REPORT

Resilient options for a future European welfare model

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Analysis of selected policy scenarios for Europe and their socio-economic implications FutuRes Deliverable 4.4*

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Abstract

In this report, we discuss and analyse different policy options aimed at increasing the long-term resilience of the future European welfare model. Based on the formal macroeconomic modelling and scenario analysis conducted before, we specifically focus on a range of policy scenarios and their likely consequences. We go beyond the previous focus on migration and automation, and explore several options specifically linked to the pension systems and other aspects of public policy, on which the governments exercise more direct control than it is the case with the largely exogenous population or technological processes. By doing so, we aim to produce recommendations on the range of possible interventions and their impacts. We also look at the long-term challenges and opportunities for the European social and economic model posed by changing demographic reality of contemporary low-fertility and high-longevity societies across Europe.

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1 Introduction

Population ageing is a universal process, especially pronounced in high-income countries. Its two main drivers: persistently low fertility, currently well below the replacement levels across Europe, and high longevity (life expectancy), slowly but surely lead to increasing the median age of European populations and growing proportions of people in the older age groups. As a side effect, the population sizes shift from a period of sustained growth to the current stagnation, only to start shrinking, especially in the absence of large immigration. The same holds for the labour supply: the number of economically active people in the economy. If the current trends continue – and given the demographic inertia their continuation over the next generation (two or three decades ahead) is nearly guaranteed – the challenges discussed in our previous reports (Barker and Bijak, 2024, 2026) are expected only to become more pronounced.

The main mechanisms behind these challenges work include several interacting pathways. Lower fertility exacerbates population ageing and contributes to lower population growth, which in turn negatively impacts the size of the labour force and in the absence of productivity increases, dampens the economic growth. In parallel, ageing drives demand for health and social care in older age, which then increases pressure on social security systems, leading to higher taxation and lower savings and investment. Some associated processes, such as increasing education levels, can moderate these mechanisms to some extent, but possibly working in different directions: on the one hand, higher education may suppress fertility levels (and in the longer term population growth), and on the other hand can increase human capital and productivity (in the shorter term).

With the clear exception of migration, demographic change is typically slow-moving. This means that the impact of these changes on many high-income countries, especially in Europe, in the horizon of one generation will still be limited in terms of its magnitude. This is in contrast to some other countries, like Japan, where low fertility rates have been low and stagnating already for a few decades, and immigration have remained very low: there the challenges are already accelerating. Some countries, especially in Southern (Italy, Spain) and Central-Eastern Europe (most of the region) can be expected to follow similar trajectories, although a couple of decades later. On the other hand, countries like the United States, where fertility decline is a much more recent phenomenon, are not expected to feel the full impact of demographic changes for a few more decades[1]. It is worth remembering here that from the three components of demographic change – fertility, mortality and migration – it is the sub-replacement fertility that is currently the main driver of population ageing in high-income countries.

At the same time, unlike fertility or mortality, migration is the one component of demographic change that is the most volatile, uncertain and least predictable[2], as it is very responsive in the short term to the changing economic conditions, political situation, policies, attitudes, and many other factors. Unlike fertility changes, the effects of which take two or three decades to manifest themselves in the economy through the labour market activity, and also unlike changes in mortality or longevity, which are usually slow-moving, migration can be very volatile and change very rapidly. At the same time, in most high-income countries, migration is one of the most important, if not *the* most important driver of the increase in the size of the population and labour supply, alleviating some of the short-term pressures on the economies and social security systems, but not fundamentally changing the long-term demographic dynamics.

In this report, we analyse the different policy options for the future European welfare model, aimed at increasing its long-term resilience. Through formal macroeconomic modelling and scenario analysis, we focus on selected policy scenarios and their likely impacts. We extend the previous work (Barker and Bijak, 2024, 2026), going beyond the focus on migration, and explore a few more policies linked to automation, pensions and social security systems. We conclude with high-level recommendations on the range of possible interventions and their consequences for different European countries.

The remainder of this report is structured as follows. Selected policy options are presented and evaluated in Section 2. They include: (a) revisiting the benefits of automation by formalising scenarios of enhanced investment in robots and AI, (b) considerations related to the type of pension systems: defined contribution vs defined benefit, and (c) extending possible financial disincentives of early retirement. The discussion of the main results as well as high-level conclusions of the analysis are included in Section 3.

[1]For an excellent summary and visualisations of demographic and economic trends from the last few decades, see Our World in Data (accessed on 1 December 2025).

[2]See e.g. Bijak (2024); for recent evidence on predictability, see Alho and Keilman (2026)

2 Policy Options

2.1 Scenarios: General remarks

Our model for examining different policy options, and its detailed specification, are described in the underlying technical report of Barker and Bijak (2026). The initial calibration of the model with respect to labour market features was focused on five-year age groups for observed labour market participation rates. Even though sudden changes in labour market policies are neither feasible nor practical, given the inertia of demographic change, some time needs to be allowed for the adjustments made to prepare for retirement preparation to show up in the labour market effects. Given this, we model the behavioural adjustment, as replicated in the data, to target the transformation of retirement decisions through a gradual cohort transition.

In practical terms, in the baseline scenarios, we assume that labour force participation rates that used to apply to the 55–59 year old age group, become gradually applied to 60–64 year-olds, based on the traditional five-year aggregation and assumption of a full retirement age of 65. This also assumes a trickle-down effect, with further adjustments in younger cohorts, who would know that they require greater and longer preparation for retirement, faced with increasing constraints. The short-term assumptions for participation rates for 55–59-year-olds slowly becoming a norm also for older age groups, is then repeated for further cohorts. In this scenario, if people aged 50–54 know that they need to work for at least 10–15 more years, then the reduction in participation will be postponed. Thus, workers entering the labour market in 2010s–2020s, would expect to retire in their 70s at the earliest, and have to work longer than their elders.

In addition, the emphasis on saving for retirement is also much greater now than it was 50 years ago which would help offset the problem somewhat. However, with low growth and increasing compulsory expenditures, young people are considering postponing saving for retirement in their 20s to enable to be in a better and safer position by their 40s by establishing a net wealth in e.g. property[3]. To some extend, this reduction in contributions can be manageable, but if it extends further, even into the 30s, this would exacerbate financial problems with pension sustainability further down the line.

[3]Source: PensionsAge report “Research highlights prevalence of young people opting out of pension contributions”, First accessed 2 April 2025.

Younger generations have higher levels of formal education than older cohorts. In addition, higher-educated individuals have higher labour market activity rates and lower unemployment rates for the same age categories, and typically work longer. Higher pension contributions also come from the higher-earning workers.

There is also a counter-effect, though, that as the education trends stabilise, the benefits of higher education are waning, and the relative increase of pensions due to higher contributions dwindles in comparison to the higher payouts of higher pension benefits. The wage premium of high vs medium and high vs low-educated workers is also expected to change as a education composition of the population evolves. Throughout the model, we have maintained the same wage premium[4].

From a demographic perspective, higher education rates of women have been traditionally considered to have suppressing effect on fertility rates. However, in recent years the rates for various educational and education mobility groups seem to be converging, with low-fertility becoming a much more universal phenomenon (e.g Ermisch, 2024). As our model focuses mainly on macroeconomic relationships, for which demography provides one of many building blocks, we do not analyse these effects in detail here.

Throughout this section, we extend the earlier analysis from Barker and Bijak (2024, 2026) by focusing on three policy-relevant scenarios: increasing the investment in automation capital (robots and AI), reforming the pension systems by universally switching towards defined contribution schemes, and finally disincentivising early retirement.

2.2 Harnessing the benefits of automation

The topic of automation of tasks in the form of robots or artificial intelligence (AI) algorithms is increasingly important as different forms of automation become increasingly more relevant and accessible. Such technological advances offer large opportunities for increasing job productivity *if* they can be applied and utilised to the maximum, complementing the human workers. The model developed in Barker and Bijak (2026) considers automation in the form of both AI technology and robots – underutilised in the existing literature, and relatively uncommon within macroeconomics.

[4]An unrealistic situation where people are assumed to remain low educated throughout their lives would show a significant reduction in output and consequently a decline in pension benefits.

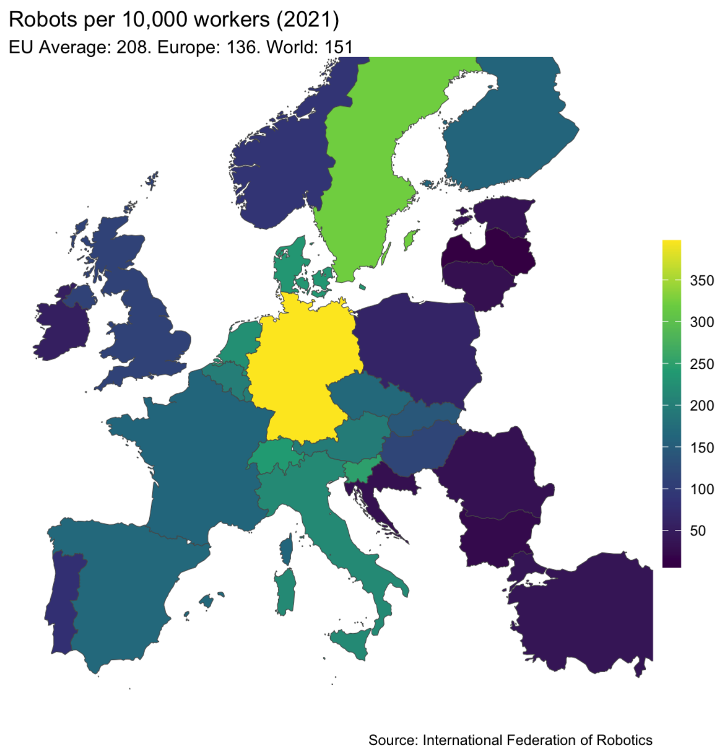
There is a great disparity in Europe of the existing rates of automation [5]. This in turn depends on the level of economic development of a country as a whole, but also reflects somewhat the dominant industries which can distort the picture somewhat, as in the case of some Central European countries (e.g. Czechia, Slovakia, and Slovenia with their automotive and other engineering-based industries), whilst suppressing the relative position of countries such as Norway (oil industry) and the United Kingdom (service-based economy). Figure 1a illustrates this diversity across Europe.

The International Monetary Fund produces an index of AI Preparedness which indicates the readiness of a country towards to adoption and rollout of AI technologies. This index, ranging between 0 and 1, is based on several factors including legal systems, available resources, and human capital. Europe is a relative leader globally, with Denmark ranking second, and the top 10 dominated by European countries. The map in Figure 1b shows the distribution of the AI Preparedness Index across Europe, with the expected picture of highly advanced and wealthier economies having higher values of the index. An exception is Estonia which has been developing its technology facilities for more than a decade, arguably becoming a hub of AI in Central and Eastern Europe.

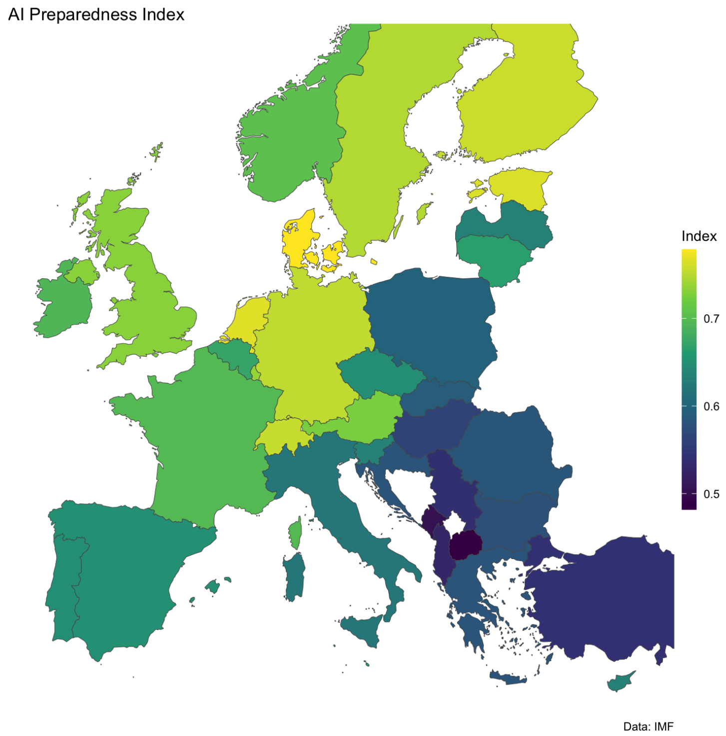
In the context of population ageing, existing research has shown that negative growth of the labour force results in an increased utilisation of robots (Abeliansky and Prettner, 2023). This shows that European economies can be expected to will rely more on robots as the population shrinks and ages – with an additional argument of increased productivity enabled by technological change complementary to the potential of human workers.

To examine the potential of increased investment in automation with our model, to assess the potential impacts of automation and AI, we produce theoretical GDP per capita scenarios under two sets of assumptions, whereby the growth rates of AI preparedness and robots per capita are increased by 1% per year. The numbers of robots are already growing at a rate of 5% per year in the baseline model, which matches the data and reports, however, AI was originally modelled as a constant parameter. Figure 2 demonstrates the significant changes from the baseline model to the one with increased growth of both types of automation capital, seen universally for all European countries under study.

[5] As the main calibration indicator, we use the number of robots in the manufacturing industry per 10,000 workers, as reported by the International Federation of Robotics (IFR).



(a) Robots per 10,000 workers – industry



(b) AI Preparedness Index

Figure 1: Robots per 10,000 workers and AI preparedness

Figure 1a shows the number of robots per 10,000 workers - missing figures indicate low or insignificant value. Figure 1b shows the preparedness (as a probability) of a country for AI. Source: IFR and IMF.

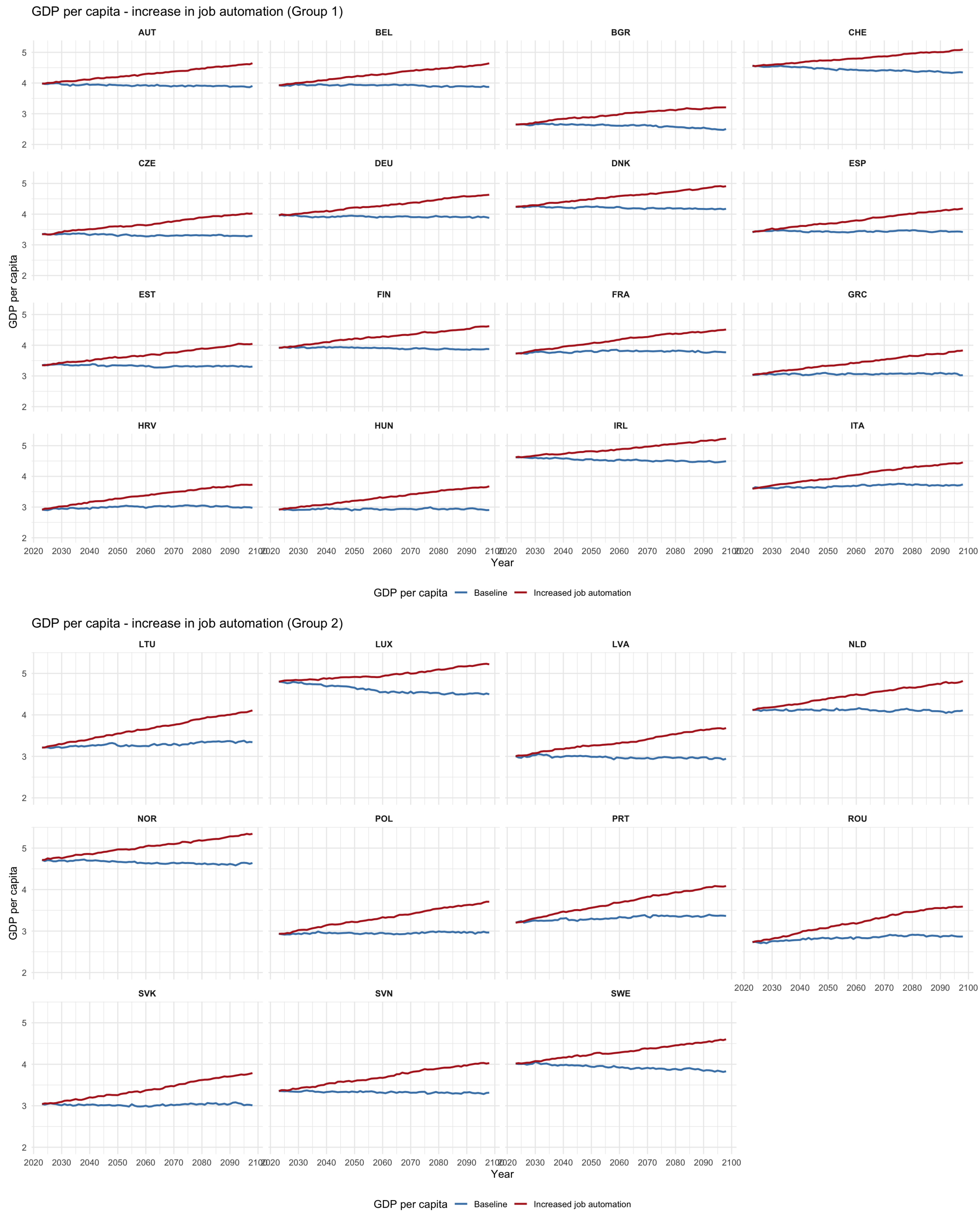


Figure 2: GDP per capita with AI and Robots

Log-transformed GDP per capita in the baseline model and with increased growth to reflect higher levels of AI Preparedness Index and number of robots per worker in 27 EU+ countries. The countries are labelled with ISO Alpha-3 codes and are split into two groups purely for presentational purposes. Source: Authors' calculations

2.3 Defined Benefit versus Defined Contribution schemes

Many pension systems are now moving to financing based on defined contributions (DC), which link the pension payments to the contributions made throughout the career, and their return on investment, rather than to final salaries, as would be the case in the defined benefit (DB) systems. The type of a pension scheme can make a significant difference, as the pay at the pre-retirement age of e.g. 60 or 65 is generally at the lifetime peak of earnings. For simplicity in the modelling of pension systems in Barker and Bijak (2026), a defined benefits scheme was used. In this simulation, we look at the effects of the contribution rate required in the defined contributions and defined benefits systems to achieve the same level of pension provision.

Figure 3 shows the effect of making the pension scheme defined contribution, which reduces the pressure on the contribution rates. The impact on various European countries is different, though: for those that already have relevantly percentage of high education in older generations, there is not much change, whilst some of the Central and Eastern European countries demonstrate larger impact, driven both by significant changes in life expectancy and higher educations rates. The net migration levels, despite their volatility, play a role, too. On the whole, across Europe, the picture is mixed, though, and the differences between the two systems are not very large.

2.4 Incentives for later retirement

Most European countries have early retirement schemes that pay out pensions with reduced rates (e.g. 5%), where such reductions can be either temporary or permanent. Other countries permit no early retirement at all. In the conetxt of long-term sustainability of pension systems, this situation raises the question of incentives for later retirement – or disincentives for earlier retirement, as possible policy options.

To examine the effects of different policy options on the pension contribution rates, several counterfactual scenarios can be run with the baseline model. Figure 4 plots the required contribution rate from the baseline scenario (blue), a reduction of an early pension by 5% (red), no reduction (purple) and no early retirement pension payment (gold). The fraction of pensioners claiming early retirement is assumed to be equal to the fraction of inactive persons at the early retirement age (55–64).

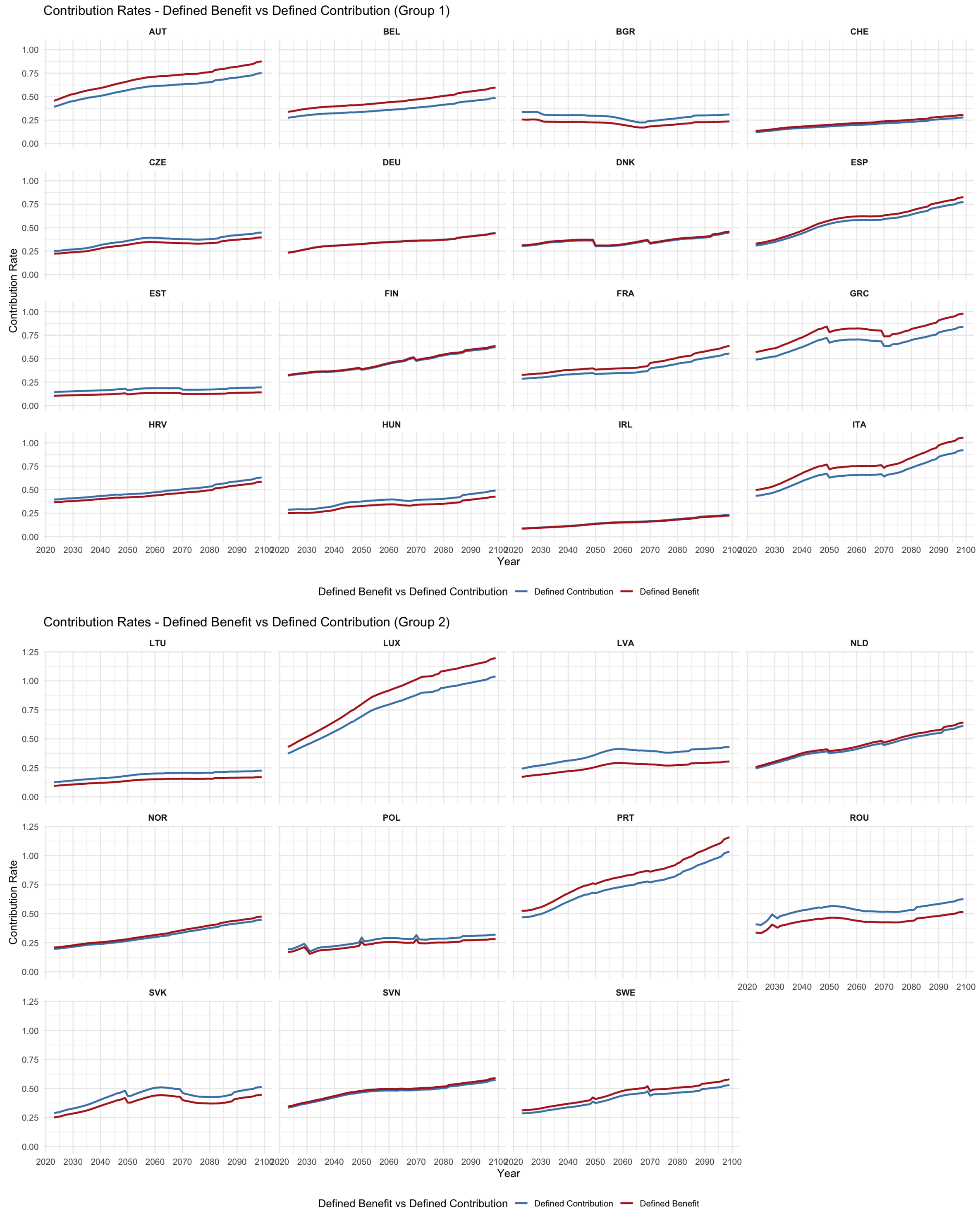


Figure 3: Simulated pension contribution rates: Defined Contribution & Defined Benefit

Simulated pension contribution rates under the baseline model assuming the Defined Contribution (DC) versus Defined Benefit (DB) pension system, for the 27 EU+ countries. The countries are labelled with ISO Alpha-3 codes and are split into two groups purely for presentational purposes.
Source: Authors' calculations and OECD, European Commission (2024) Explorer

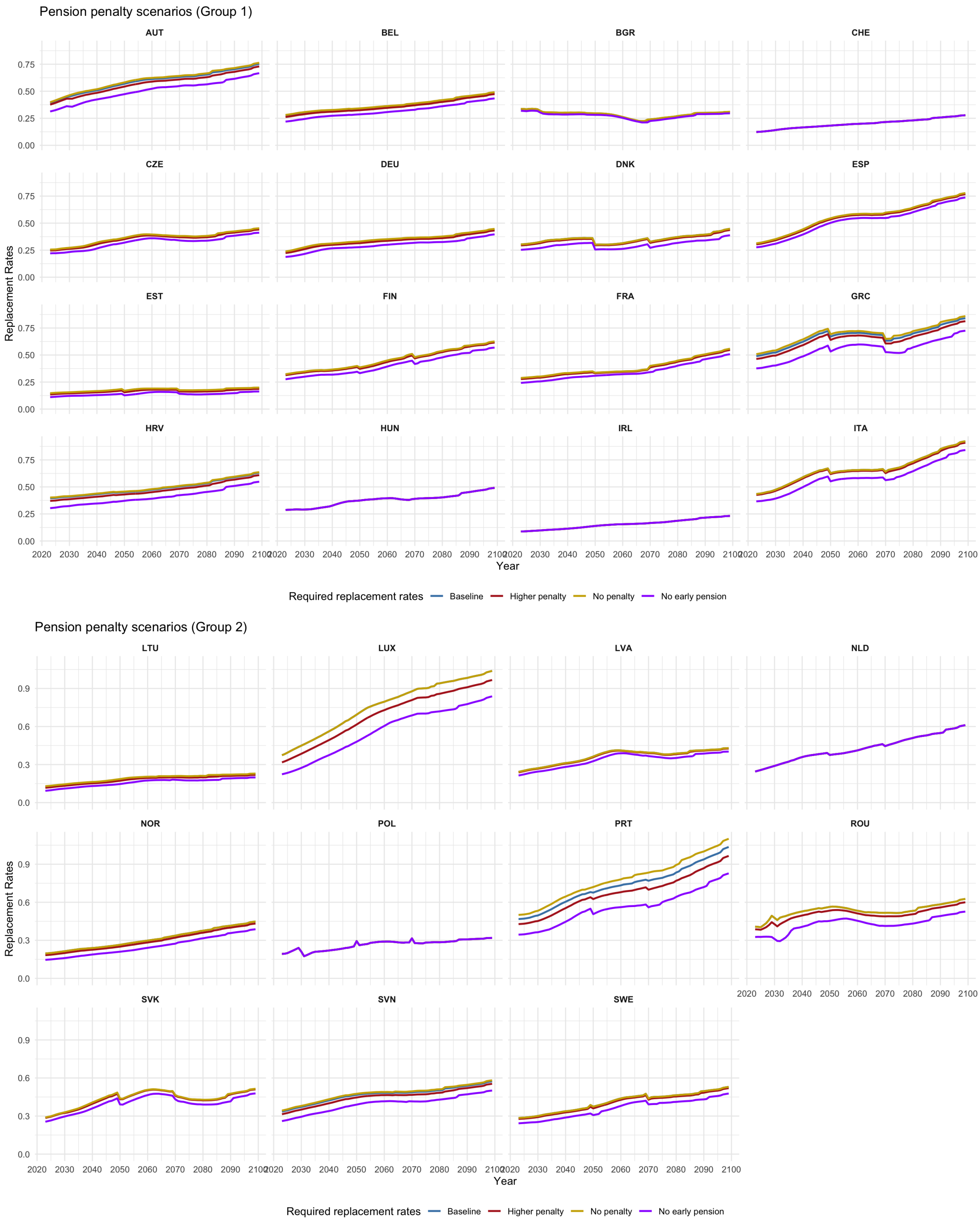


Figure 4: Current pension contribution rates and different early retirement options

Required and current contribution rates for the baseline model (blue), a reduced early pension (red), no reduction (purple), and no early retirement pension payment (gold), for the 27 EU+ countries. The countries are labelled with ISO Alpha-3 codes and are split into two groups for presentational purposes. Source: Authors' calculations

The results of the analysis are mixed, primarily due to a range of factors that contribute to existing policies, such as: (i) whether paid early retirement is already available, (ii) what is the difference between early and standard retirement age, (iii) what is the labour market participation at early retirement age, and (iv) what incentives and disincentives already exist. The three counterfactual scenarios examined in this section allow for making three general conclusions. First, not 'penalising' early retirement increases the required contribution rate. Second, higher levels of disincentives for early retirement reduce the required contribution rate by a small amount. Third, eliminating early retirement altogether has the greatest impact in reducing the required contribution rate.

Of course, the possibility of eliminating early retirement and the associated pension payouts in many countries would be politically unacceptable and is therefore highly unlikely. At the same time, given that some other countries, including Ireland and the Netherlands do not offer early retirement, the possibility remains, even if it is unpopular.

3 Discussion and Conclusion

This paper and Barker and Bijak (2026), on which this policy report is based and which it extends, give a unique insight into the different pension schemes in Europe for a large selection of countries. The model has been extensively calibrated to a near microsimulation. In the future, there are greater opportunities for developing the model, including through age-specific optimisation. In terms of high-level substantive findings, the results of our analyses confirm that working lives need to be extended, even though the impact of these, and other policy changes, will unfold only relatively slowly, over the course of several decades. In this case, the slow pace of demographic change is a blessing, as it allows time for making the necessary adjustments to create a more resilient and sustainable socio-economic system, going beyond pensions. In particular, the effective retirement age cannot change by much in five years, as there need to be jobs to match, both younger and older workers need to be enabled to access the jobs that they train for, and so on.

In an ideal world, addressing the long-term challenges of population ageing through a suitable multidimensional mix of economic and social policies, would lead to more resilient societies and economies in the longer horizon, with labour markets and social security systems that remain well suited for purpose over the next few decades. Such a world would benefit from longer working lives aided by modern technology and drawing on richer experience. In addition, ageing might bring about cultural change, whereby with a different composition of population and changing dynamics of intergenerational relationships and political preferences, social priorities may also change. To that end, if demographic change suppresses economic growth, it may be possible that growth itself ceases to be a priority policy objective. At the same time, in the status quo scenario, dominated by short-term responses only to acute challenges, the main, most direct mechanisms behind the impact of population ageing include the shrinking and ageing of the labour force, stagnation of productivity, as we;; as expansion of the demand for health and social care and social security, which may be difficult to match with adequate labour supply. In the long run, such elements can ultimately have detrimental impact on the quality of life in its many dimensions, some of which go beyond purely economic indicators.

Across Europe, all the elements of the policy portfolio and socio-technological change (such as migration or task automation) will form a part of a broader mitigation strategy, although on their own, none will be decisive. The current picture, confirmed in this report, is that the mitigation of the challenges of ageing will need to involve a broad range of different tools, such as reforms of the pension systems (including later retirement, incentives for longer contributions, auto-enrolment into workplace pensions, and so on), increasing economic activity throughout the life course, especially in the age groups 55–75 and for under-represented groups, introducing life-long upskilling programmes, and – crucially – harnessing the technological change to support longer productive lives.

None of these changes on their own would be sufficient to offset the impact of shifting demographics on the economy in the long run, though. In particular, migration on its own is not a long-term solution to the challenges of ageing (United Nations, 2000; Bijak et al., 2008), especially to the extent it can respond to policies in a desired way (which is debatable, see Castles, 2004). Still, migration would remain a part of the response, especially to the most acute labour market pressures, but should ideally link with other policies, especially through labour market integration of migrants. Any residual impact of increased longevity will require adapting our societies and the economic model, and preparing it for a different, shrinking and ageing world.

As for the priority areas for future work on the demographic impact on macroeconomic variables, the circular relationship between demography and housing availability and pricing requires attention: housing is affected by current demography (besides a suite of other factors, such as interest rates, credit, money supply, and so on), but also affects it, with a time lag, through family formation and fertility decisions. There is increasing evidence that housing costs contribute substantially to the current low fertility rates (see e.g Brauner-Otto, 2023; Li, 2024), and by extension to the size of the future labour force. Other macroeconomic variables (wages, productivity, interest rates, inflation) of course also moderate this relationship, and would therefore ideally require exploring by using formal modelling techniques, to shed some light on the trade-offs involved.

The scenarios presented and discussed in this report, as well as in the previous ones (Barker and Bijak, 2024, 2026), confirm that in terms of the actionable policy 'solutions' to the challenges of ageing, there is no silver bullet. An important difficulty is that the economic consequences of ageing will play out over the horizon of several decades from now, which is well beyond the length of the usual electoral cycles. At the same time, unpopular reforms, such as increasing the retirement age, can carry an immediate electoral penalty for the governments that would implement them. In addition, as with any reforms, there is the balance of current economic costs of their implementation versus the long-term deferred benefits – and in the case of population ageing, it can take several decades until the benefits become apparent.

Looked through this lens, the demographic challenge of ageing then becomes a question of correctly pricing the long-term negative economic externalities, such as the current inactivity exacerbating future difficulties *vis-à-vis* the short-term costs of reforms. It might be the case that information on long-term trends needs to be more overtly included in the bond markets, so that the governments have a more realistic and long-term structure of incentives. Some rating agencies are already including ageing in their risk calculations, alongside other macro-level slow-onset risks, such as climate change, but mainly over long horizons, with no immediate impact of demographic perspectives on the ratings (see e.g. Scope Ratings, 2023). Discounting the longer-term future costs and benefits explicitly for the current pricing of government debt may offer an additional element of the solution towards a more sustainable economic and demographic future of Europe.

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