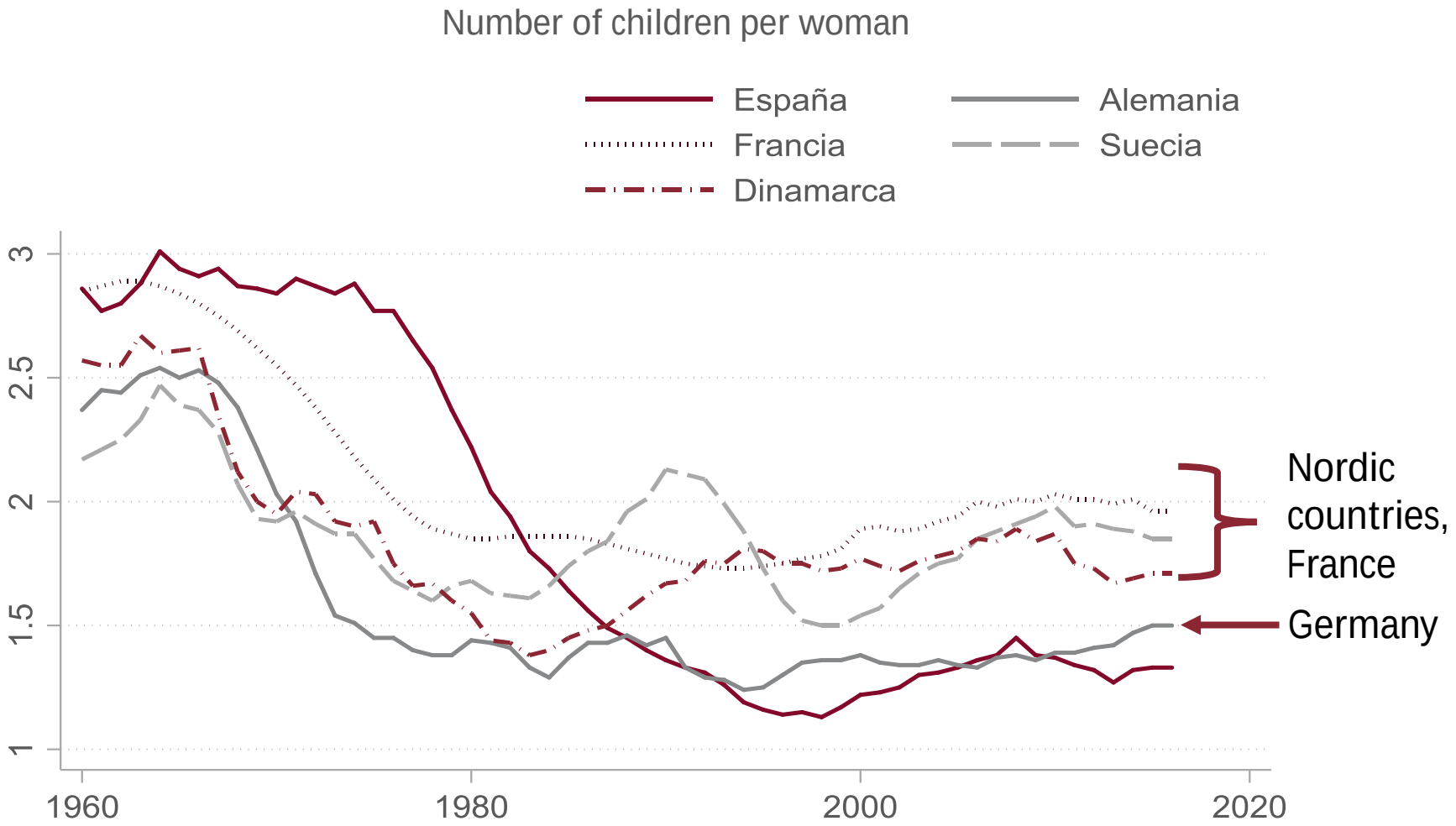
Methodological focus:

- **Own forecasts,** in line with other long-standing institutions, such as the American Congressional Budget Office
- **Integrated approach and with a probabilistic focus**



Is there an upward trend in the number of births per woman?

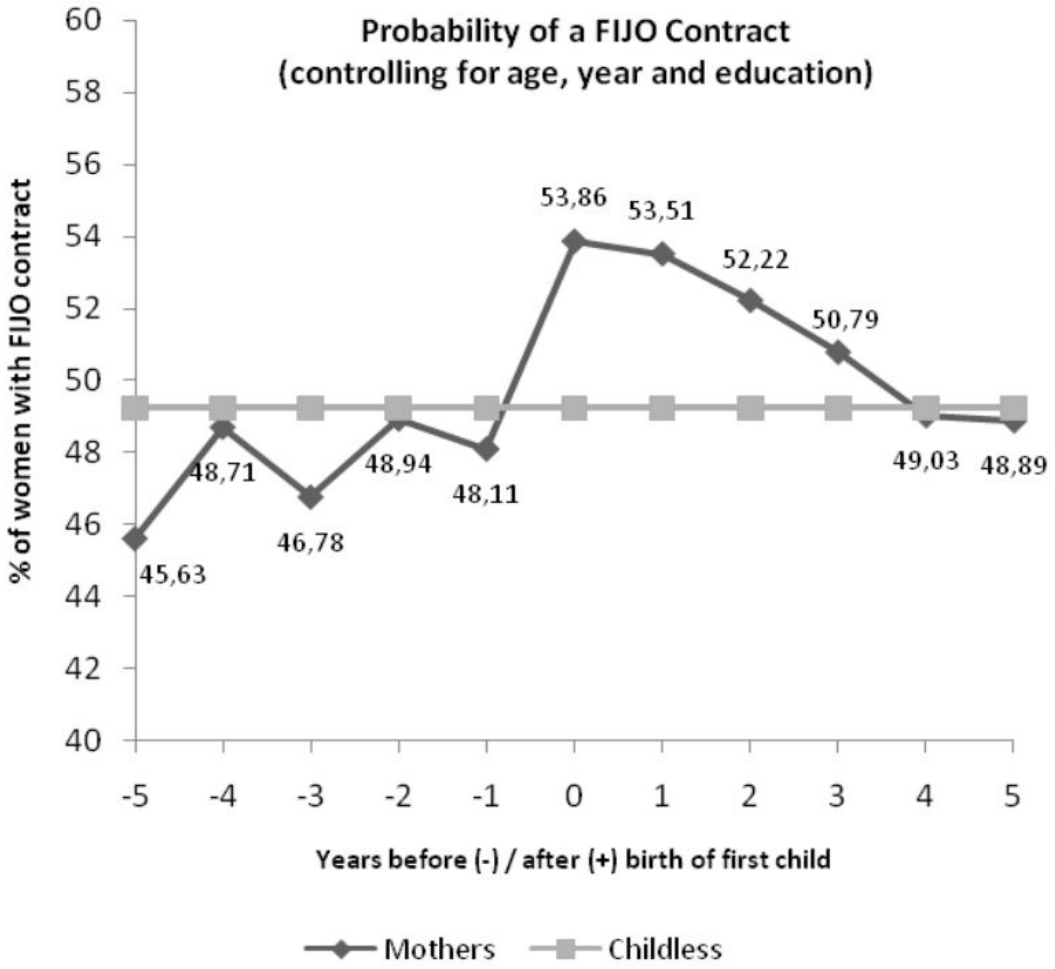
- **The fertility of women in Spain is currently among the lowest in the world…**



Fuente: World Bank

Is there an upward trend in the number of births per woman?

- **Combination of economic, social and cultural reasons. Most of these are idiosyncratic (labour market, housing, …)**



Aitor Lacuesta, D. Fernández-Kranz and N. Rodriguez-Planas (2013)

1. High seasonality, especially among young people, can hinder fertility (Auer and Danzer 2014, of the rich and Iza 2005)
2. Survey evidence reflects the desire of Spanish women to have more children
3. Improvements in the labour market can help the demography to internalise these changes

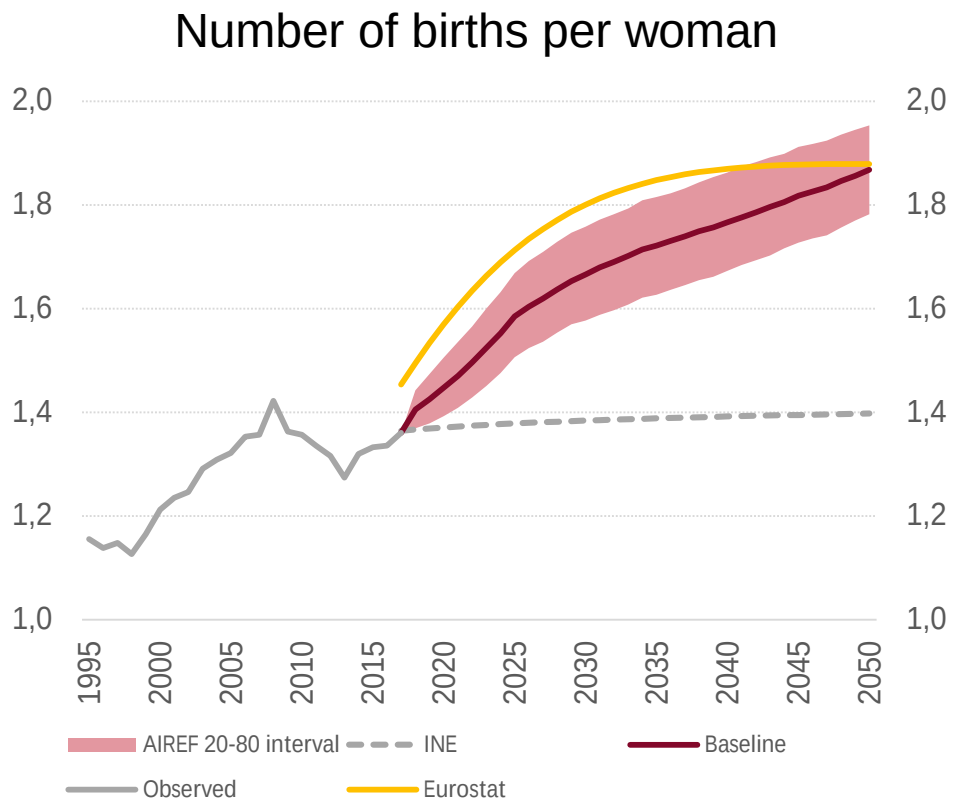
Is there an upward trend in the number of births per woman?

- **An extrapolation of the current trend would especially reflect the effect of these short-term factors** (labour market, housing, …)
- **AIReF expects that fertility**, summarised as the number of births per woman of childbearing age, **will gradually increase in the forecasting horizon**
- **This increase is based on the long-term conditional convergence** to the fertility of the countries of our cultural and economic environment
- **Demographic conditioning tends to generate pressures in the labour market**, with excess demand to which variables will respond endogenously [fertility, immigration]
- **Implicitly, this also implies convergence in the best practices and policies**
- **There is some evidence that certain policies have been successful** in raising the birth rate in a relatively short period of time

Is there an upward trend in the number of births per woman?

AIReF's forecasts progressively converge to [1.8-2] births per woman in 2050

Births per woman	
2017	1.36
AIReF 2050	[1.8-2]
INE 2050	1.40
Eurostat 2050	1.88



- Compared to those of the INE that prolong the latest data or Eurostat, which implies a more abrupt growth in the short term

Immigration: recent evolution shows an upward trend at the global level

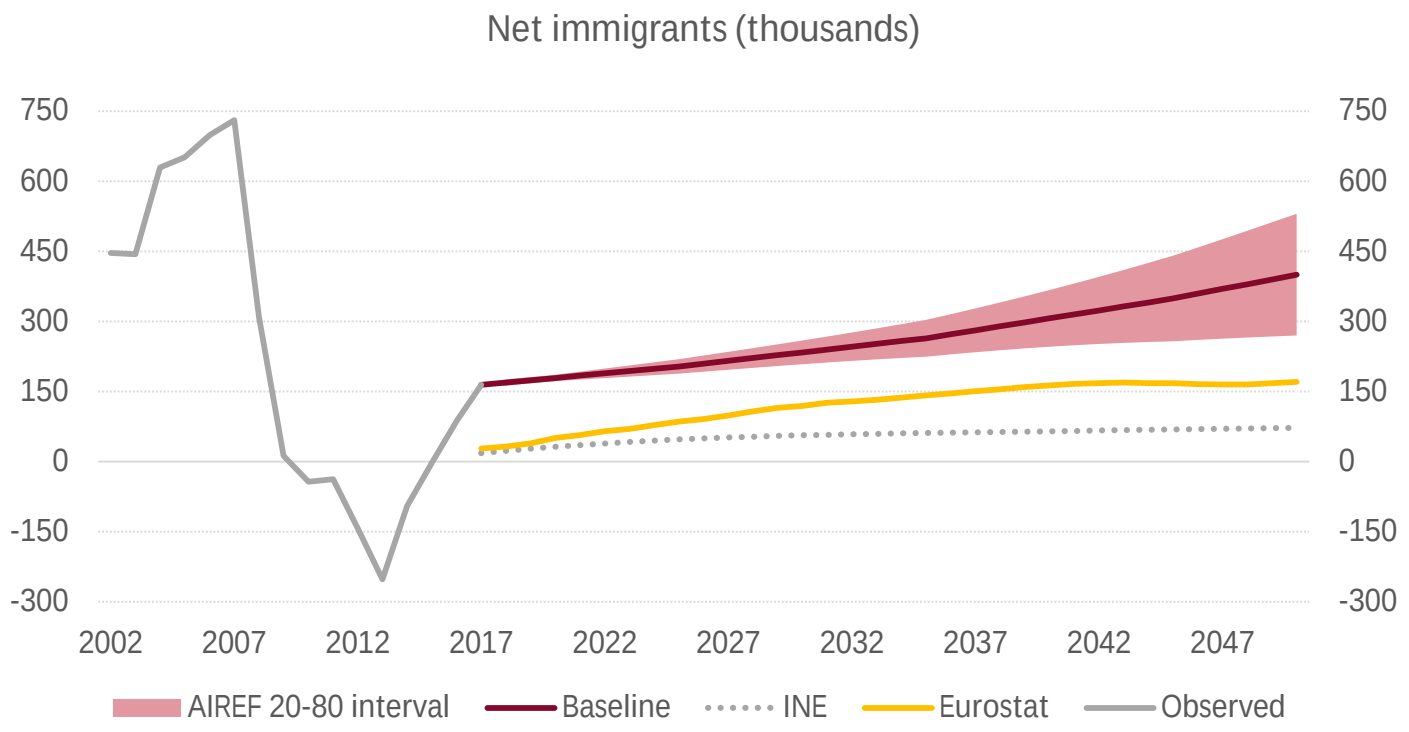
- **Immigration is the demographic phenomenon most clearly conditioned by economic factors**, including short-term factors
- **In the long term, current global trends,** economic inequality and the very different demographic realities **suggest that immigration is going to continue to increase as a global phenomenon**
- **In the absence of restrictive migration policies, there is expected to be a flow of workers from the youngest countries to the oldest**
- **Spain is unlikely to be an exception to this global trend**
- **The latest data point in this direction**

How has AIReF faced the challenge of modeling immigration?

- **AIReF has commissioned an expert in the field to create a migration forecasting model**
- **The model considers economic and demographic factors and pre-existing networks** of immigrants in each country
- **A key factor:** different demographic structure between origin and destination
- **The forecast assumes the maintenance of constant migration policies around the world**
- **Positive economic impact but can generate feelings of rejection**
  - it has to do with social factors, related to cultural distance (M. Tabellini, 2018)
  - it can result from a misperception of the nature and scope of immigration (Cassie et al. 2018:

Immigration: net flow of about 250,000 people expected between 2018-2050

- **AIReF's forecasts are far above the flows expected by INE and Eurostat**

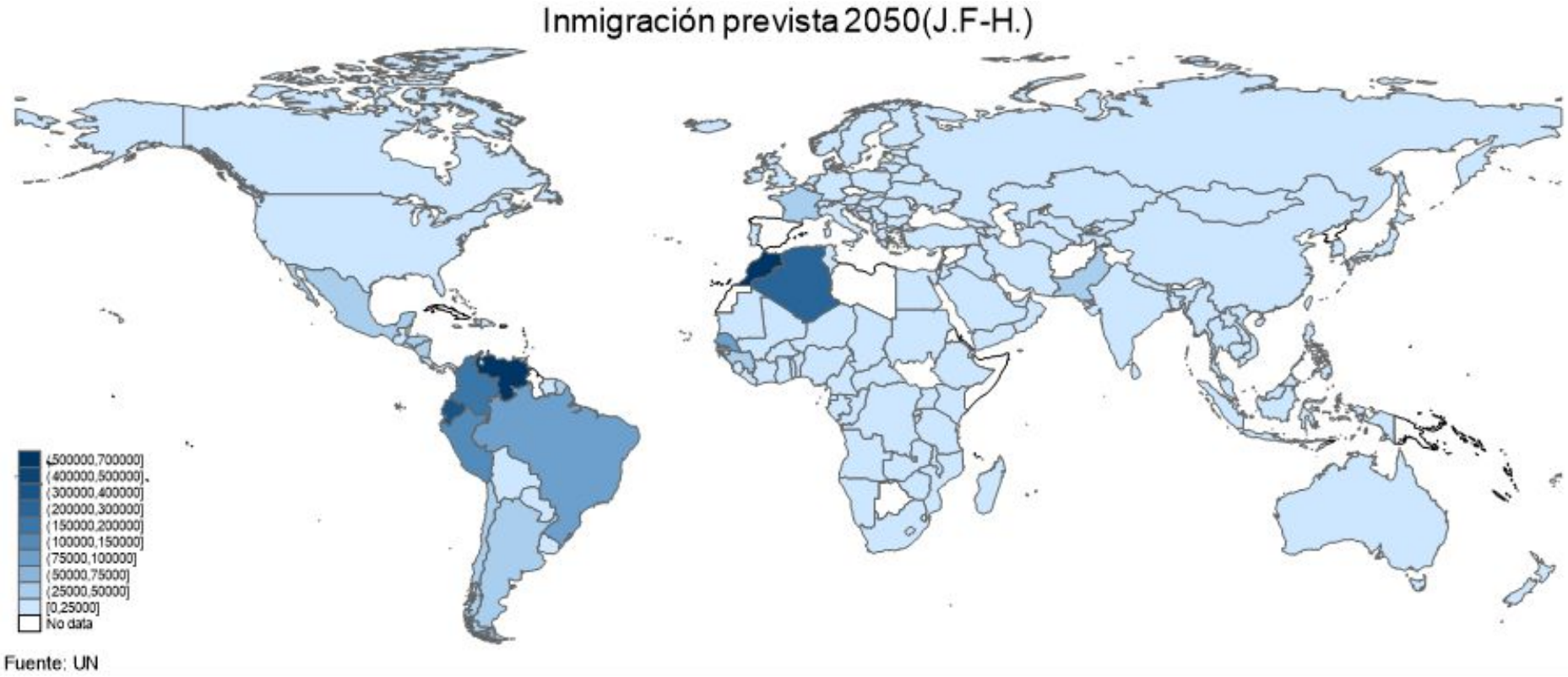


In spite of this, in terms of stock of immigrants over the total population, levels are still in line with our environment:

2017: 9.8%
2033: [11.3-12.2%]
2050: [13.2-16.7%]

Immigration: net flow of about 250,000 people expected between 2018-2050

- **Incoming flows will continue to mostly originate from Latin America as well as Africa due to its own demographic pressures**

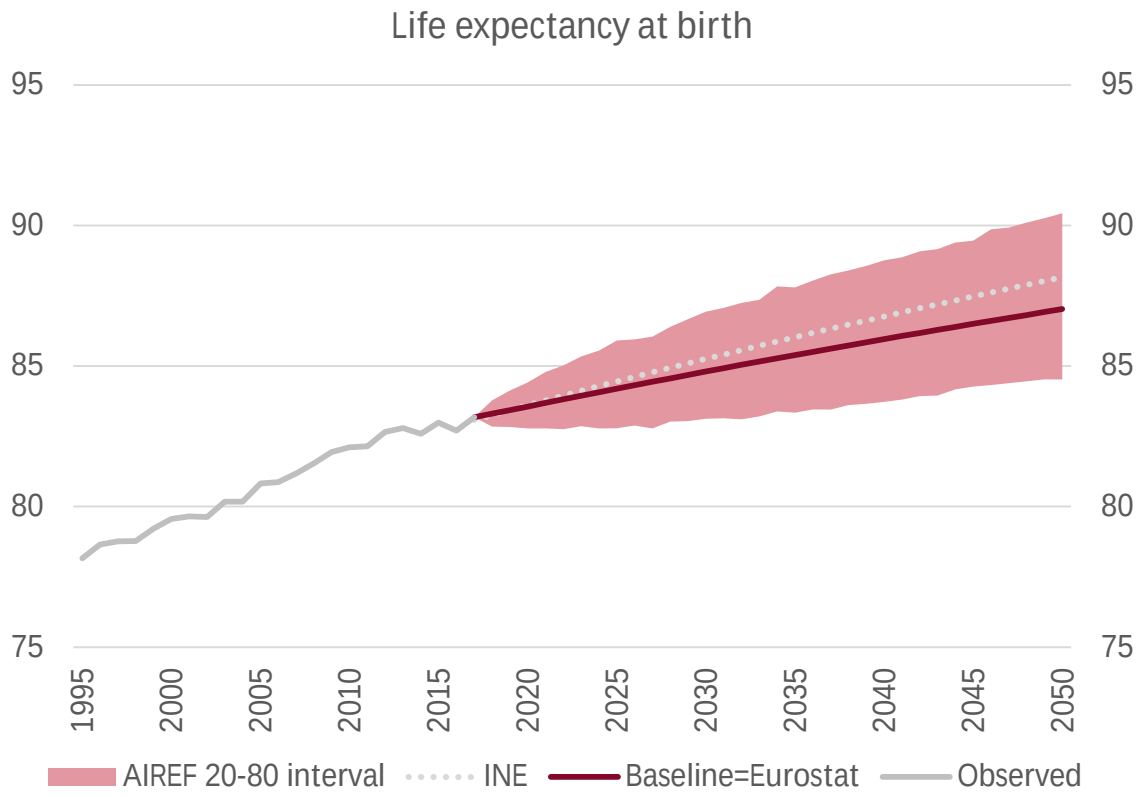


Life expectancy: Will it continue to grow at the rate of past decades?

- **Life expectancy has increased** very steadily in recent years.
- **There seems to be no clear evidence of a limit or asymptote**
- **Key determining factors for the future:**
  - Improvement in childhood mortality: there is little margin
  - Elements that are non-linear and difficult to forecast: drugs, technological advances
  - The welfare state, care of the elderly: the benefits have been occurring at the end of the distribution, in the elderly
- **AIReF has modelled mortality on a hypothesis of long-term convergence**
  - There is evidence of compression of the life expectancy between European countries
  - Determining factor: the convergence of these countries in economic terms (per capita income) and of social and health benefits (standard of life)

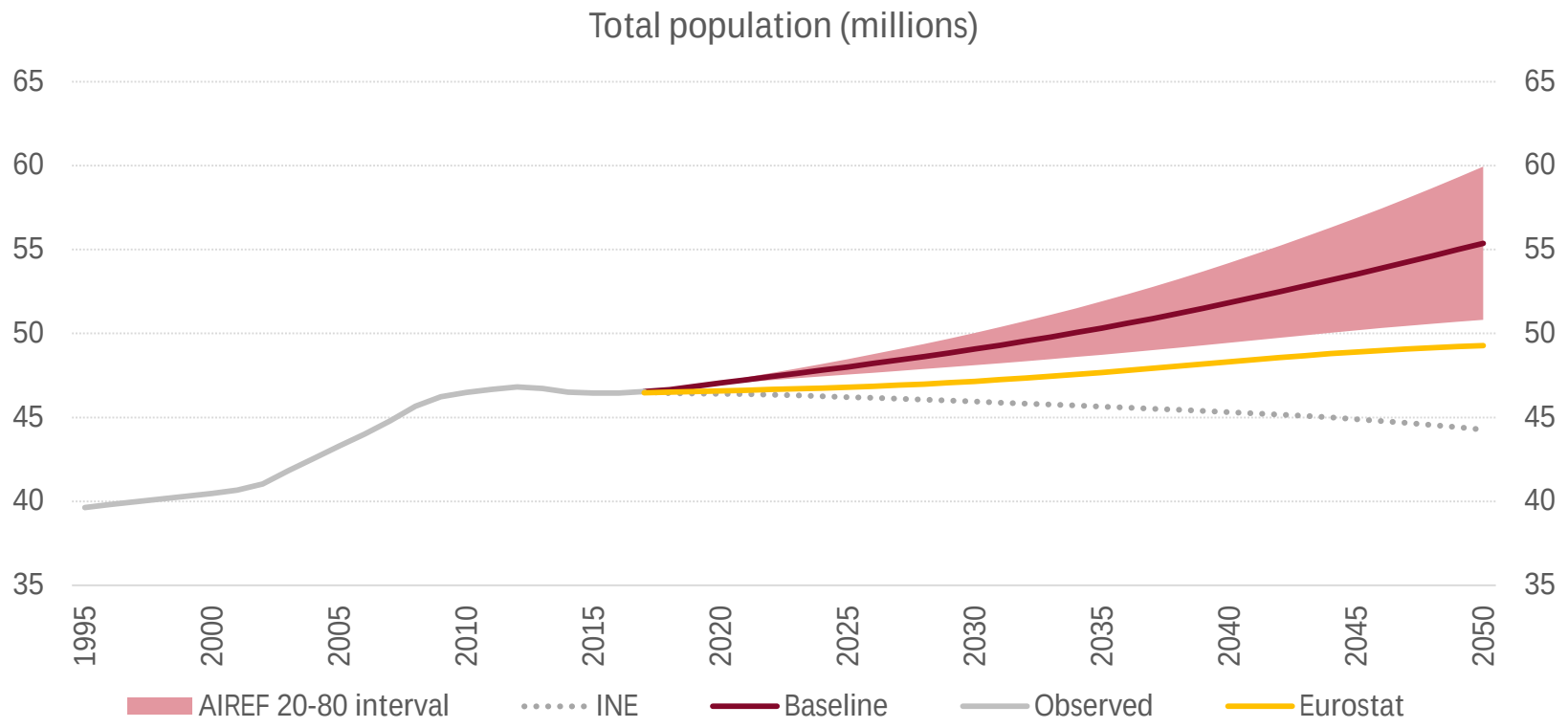
Life expectancy: Will it continue to grow at the rate of past decades?

AIReF's forecast is very close to INE or Eurostat projections



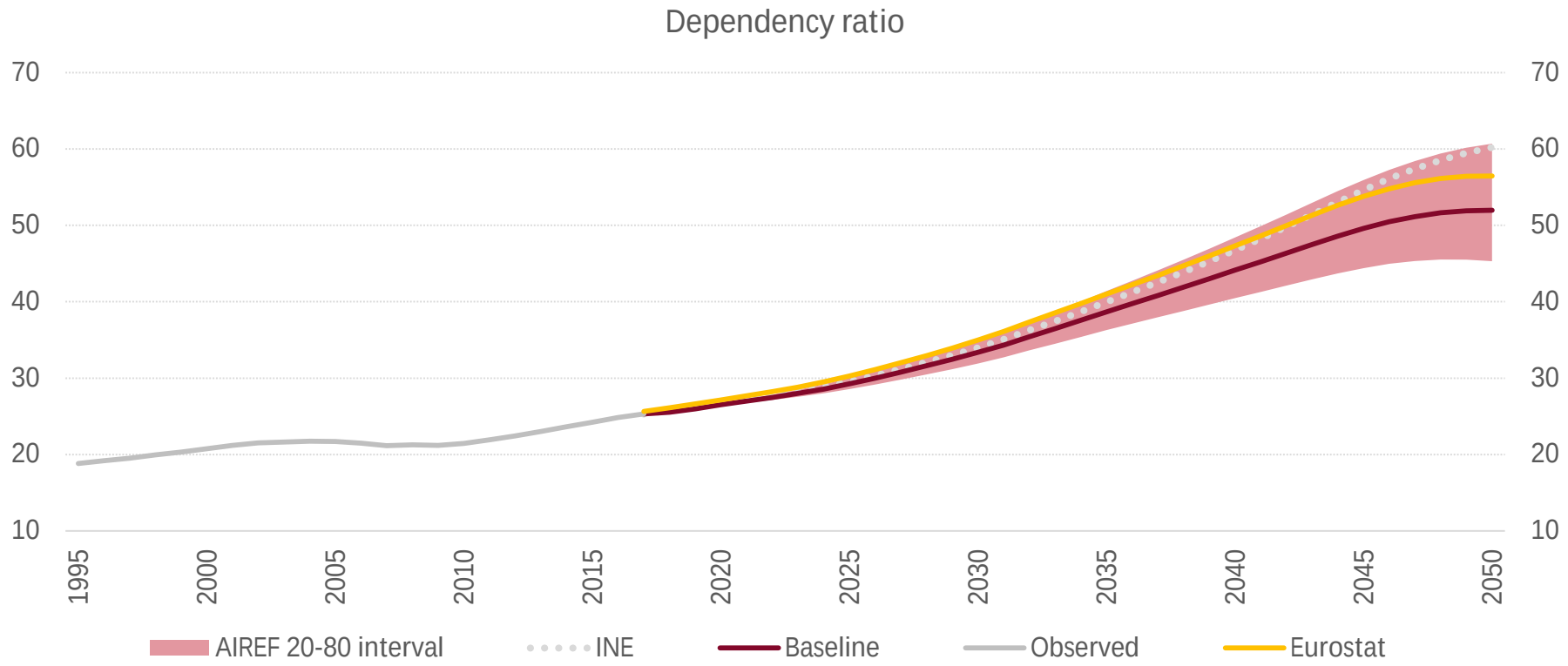
Life expectancy at birth	
2017	83.2
AIReF 2050	[85-90]
INE 2050	88.2
Eurostat 2050	87.0

Demographic scenario summary: distance from official projections



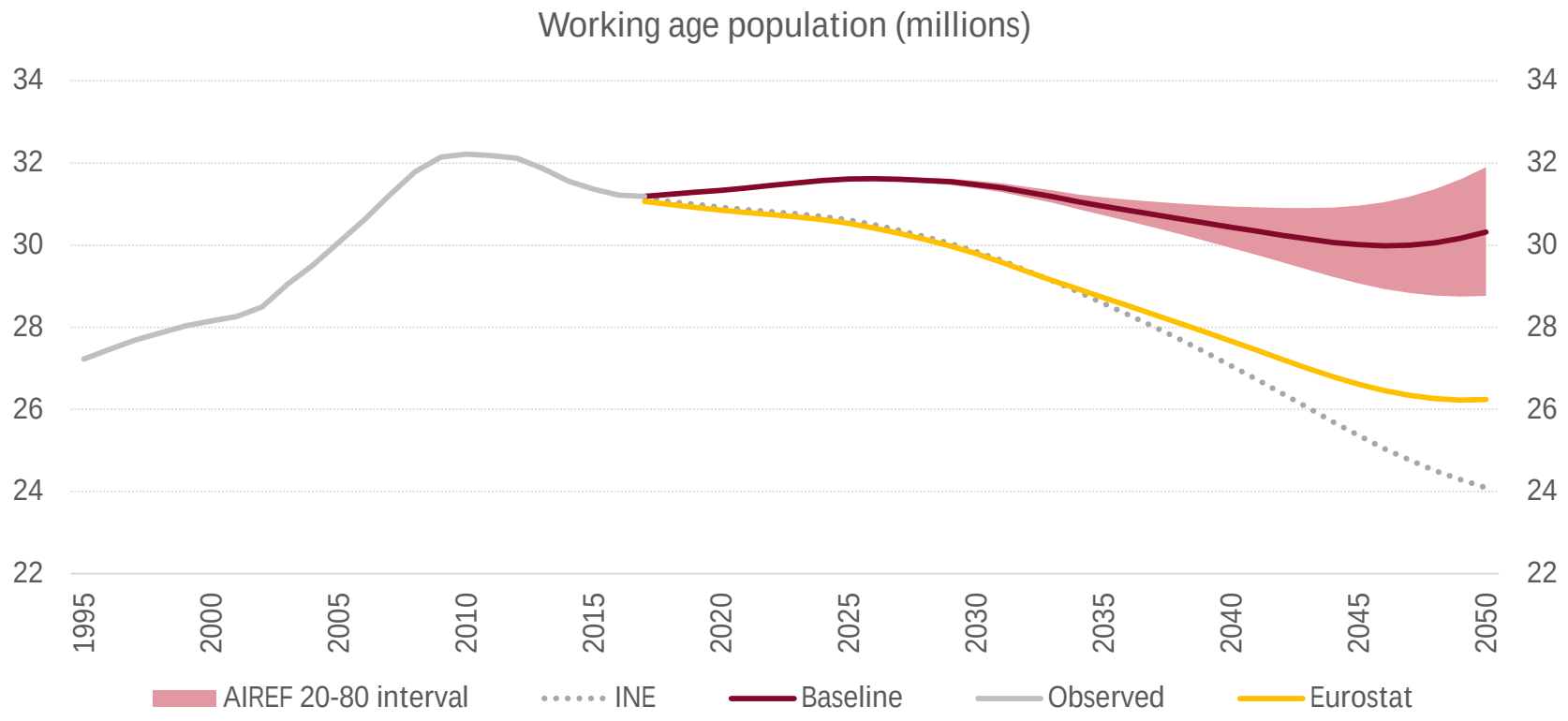
- The total population will increase to between **50 and 60 million** people in 2050
- INE and Eurostat expect a significantly lower total population

Demographic scenario summary: distance from official projections



- The dependency ratio doubles in the next 30 years, **standing between 45% and 60%**
- The INE anticipates a dependency ratio of 60% in 2050, which coincides with the upper limit

Demographic scenario summary: distance from official projections



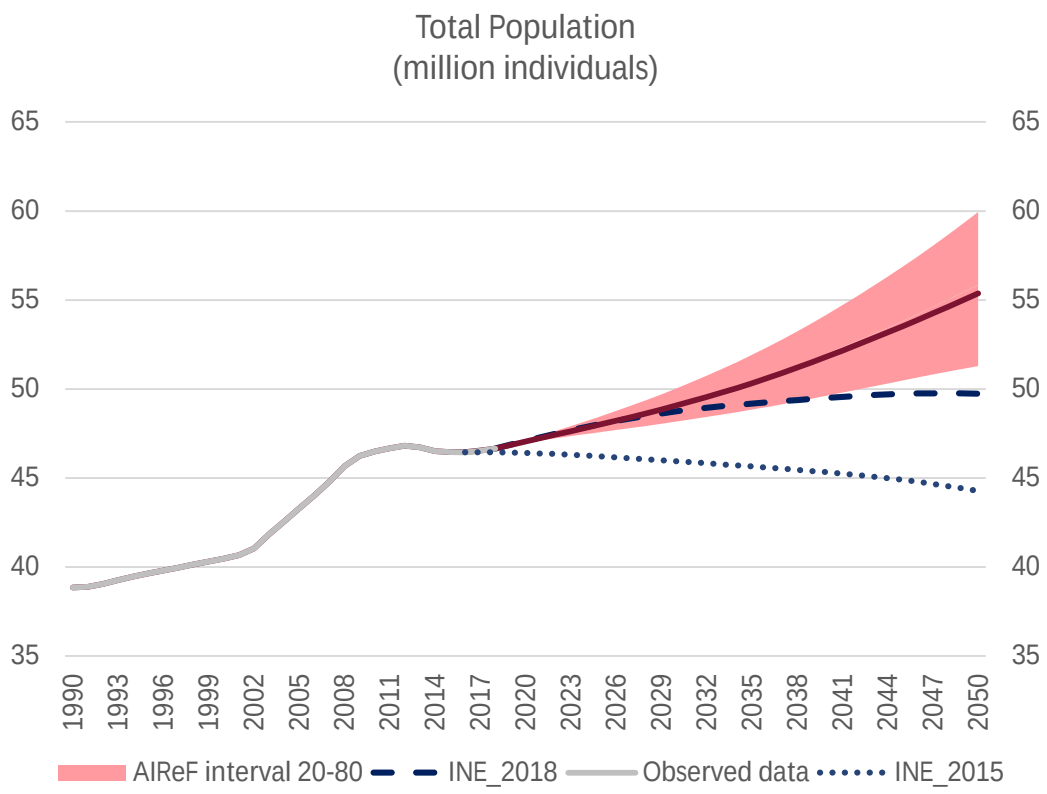
- The working-age population remains stable between **29 and 32 million**
- In contrast, the INE anticipates a reduction in the working-age population of 7 million people

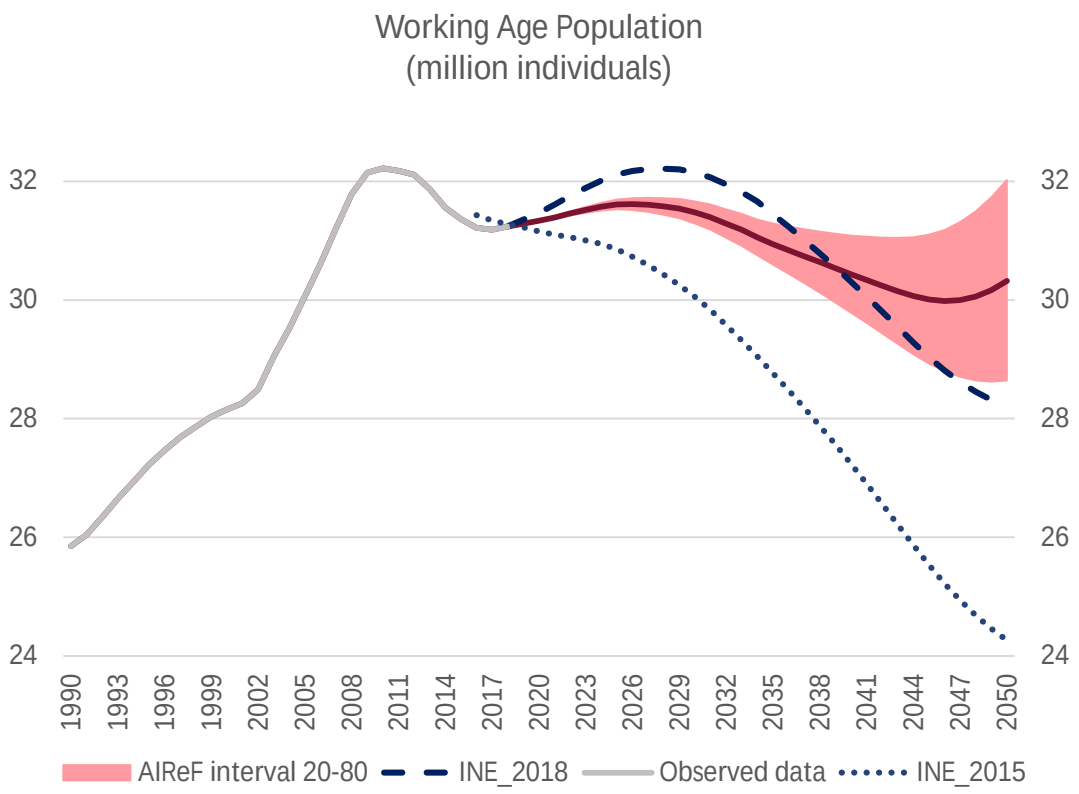
Breaking news: INE's latest update comes along with a change in methodology

- **Up to 2018 the Spanish Statistical Institute (INE)** based its projections on naive extrapolations of the most recent trends or even just repeated the last available figure for each component (e.g. for emigration)
- **In 2018 INE has thoroughly revised its demographic methodology**. Current projections for each component are anchored to values obtained from a survey of demographers.
- **Limitations:**
  - Current approach is more akin to a forecast than earlier projections but it's essentially a black box
  - By construction it is non stochastic and the distribution for each component can't be given a probabilistic interpretation.

Breaking news: INE's latest update comes along with a change in methodology

- **Bottom-line results:** Aggregate figures are similar to those of AIReF, especially closer in terms of net immigration figures





AIReF makes the forecasts and methodology available to users

- **Demography and economy coherence:** AIReF believes that demographic and economic forecasts should be carried out coherently
- **Demographic conditioning** tends to generate pressures in the labour market, with excess demand to which variables will respond endogenously [fertility, immigration]
- **Absence of bias in the analysis:** considering the interaction with the economy leads to very different conclusions to those customarily offered by statistics institutes
- **Uncertain context:** AIReF considers that forecasts should be offered with a realistic measure of their level of uncertainty, which is very high in the long term.
- **Importance of policies:** This uncertainty in the long term is the reflection of the freedom that society has today to change its reality within 50 years

Pirámide de población Año 2001

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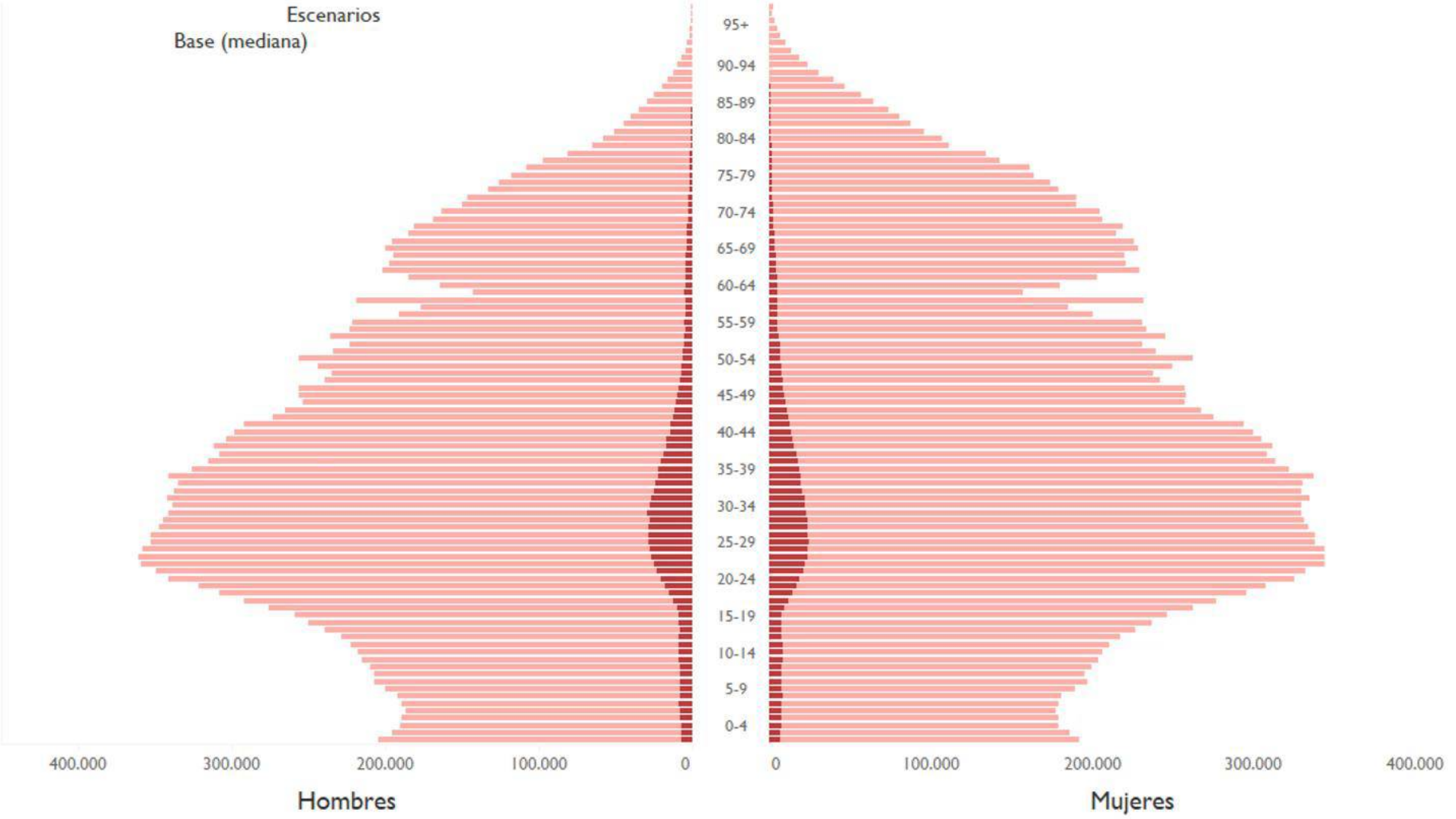


Población total

40.665.543

	2001	
Española	38.927.569	95,73%
Extranjera	1.737.974	4,27%

Población de 67+

5.993.853

Edad de trabajar (16-66)

28.260.736

Menores (0-15)

6.410.954

Mujeres

19.913.152
828.502

20.741.654

Hombres

19.014.417
909.472

19.923.889

Escenarios:
I. Escenario base con hipótesis establecidas en la mediana
II. Escenario en el percentil de distribución 20 de la tasa de dependencia: hipótesis de alta fertilidad, baja esperanza de vida y alta inmigración
III. Escenario en el percentil de distribución 80 de la tasa de dependencia: hipótesis de baja fertilidad, alta esperanza de vida y baja inmigración
IV. Escenario en el percentil de distribución 20 de la población: hipótesis de baja fertilidad, baja esperanza de vida y baja inmigración
V. Escenario en el percentil de distribución 80 de la población: hipótesis de alta fertilidad, alta esperanza de vida y alta inmigración

Fuentes: Instituto Nacional de Estadística y AIReF

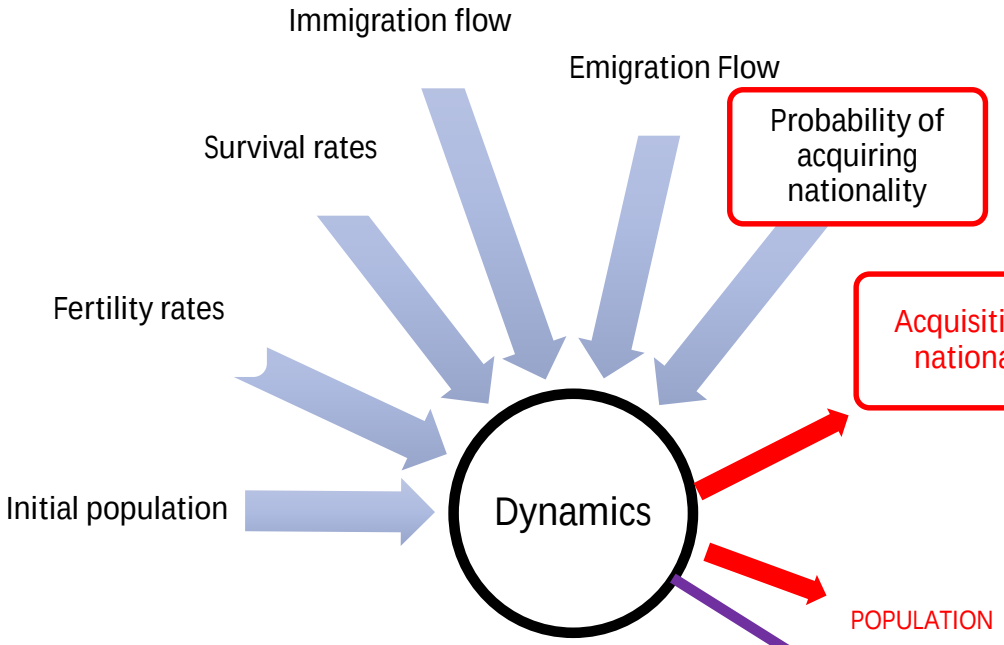
Methodology Annex

Methodology

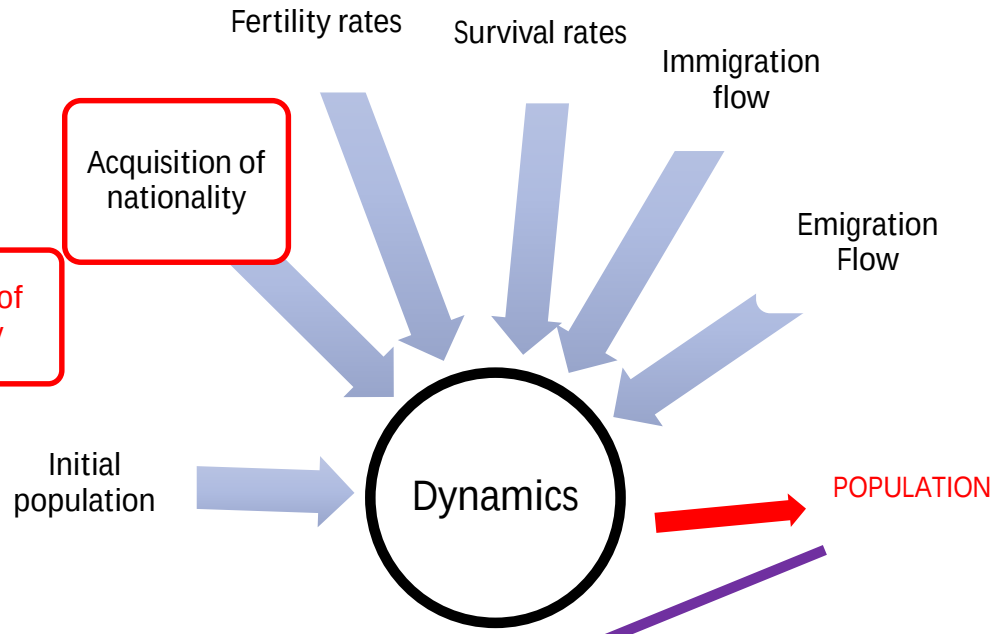
	INE	Eurostat	UN	AIREF
General model	Cohorts model (components)			
Breakdown by gender	Yes			
Breakdown by age	Single ages: 1 100+			
Breakdown by nationality	Yes	No	No	Yes
Fertility	Deterministic: curve projection	Deterministic: simple projection. Assumes long-term convergence between countries.	Stochastic: dynamic model estimated using a broad panel of countries	: Stochasticdynamic model conditioned to those of a panel of European countries
Procedure	Bottom up	Top down	Top down	Bottom up
International Information	No	Yes	Yes	Yes
Mortality	Deterministic: curve projection	Deterministic: simple projection. Assumes long-term convergence between countries.	Stochastic: dynamic model estimated using a broad panel of countries	: Stochasticdynamic model conditioned to those of a panel of European countries
Procedure	Bottom up	Top down	Top down	Bottom up
International information	No	Yes	Yes	Yes
Immigration/Emigration	Deterministic: virtually constant from the latest data	Deterministic: steady growth towards the long term of zero net flows between countries	Deterministic: steady growth towards the long term of zero net flows between countries	Stochastic: multilateral gravity model
Procedure	Top down	Top down	Top down	Top down
International information	No	Yes	Yes	Yes

METHODOLOGY: FERTILITY AND SURVIVAL

Foreign population



Spanish population



TOTAL POPULATION (h,m)

METHODOLOGY: FERTILITY AND SURVIVAL

- In the **first stage**: for each year, a function is adjusted to the age-specific fertility curves (distinguishing between Spaniards and foreigners) and the survival curves (men and women separately).

  Selected functions:

$$f_{i,t} = \beta_{0,t} \exp - \left(\frac{i - \beta_{1,t}}{\beta_{2,t}} \right)^2$$

Intensity — Modal age — Dispersion

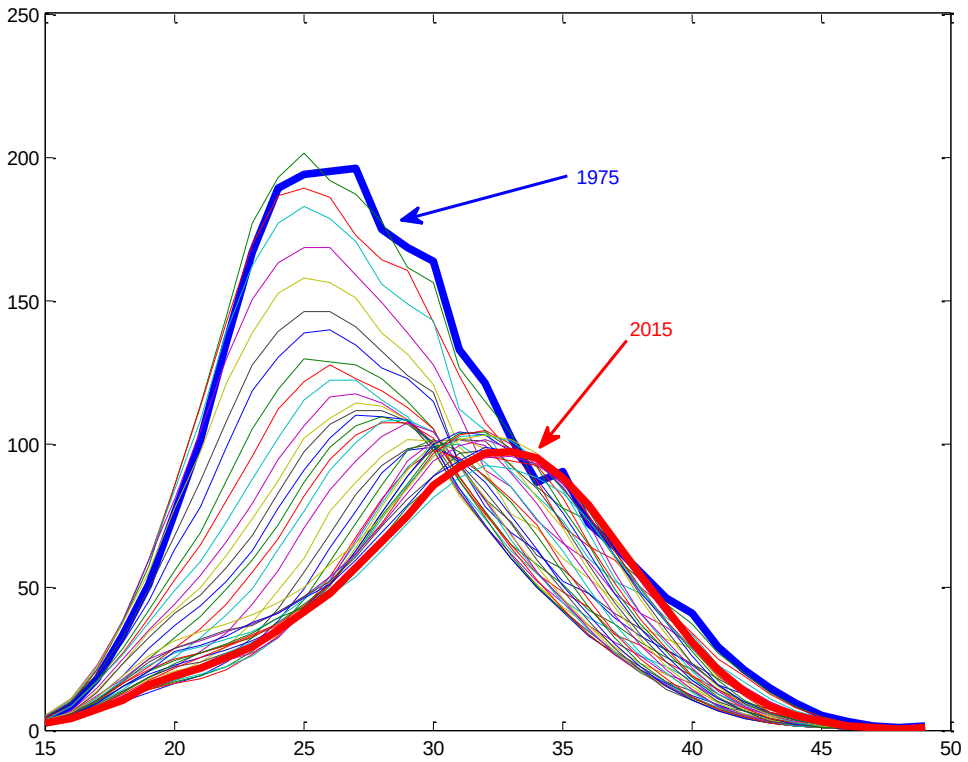
$$s_{i,t} = \beta_{0,t} + \beta_{1,t}\, i^{\beta_{2,t}} + e_{i,t}$$

Reference — Intensity — Curvature

- In the **second stage** the long term evolution (2100) of the factor model parameters β is conditioned to the series of number of births per woman (BPW) and life expectancy at birth (LEB) of a panel of European countries (including Spain).

FERTILITY:

Fertility rates: observed curves

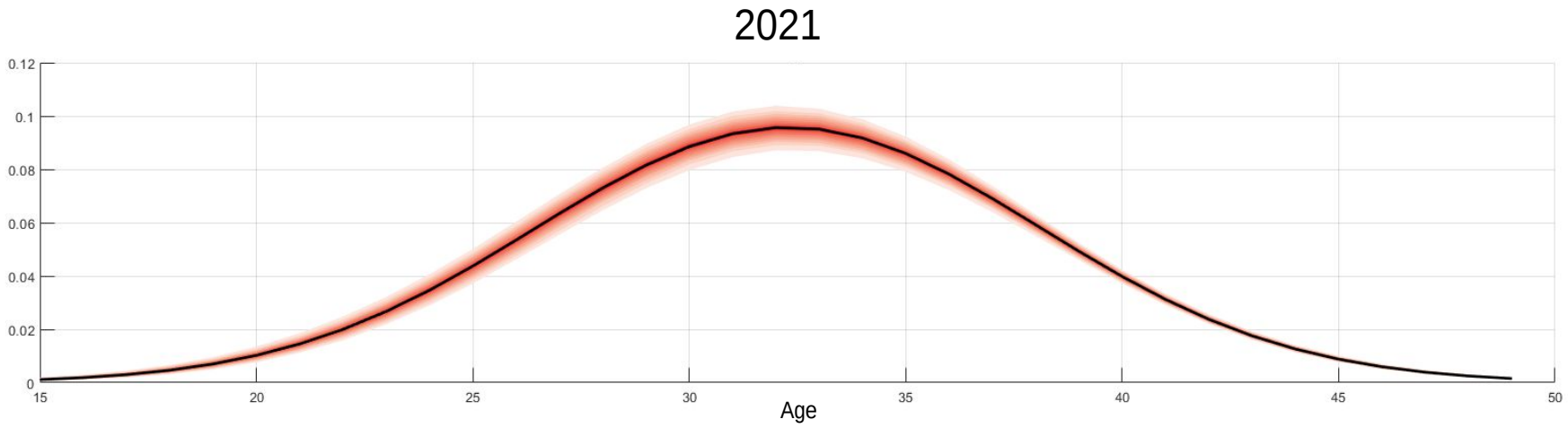


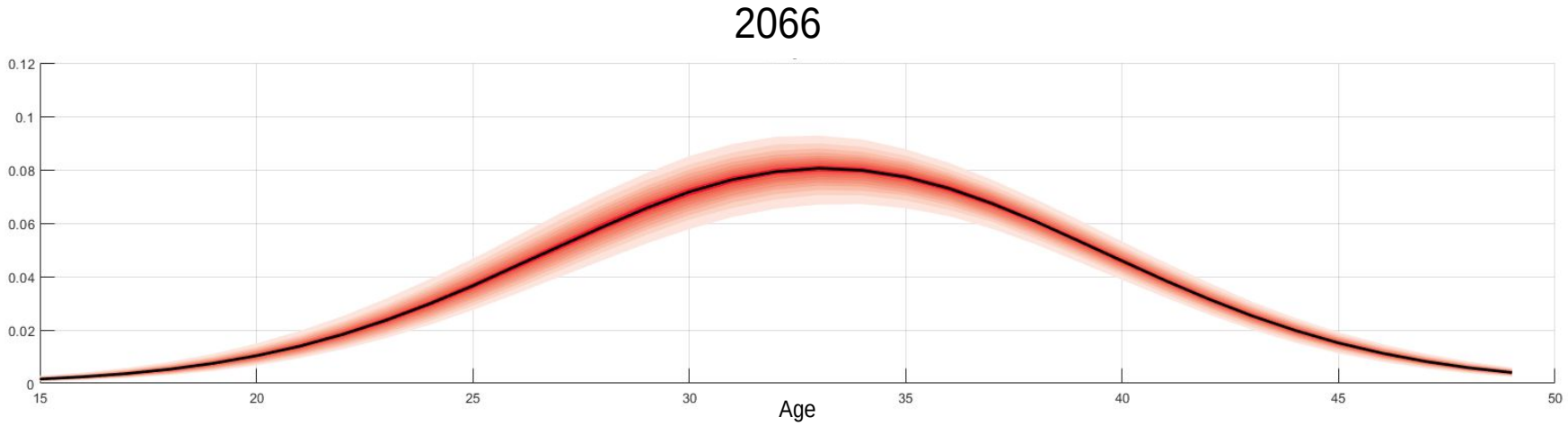
- For each year a parametric curve is adjusted:

$$f_{i,t} = \beta_{0,t}\, exp - \left(\frac{i - \beta_{1,t}}{\beta_{2,t}} \right)^2 + e_{i,t}$$

- The three parameters that characterise these curves form a multiple time series, susceptible to VAR modeling.
- The VAR model allows us to project, via Monte Carlo, the three parameters and consistently generate the corresponding fertility curves and probability intervals.

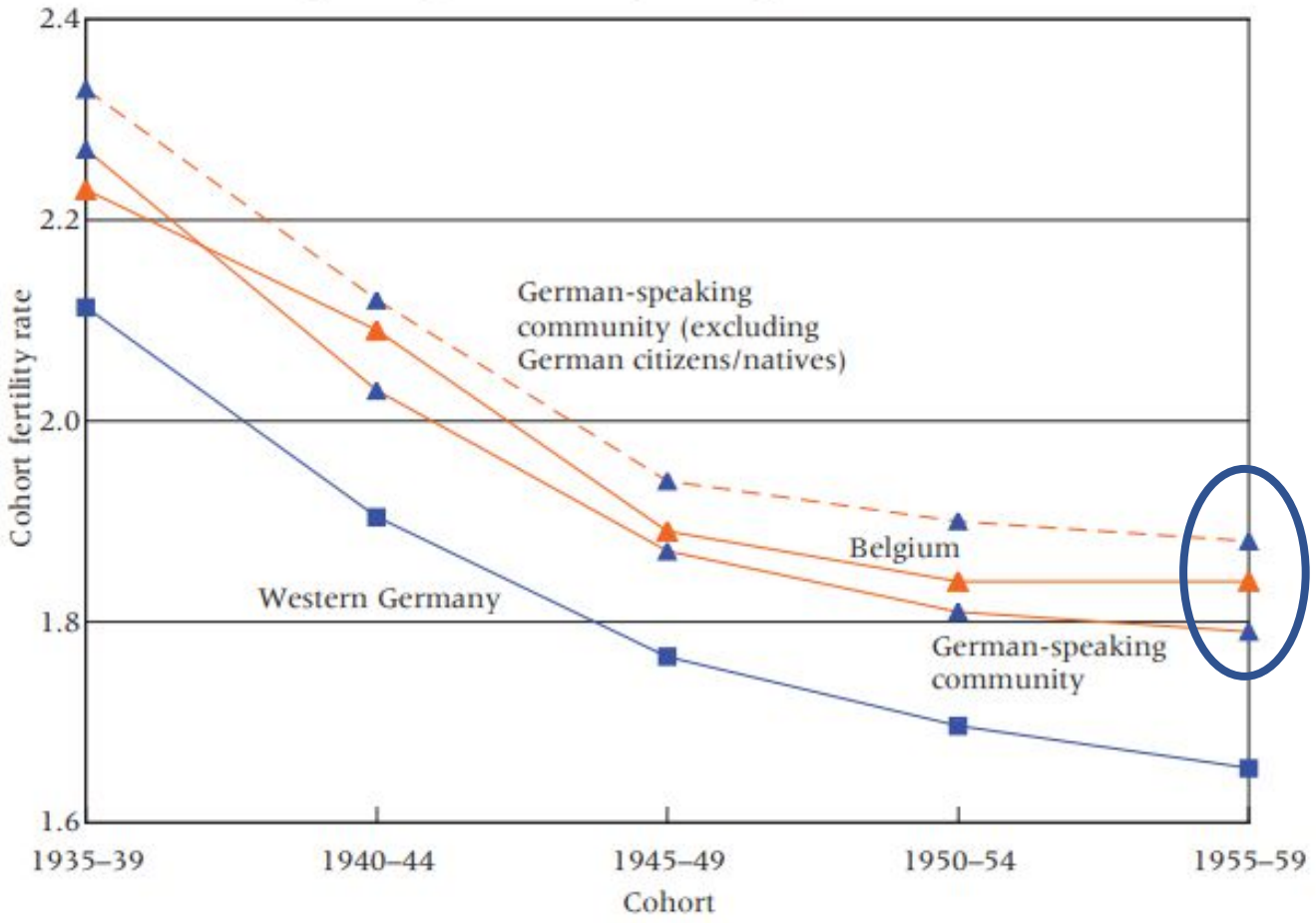
FERTILITY:


2021
0.12
0.1
0.08
0.06
0.04
0.02
0
15
20
25
30
35
40
45
50
Age


2066
0.12
0.1
0.08
0.06
0.04
0.02
0
15
20
25
30
35
40
45
50
Age

Is there an upward trend in the number of births per woman?

There is some evidence that certain policies have been successful in raising the birth rate in relatively short periods Klusener et al (2013)



SOURCES: Statistics Belgium, 2001 Census; SUF German microcensus 2008 (FDZ 2010b); authors' calculations.

An historic experiment shows that the Germanic community tends to assume patterns close to Belgian society, influenced by policies

Immigration forecasts model

Model: Random Utility Maximization (Heckman, 1972)

$$ln\,\frac{P_{odt}}{P_{oot}} = \frac{1}{\tau}\,\beta' x_{odt} - \beta'\,x_{oot} + MRM_{odt}$$

- In the model the migrant maximizes a utility function and this determines the likelihood of bilateral migration between each pair of countries

- The term MRM_{odt} represents the multilateral resistance to migration (policies, third countries…)

Estimated model

$$ln\,\frac{M_{odt}}{M_{oot}} = \frac{1}{\tau}\,\beta' x_{odt} - \beta'\,x_{oot} + \varepsilon_{odt}$$

The estimated model replaces the probabilities with migratory flows and is estimated based on bilateral immigration databases:

The vector x_{odt} contains, for each country of destination (x_{oot} origen):

1. The country's demographic structure.
2. The economic conditions, approximated by the GDP per capita
3. A network effect, approximated by the number of immigrants of that nationality in the country

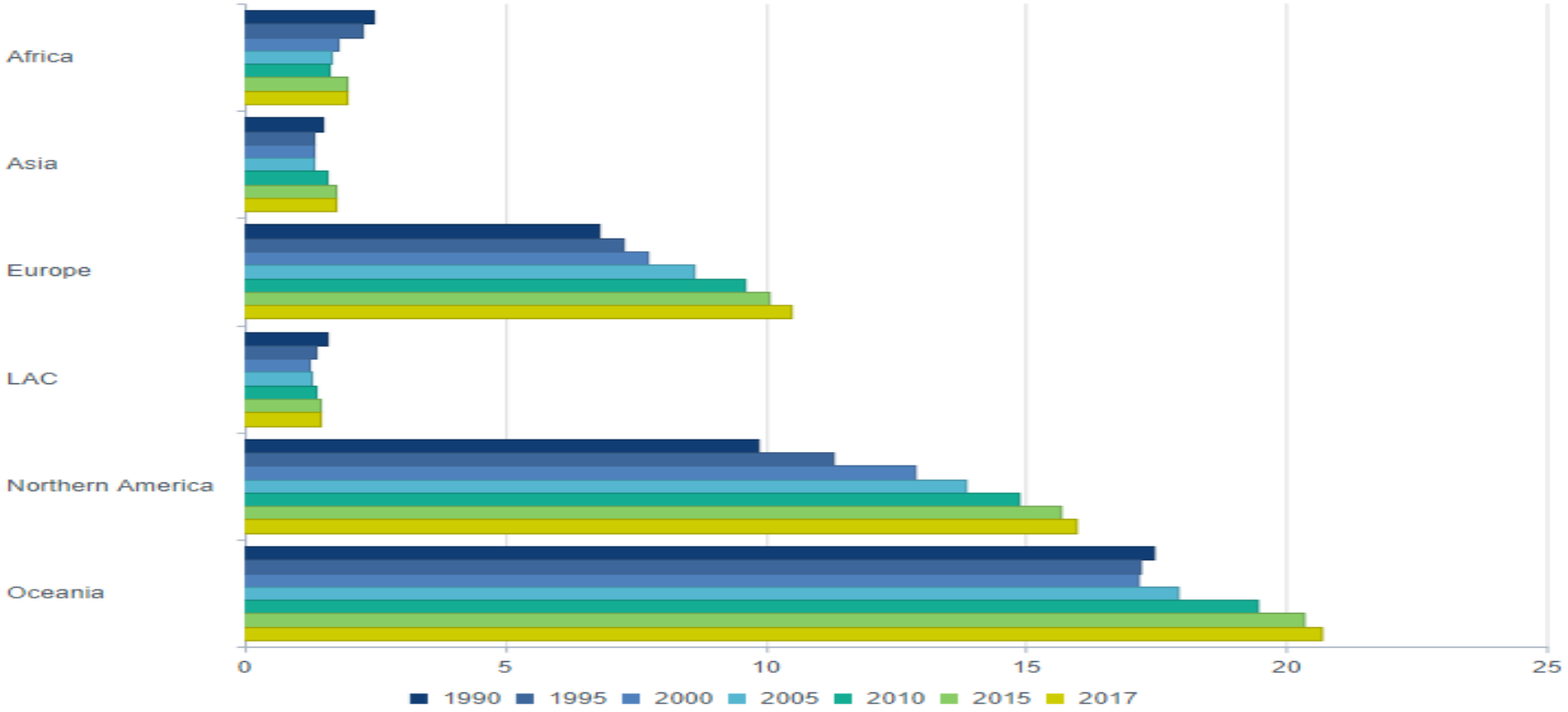
Estimated model

- The estimated model is used to predict by replacing the determinants of immigration with forecasts.
- The demographic forecasts are obtained from the UN scenarios
- JFH (2018) uses ten-year data and stock variation of as an approximation to the net flow of immigrants.
- The forecasts of GDP per capita are obtained from IMF forecasts in the short term and historical trends for longer horizons
- The model assumes constant migration policies
- The model generates estimates of bilateral migration flows for each country in the world.

Immigration: recent developments shows an upward trend at the global level

- **In the absence of restrictive migration policies, there is expected to be a flow of workers from the youngest countries to the oldest**

Percentage of migrants over population according to destination.



UN, World Migration Report 2018