EU climate risks, demographic change and debt sustainability

Integrating structural risks in long-term sovereign DSA

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Climate risks and demographic change are among the most important structural challenges sovereigns will face in coming decades and should be effectively understood and integrated into sovereign credit assessments. We propose to build on Scope's established analytical frameworks and lay the foundations for long-term debt sustainability analyses that consider the impacts of population ageing and differing climate scenarios for sovereigns, with a focus on EU countries.

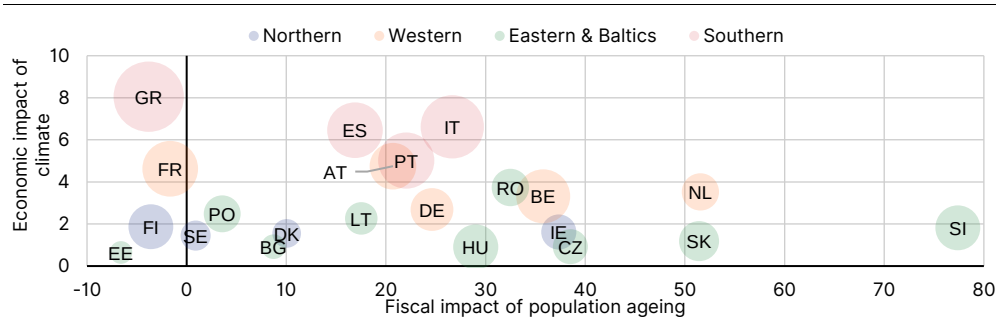
Global warming has led to widespread changes in the climate, while much-needed emissions reductions will have profound economic implications[1]. Similarly, population ageing has an important impact on countries' growth and fiscal outlooks. Incorporating climate and demographics via longer time horizons for debt sustainability analysis is critical for properly assessing the materiality of these factors for long-term sovereign risk. Our proposed long-term debt sustainability analysis (DSA) framework incorporates the fiscal costs of population ageing as well as the economic impacts of chronic physical and transition risks (though excluding acute physical risks) through 2050.

We find that climate and demographic risks moderately impact medium-term public debt trajectories for most countries but become increasingly credit relevant and mutually reinforcing in the long run. Population ageing presents the greatest challenge through 2050, potentially increasing public debt by up to 21pps of GDP on average across EU countries. The climate-related impact of a 'disorderly' transition could lead to a further increase of public debt of around 5pps of GDP on average, above that estimated under the 'orderly' (1pp) or 'hothouse' (3pps) scenarios.

Favourable underlying debt dynamics in Southern and Northern EU countries could lead to substantial debt consolidation in coming decades despite the combined impact of climate and demographics. Conversely, the dual impact of climate and particularly demographic factors could exacerbate poor underlying dynamics and lead to a substantial increase in public indebtedness in Western and Eastern EU through 2050 absent an effective policy response.

Figure 1: Impact of ageing and climate risks on EU public debt ratios, 2022-50

pps of GDP



Source: Scope Ratings

Related Research

EU's climate goals: few countries on course to be "Fit for 55"; further reforms needed
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[1] IPCC (2023), Synthesis Report of the Sixth Assessment Report; Pisani-Ferry (2021), Climate Policy is Macroeconomic Policy, and the Implications Will Be Significant.

Incorporating climate transition and demographic risks in long-term debt sustainability analysis

Leadership in incorporating climate and social risks in sovereign ratings

Scope was the first major credit rating agency to incorporate environmental and social factors explicitly and systematically in its sovereign rating methodology as part of a standalone ESG risk pilar. Our quantitative assessments of environmental risks provide a snapshot of countries' carbon intensity (transition risks), exposure to natural hazards (physical risk) and ecological budget balances (resource risks). Our assessments of social risks include measures of income inequality, labour force participation, and population ageing. Our qualitative assessments consider a country's policies to bolster its environmental and social performance and address structural risks.

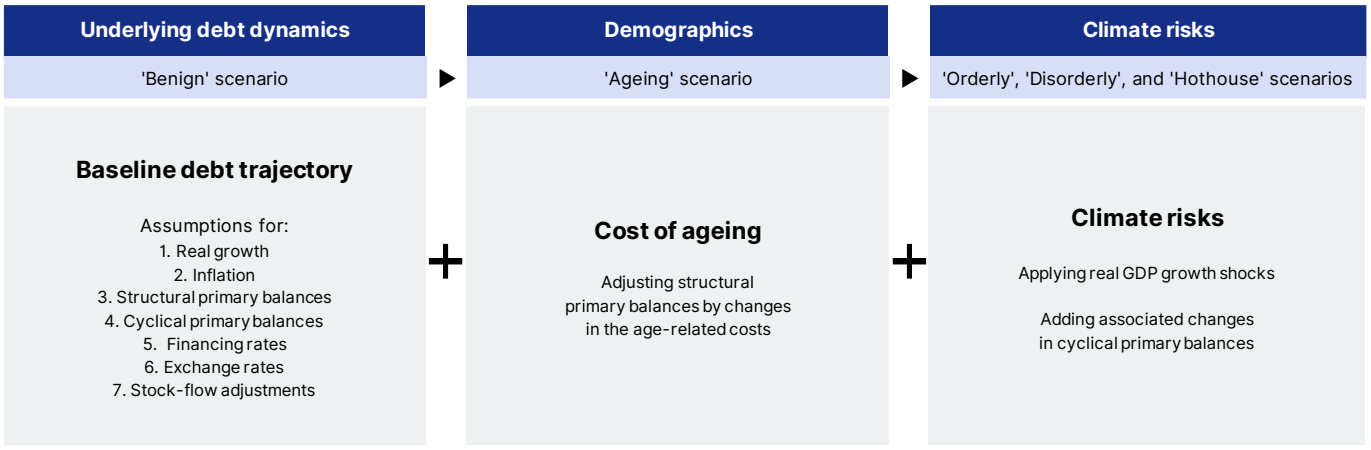
Climate- and demographics-smart long-term DSAs…

To incorporate long-term climate shocks and demographic trends, we build a DSA framework, with a time horizon extending to 2050 (see Appendix I for an overview of the DSA assumptions). These projections include a 'benign' scenario, which omits the cost of ageing and the macro-economic impact of climate-related risks (**Figure 2**). We then add the projected fiscal costs of ageing as presented in the European Commission's Ageing Report [2] under the 'ageing' scenario, which assumes current policy settings are unchanged**.**

…using widely recognised climate stress testing

Finally, we adjust the growth and fiscal balance assumptions of the 'ageing' scenario for the expected growth impact of climate-related risks under the 'orderly', 'disorderly', and 'hothouse' scenarios developed by the Network for Greening the Financial System (NGFS). The scenarios are widely used by major central banks and regulators. The scenarios factor in transition risks related to policies needed to curb greenhouse gas (GHG) emissions as well as chronic physical risk related to rising temperatures (see Appendix II for an overview of the NGFS scenarios). The NGFS has not yet released country-level data for acute physical risks related to extreme weather or climate events, which are therefore excluded from our analysis.

Figure 2: Overview of Scope's long-term DSA scenarios



Source: Scope Ratings

[2] European Commission (2021), The 2021 Ageing Report: Economic and Budgetary Projections for the EU Member States.

The double materiality of climate and demographic risks for long-term debt trajectories in the EU

Climate and demographic risks for public debt are material only over the long term

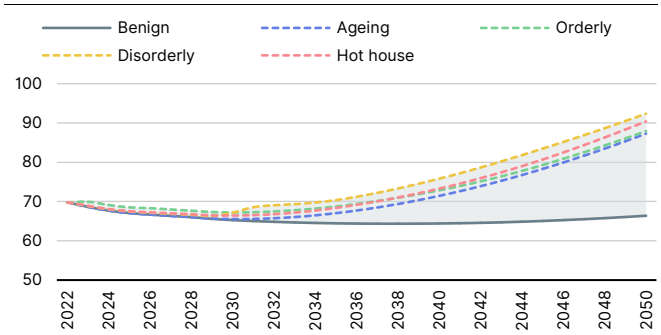
We find that climate and demographic risks are relatively contained over the medium-term but will pose an important and growing challenge for the public debt trajectories of EU sovereigns over the next three decades. Public debt trajectories are broadly similar across all scenarios during the first decade; they only begin to materially diverge by the beginning of the next decade.

Population ageing poses greatest challenge, exacerbated by climate factors

Population ageing presents the greatest challenge, potentially pushing up public debt by 21ps of GDP versus the 'benign' scenario on average across EU member states (**Figure 3**). In addition, relative to 'ageing' scenario (excluding climate factors), the EU average public debt-to-GDP ratios could be 1pp, 3pps, and 5pps higher under the 'orderly', 'hothouse', and 'disorderly' transition scenarios respectively by 2050. Importantly, population ageing and climate factors will materialise concurrently and compound the upward pressures the trajectories of public debt.

Figure 3: Average public debt-to-GDP ratio across the EU

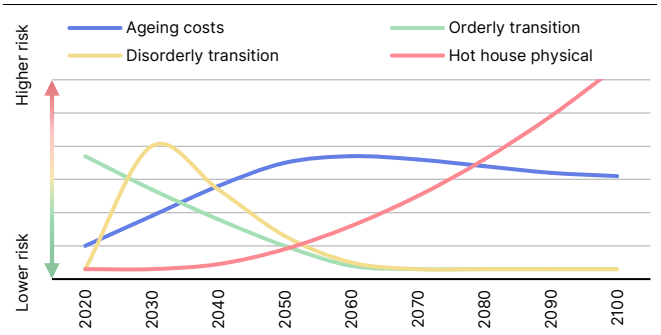
% of GDP



Note: The EU average is shown as a simple average.
Source: Scope Ratings

Figure 4: Stylized public debt risks per risk factor

Illustrative risk levels



Source: Scope Ratings

Peak risk horizons differ greatly per risk factor

The main risks associated with each scenario peak at different times (**Figure 4**). Demographic pressures in the EU will build gradually and peak in the 2050s and 2060s before stabilising at higher levels throughout the second half of the century. Transition risks under the 'orderly' and 'disorderly' scenarios are highest in the next 10 to 15 years but should dissipate gradually as countries converge to a net zero economy. Conversely, unbridled climate change under a 'hothouse' scenario could lead to irreversible physical damages, which could grow exponentially in the second half of the century if countries are unable to adapt to these changes effectively.

Early, pro-active climate mitigation remains the best option

Of all our climate scenarios, an 'orderly' transition consistently presents the lowest risks for countries' public debt trajectories, except for Ireland. In addition, the transition impact for public debt ratios subsides gradually from 2040, while the adverse impact of a 'hothouse' scenario is expected to continue rising beyond our time horizon. Therefore, despite the near-term transition cost, mitigating GHG emissions through early and effective climate action could prevent an unsustainable debt increase during the second half of the century and remains the best policy option to avoid irreversible damages, as also highlighted by the IPCC [3].

Regional disparities are large, especially for Southern EU

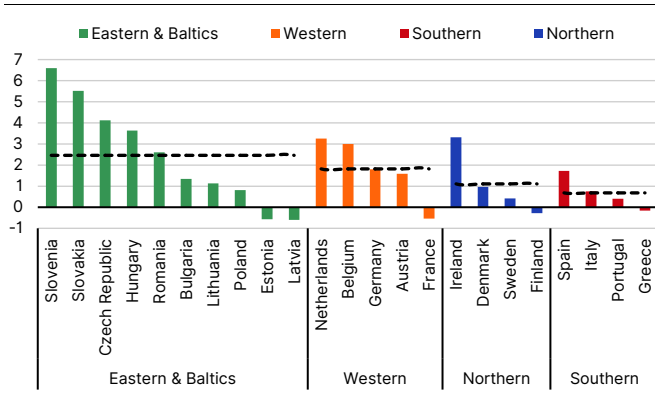
EU-wide averages hide wide regional differences. The impact of population ageing outweighs that of climate-related risks for most countries with the exceptions of Estonia, Greece, France, Latvia, Finland and Sweden for which age-related costs will not increase materially in coming decades.

[3] IPCC (2023), Climate Change 2023 Synthesis Report: Summary for Policymakers.

Eastern, Baltic and western European countries generally face the biggest increase in age-related costs while those in the south and north are more contained (**Figure 5**, see Appendix III for an overview of regional trends over time) [4]. Climate-related GDP losses mostly reflect transition risks and are highest in southern, northern, and western countries, while eastern and Baltic countries appear more insulated (**Figure 6**, see Appendix IV for an overview of country-level GDP losses). These differences reflect both differing levels of carbon intensity and climate ambition, with more (less) stringent emissions reductions typically assumed in NGFS modelling for higher (lower) income countries.

Figure 5: Change in total cost of ageing, 2028-50

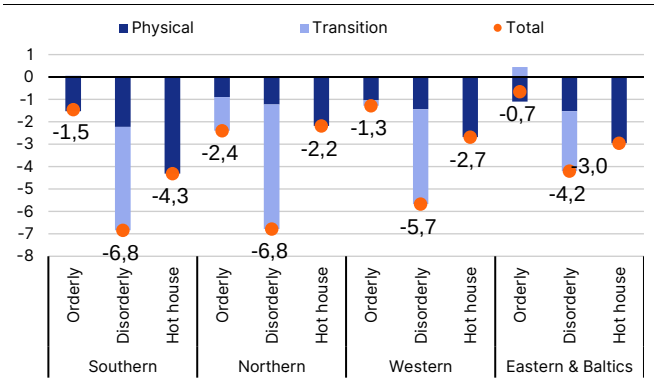
pps of GDP



Note: We present here the ageing costs over 2028-50 as this is the period during which our model explicitly accounts for structural changes in age-related costs.
Source: European Commission, Scope Ratings

Figure 6: Regional GDP losses vs a no climate scenario, 2022-50

%



Note: Regional figures are simple averages.
Source: NGFS, Scope Ratings

The main regional differences are as follows (see **Figure 7**, next page)[5]:

The northern EU region benefits from favourable underlying debt dynamics, which result in a large decline in the region's average debt ratio to 18% of GDP in 2050, from 45% in 2022 under a 'benign' scenario. Fiscal pressures due to population ageing are relatively contained, apart from those in Ireland, but will push up debt by 11pps of GDP on average. Climate risks could add an additional 3pps of GDP to debt under the 'disorderly' scenario, a modest uptick in view of the region's solid consolidation prospects.

The western EU region has weak underlying debt dynamics with the region's average debt-to-GDP ratio rising by 9pps over 2022-50 to 91% in 2050 under the 'benign' scenario. The increase in the cost of ageing will add an additional 26pps and to the region's public debt ratio on average by 2050. The additional debt stemming from climate risks is negligible under the 'orderly' scenario (<1pps of GDP) but could reach 4pps under the 'hothouse' and 7pps under the 'disorderly' scenarios. As such, the region's average debt-to-GDP ratio could near close to 130% by 2050, not far from that of Southern EU today (137%).

The eastern and Baltic EU region has the weakest underlying debt dynamics, due to expectations of sustained structural deficits and weakening growth as their income levels converge with that of other EU countries. Our 'benign' scenario projects the average debt ratio to reach 67% by 2050,

[4] The country/region classification we use throughout this report is as follows: Southern EU (Greece, Italy, Portugal, and Spain), Eastern EU (Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovenia, and Slovakia), Western (Austria, Belgium, France, Germany, Luxembourg, Netherlands), Northern EU (Denmark, Estonia, Finland, Ireland, Lithuania, Sweden). Croatia, Cyprus, Luxembourg and Malta are not covered by NGFS data.

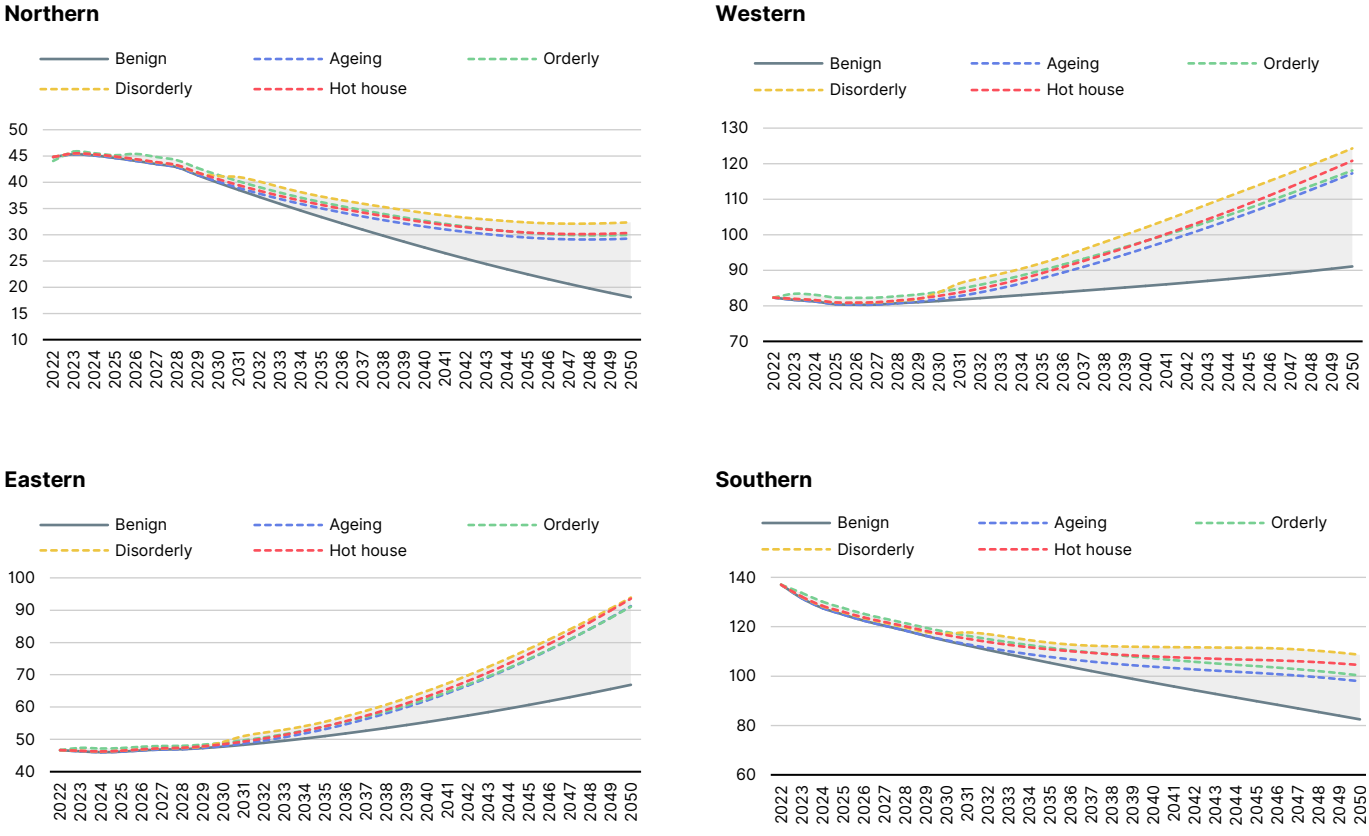
[5] We present regional averages throughout this report as simple averages rather than weighted by GDP as the former is more representative of individual sovereign risk across a region.

up by over 20pps from 2022. The region also faces the highest increase in age-related costs, which will place the average debt ratio on a firmly rising trajectory, reaching 91% of GDP by 2050. Climate risks present a more manageable challenge, adding only 2-3pps of GDP to debt by 2050 under the 'disorderly' and 'hothouse' scenarios and close to no impact in case of an 'orderly' transition. This likely reflects less stringent emissions reductions for the region assumed in NGFS climate modelling despite their relatively carbon intensive economies.

The southern EU region displays very strong underlying debt dynamics with the region's average debt ratio expected to fall by 55pps over 2022-50 to 83% of GDP. This reflects significant debt consolidation in Greece (-88pps) and Portugal (-80pps) for instance. The increase in the costs of ageing is relatively moderate for the region, thanks in part to past reforms to address long-term pension liabilities and already elevated spending. Still, ageing will add 15pps of GDP to the region's average debt ratio by 2050. To this, a 'disorderly' transition and 'hothouse' scenario could add another 11pps and 7pps of GDP respectively. Importantly, the combined effects of population ageing and climate factors should only slow down, rather than reverse, the expected decline in the region's average public debt-to-GDP ratio.

Figure 7: Regional average public debt trajectories

% of GDP



Note: Regional figures are simple averages.
Source: Scope Ratings

Pre-existing debt vulnerabilities compound credit challenges

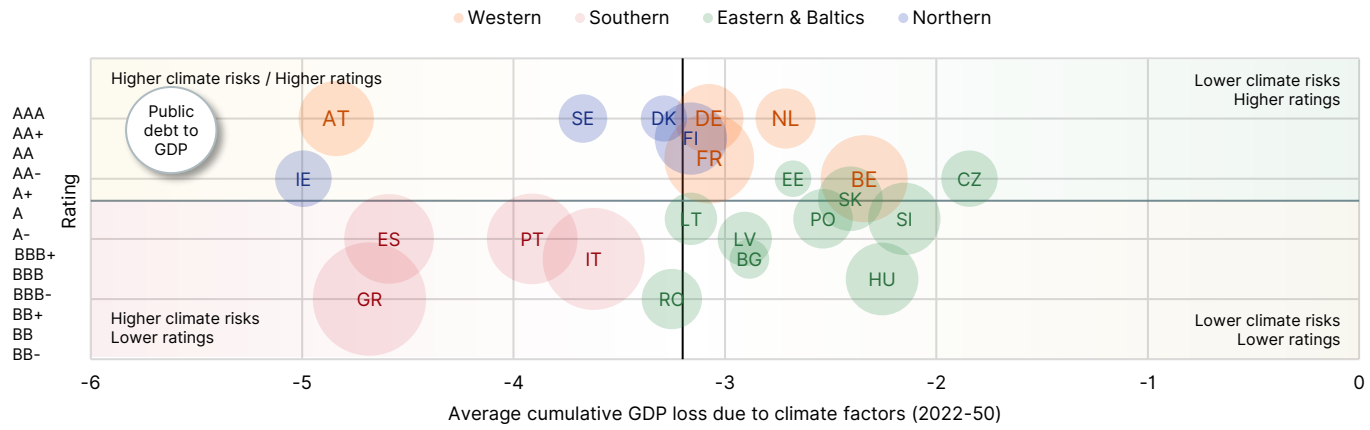
Southern EU countries are the most exposed to climate risks, have the highest debt burdens, and have lower credit ratings (**Figure 8**). The average public debt ratio of the most exposed quartile of EU countries to climate risks stood at 105% of GDP in 2022, versus 71% for the least exposed quartile. The inclusion of acute physical climate risks would aggravate this further. Southern EU

countries face climate change-related welfare losses several times larger compared with those in northern EU countries[6].

This leaves some EU members states with less fiscal space to face disproportionate climate risks vis-à-vis their peers. In addition, the need for climate action could conflict with the consolidation objectives under the EU fiscal framework as few EU countries have sufficient fiscal space to deliver on their Paris Agreement targets within the deficit and debt limits of the European Commission's proposal for new EU fiscal rules[7].

Figure 8: Exposure to climate risks versus Scope's sovereign ratings and 2022 public debt ratios

Ratings (vertical), % (horizontal), % of GDP (circle size)



Note: We do not make a judgement on which transition scenario is most likely and thus present the average growth shock across all climate scenarios per country. Axes cross at EU averages.
Source: IMF, NGFS, Scope Ratings

National mitigants to the challenges posed by climate change include revenue-side measures such as an explicit carbon tax or levy on the financial assets of the wealthiest, as suggested by Pisani-Ferry and Mahfouz[8]. Long-term spending cuts are complicated by the resources needed to cover population ageing, defence, higher interest costs, and demands for better quality public services.

However, some spending could effectively be redirected towards climate action. For instance, fossil fuel subsidies – worth around EUR 55-60bn per year[9] – in the EU, still exceed that for renewable energy in 15 member states. This represents over one tenth of the EUR 620bn EU wide annual additional investments needed to meet the objectives of the Green Deal and RepowerEU[10].

In addition, EU-level instruments and policies can help reduce the asymmetric climate challenges member states face. This can include more extensive use of burden-sharing mechanisms such as the Recovery and Resilience Facility which has proved effective in addressing disparities in fiscal space and fostering more ambitious public investments and reforms across member states. In addition, a proposed 'Green Golden Rule', which excludes net green investment from fiscal metrics used to measure fiscal rule compliance, could alleviate the tension between the need for fiscal consolidation under EU rules and the need to fund green expenditures[11].

[6] European Commission (2020), JRC PESETA IV project report: Economic analysis of selected climate impacts.
[7] Mang & Caddick (2023), Beyond the Bottom Line: How Green Industrial Policy Can Drive Economic Change and Speed Up Climate Action.
[8] Pisani-Ferry, & Mahfouz (2023), Les incidences économiques de l'action pour le climat.
[9] European Court of Auditors (2022), Energy taxation, carbon pricing and energy subsidies.
[10] European Commission (2023), 2023 Strategic Foresight Report.
[11] Darvas and Wolff (2021), A green fiscal pact: climate investment in times of budget consolidation.

Long-term strategies needed for demographic challenges

Similarly, EU member states should formulate long-term strategies to ensure demographic changes are fiscally sustainable. Policy actions can include measures to raise employment rates for women and older workers, enhance productivity, and adapt pension, health care and long-term care systems to rationalise spending. Improving legal migration frameworks such as outlined in the European Commission's Action Plan on Integration and Inclusion 2021-27 can also help fill skills shortages and help offset the expected decline in the workforce. Pension reforms across EU countries in the last decade have helped contain age-related costs though this has been insufficient to curb the increase in public spending. Some countries have reversed these policies, while further adjustments remain politically and socially challenging.

Discussion and limitations

Long-term modelling involves deep uncertainty and limitations

Modelling the complex interactions between population ageing, climate change, economic performance and public debt sustainability over very long-time horizons carries deep uncertainty and results from scenario analysis should be interpreted with caution.

The scenarios presented in this report are not a forecast of what is likely to happen nor a prescription for what should happen, but they offer a narrative for what *could* happen. As such, they provide useful insights for assessing sovereigns' relative exposure to demographic and climate risks. These projections are useful insofar as they identify long-term fiscal risks and signal whether fiscal, social and climate policy adjustments could be needed.

Still, this modelling exercise presents an incomplete picture of the opportunities and risks associated with each scenario and includes several simplifying assumptions:

Acute physical risks and adaptation: We do not include the impact from acute physical risks despite their relevance due to lack of country-level NGFS data. We also do not account for adaptation measures, which will become increasingly important to face rising natural risks and could significantly reduce their impact if they are implemented optimally and avoid maladaptation[12].

Carbon tax revenue: We do not consider the potential tax revenue explicit carbon pricing measures can generate. We assume that shadow carbon prices are revenue neutral because they encapsulate all climate policies including explicit carbon pricing, regulations, subsidies, etc. As such, governments cannot collect 100% of the shadow price as if it was a pure carbon tax, as stated by the NGFS[13]. In addition, we assume that governments will use any revenue generated by carbon pricing to finance social measures or green spending to ensure a smooth and just transition.

Opportunities from the green transition: Our projections do not explicitly account for the benefits of the low-carbon transition to limit global warming to below 2°C. For instance, our modeling does not include opportunities and potential productivity increases from more efficient low-carbon technologies. Nor do the transition effects fully capture the effects of structural shifts on the economy for employment, as well as health and well-being. This could support human capital development and provide up to two million extra jobs in growing green sectors across the EU[14].

They also do not account for the domestic demand gains due to lower energy bills, the reduction in foreign dependence on fossil fuels, and the substantial multiplier effect of green investments. The French authorities found that green investments and lower energy spending could have a positive incremental effect on GDP of around 4% by 2050 in France[15].

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[12] Lisa, and Schipper (2020), Maladaptation: When Adaptation to Climate Change Goes Very Wrong.

[13] Network for Greening the Financial System (2022), Not too late – Confronting the growing odds of a late and disorderly transition.

[14] European Commission (2022), Towards a greener future: employment and social impacts of climate change policies, In: Employment and Social Developments in Europe 2019.

[15] Ministère de la Transition écologique, The Macroeconomic Evaluation of France's Second Low Carbon Strategy (SNBC2) with the ThreeMe Model.

Uncertain abatement costs: These depend on the pace of green innovation and could be far lower than expected if major green technologies follow similar trends as renewables have in recent decades. However, the costs of the transition could also be higher than anticipated, for instance due to the challenges of integrating large and rising share of intermittent renewable power into the energy system[16].

A first step towards a consistent and rigorous approach

Regardless of these limitations, our results show that demographic and climate risks can have tangible implications for long-term public debt trajectories and thus sovereign risk in the EU, underpinning our decision to explicitly incorporate both factors into our methodology.

This report provides a steppingstone to improving our understanding of the impact of long-term structural challenges for sovereign creditworthiness. Future research will seek to address outstanding limitations, improve comparability across all sovereign issuers, and our ability to account for country specificities, policies and mitigants.

[16] Ueckerdt, et al. (2013), System LCOE: What are the costs of variable renewables?.

Appendix I. Main assumptions for Scope's long-term debt projections

The debt projections presented in this report on based on a central **benign scenario** which constitutes the starting point for the analysis. Our deterministic debt projections use the following assumptions:

Metric	Assumption
Real growth	We use the IMF's World Economic Outlook forecasts for growth through 2028. Thereafter, we assume that real growth is in line with long-term growth trends taken from the NGFS baseline[17].
Inflation	Inflation is in line with IMF forecasts through 2028. Thereafter, we assume that inflation converges to 2% (the ECB target rate).
Primary balance	Primary balances are composed of: i) structural primary balances, based on IMF forecasts through 2028 and assumed constant thereafter; and iii) the cyclical balance derived from budget balance semi-elasticities[18].
Financing rates	Financing rates are implied based on budget balance projections of the IMF through 2028 and are assumed constant thereafter.
Exchange rate changes	Exchange rates are assumed to be constant after 2028.
Stock-flow adjustment	Stock-flow adjustments are set to zero after 2028.

Alternative scenarios include:

- **Ageing** (includes population ageing)**:** we adjust the structural primary balance to add the change in age-related costs, including healthcare, pensions and long-term care as presented in the European Commission Ageing Report. We add these costs from 2028 on, as IMF forecasts for structural primary balances over 2023-28 already include age-related costs.
- **Orderly** (includes population ageing and climate risks): We adjust the growth and fiscal variables of the ageing scenario to include the transition risks associated with the NGFS orderly transition scenario. We apply country-level GDP growth shocks and make associated adjustments to cyclical budget balances based on countries' budget balance semi-elasticities.
- **Disorderly** (includes population ageing and climate risks): We adjust the growth and fiscal variables of the ageing scenario to include the transition risks associated with the NGFS disorderly transition scenario. We apply country-level GDP growth shocks and make associated adjustments to cyclical budget balances based on countries' budget balance semi-elasticities.
- **Hothouse** (includes population ageing and climate risks): We adjust the growth and fiscal variables of the ageing scenario to include the transition risks associated with the NGFS hothouse transition scenario. We apply country-level GDP growth shocks and make associated adjustments to cyclical budget balances based on countries' budget balance semi-elasticities.

[17] To ensure consistency across IMF and NGFS growth assumptions, we scale NGFS baseline growth projections to 2028 growth forecasts by the IMF as follows:

$$Growth_t = Growth_t^{NGFS} * \frac{Growth_{2028}^{IMF}}{Growth_{2028}^{NGFS}}$$

[18] We derive budget balance semi-elasticities by regressing the change in the cyclical component of budget balances against GDP growth, in line with Fatas and Mihov (2012), Fiscal Policy as a Stabilization Tool.

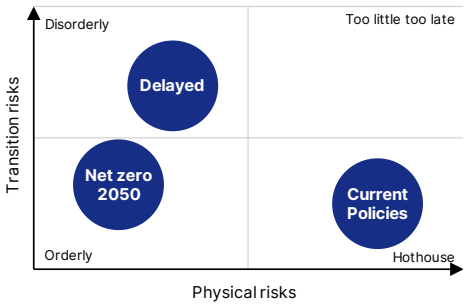
Appendix II. Network for Greening the Financial System scenarios

Our long-term DSA model incorporates climate risks based on three NGFS scenarios. These scenarios are designed to provide a common basis for analysing climate risks for the economy and financial system. with a consistent set of variables and assumptions for analysing climate risks. The NGFS defines three broad scenario categories as follows[19]:

- **Orderly** scenarios assume climate policies are introduced early and become gradually more stringent. Both physical and transition risks are relatively subdued. Within this category we adopt the Net Zero 2050 scenario.
- **Disorderly** scenarios explore higher transition risk due to policies being delayed or divergent across countries and sectors. For example, carbon prices are typically higher for a given temperature outcome. Within this category, we adopt the Delayed Transition scenario.
- **Hot house** scenarios assume that climate policies are implemented in some jurisdictions, but global efforts are insufficient to halt significant global warming. The scenarios result in severe physical risk including irreversible impacts like sea-level rise. Within this category, we adopt the Current Policies scenario.

Figure 9: NGFS scenarios at a glance

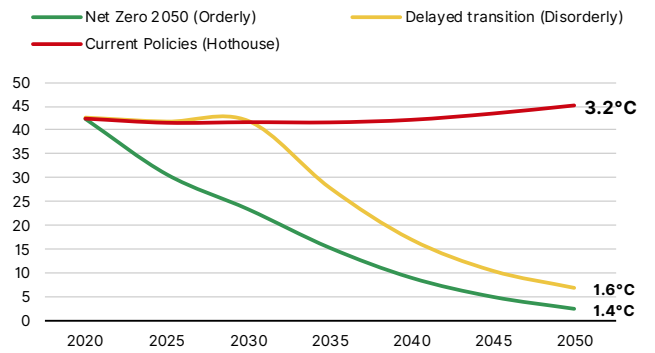
Scenario	Physical risk	Transition risk			
	Global warming	Policy reaction	Technological change	Carbon dioxide removal	Regional policy variation
Net zero 2050	1.4°C	Immediate and smooth	Fast change	Medium-high use	Medium variation
Delayed	1.6°C	Delayed	Slow then very fast change	Low-medium use	High variation
Current Policies	3°C+	No ramp up in policies	Slow change	Low use	Low variation



Note: The cells in the table are coloured based on associated macroeconomic risks as determined by the NGFS with lower (green), moderate (yellow), and higher (red) risks.
Source: Network for Greening the Financial System

Figure 10: Global CO2 emissions by scenario

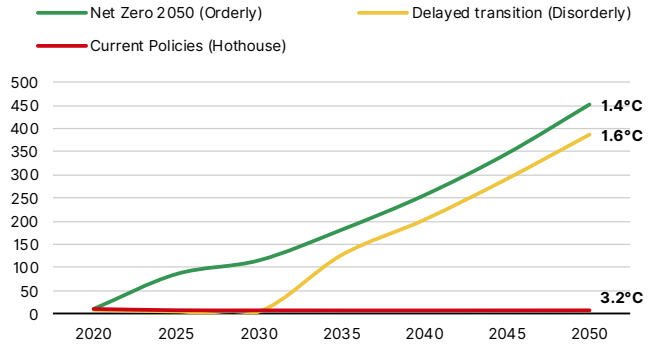
GtCO2 per year



Note: World aggregates mask strong differences across sectors and countries.
Source: NGFS, REMIND Model

Figure 11: Global shadow carbon prices by scenario

USD per tCO2



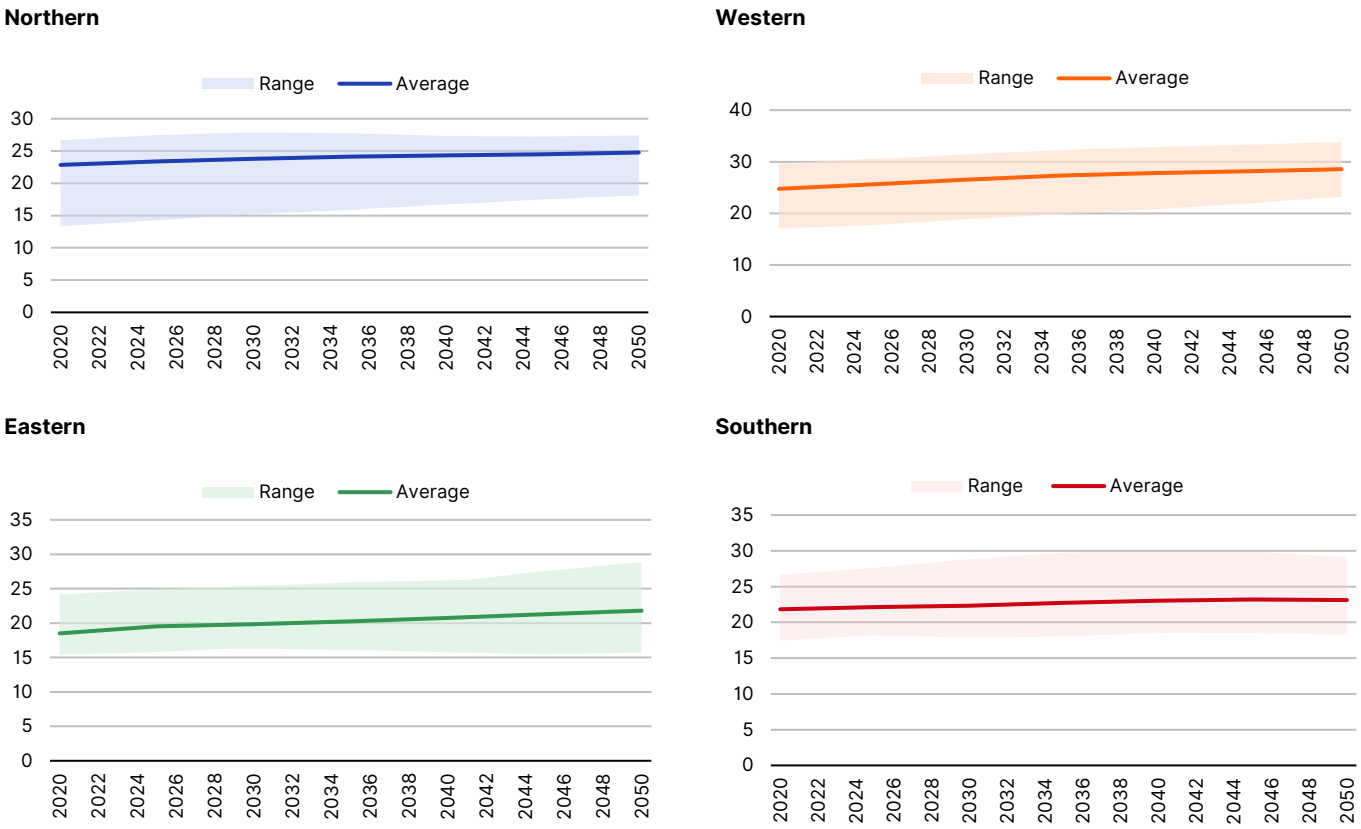
Note: World averages mask strong differences across sectors and countries.
Source: NGFS, REMIND Model

[19] Network for Greening the Financial System (2022), NGFS Scenarios for central banks and supervisors.

Appendix III. Overview of the costs of ageing per region in the EU

Figure 12: Total annual costs of ageing – Regional trends

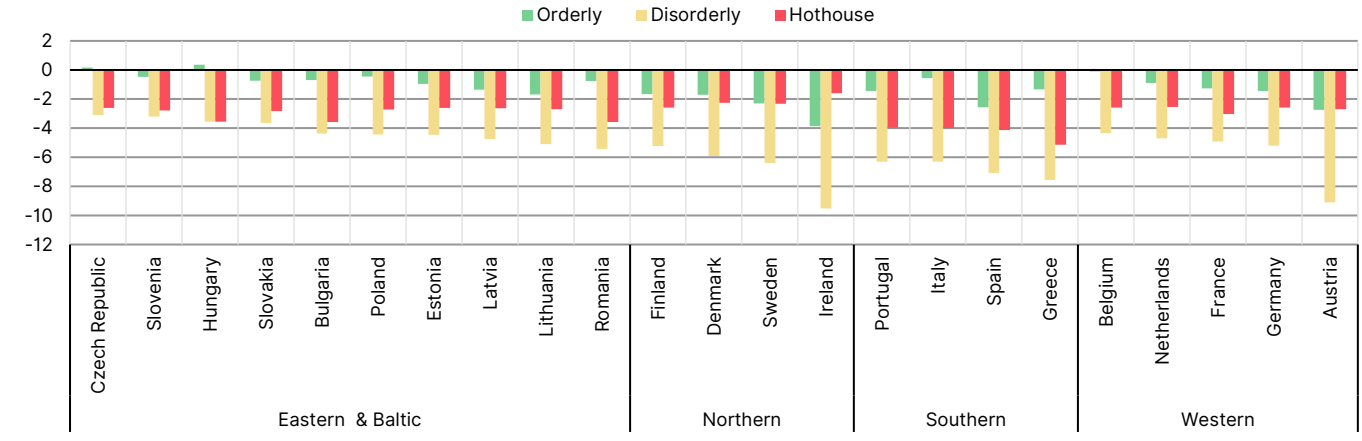
% of GDP



Source: European Commission, Scope Ratings

Appendix IV. GDP losses due to climate factors in EU countries

Figure 13: Climate-related cumulative GDP losses versus a scenario without climate risks, 2022-50, %



Source: NGFS, Scope Ratings

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