European Commission

ISSN 2443-8014 (online)

Fiscal Sustainability Report 2021

Volume 1

INSTITUTIONAL PAPER 171 | APRIL 2022

EUROPEAN ECONOMY

Economic and Financial Affairs

European Economy Institutional Papers are important reports analysing the economic situation and economic developments prepared by the European Commission's Directorate-General for Economic and Financial Affairs, which serve to underpin economic policy-making by the European Commission, the Council of the European Union and the European Parliament.

This paper exists in English only and can be downloaded from https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en.

Luxembourg: Publications Office of the European Union, 2022

PDF ISBN 978-92-76-43940-0 ISSN 2443-8014 doi:10.2765/682828 KC-BC-22-008-EN-N

CREDIT
Cover photography: © iStock.com/kwasny221

European Commission
Directorate-General for Economic and Financial Affairs

Fiscal Sustainability Report 2021

Volume 1

EUROPEAN ECONOMY

Institutional Paper 171

ACKNOWLEDGEMENTS

This report was prepared in the Directorate-General for Economic and Financial Affairs under the direction of Maarten Verwey (Director-General), Declan Costello (Deputy Director-General) and the supervision of Lucio Pench (Director for Fiscal Policy), Giuseppe Carone (Head of Unit until December 2021) and Stéphanie Pamies (Head of Unit).

Stéphanie Pamies was the coordinator of the report. The main contributors to the report were Pedro Arevalo, Ben Deboeck, Nicola Gagliardi, Fabrice Orlandi, Eloïse Orseau, Stéphanie Pamies and Anda Patarau. For Part I, Guillaume Cousin (DG ECFIN) contributed to Section I.1.2., Adriana Reut (DG ECFIN) contributed to Section II.3.3, Alessandra Cepparulo and Vito Ernesto Reitano (both DG ECFIN) contributed to Section I.2.1.6, and Stefan Zeugner and Vitor Martins (both DG ECFIN) contributed to Section 4.1. Chapter 4 benefitted from comments by Ingrid Toming (DG ECFIN). Contributions to Sections 4.2 (SYMBOL model) and Annex A6 were provided by Mario Bellia, Francesca Di Girolamo, Andrea Pagano, Marco Petracco Giudici (all DG JRC), and these parts also benefitted from comments by DG FISMA D1, D3 and E.RTF staff, Alexandros Tavoutsoglou (DG FISMA E2), and Sven Langedijk (DG ECFIN). For Part II, Chapter 1 benefitted from comments by Kieran Mc Morrow, Anna Thum-Thysen, Jan in 't Veld, Philipp Pfeiffer, Emiel Afman and Gerrit Bethuyne (all DG ECFIN). Chapter 2 benefitted from comments by Elva Bova, Anna Dimitrijevics, Björn Dohring, Quentin Dupriez, Asa Johannesson-Linden, Sven Langedijk, and Diana Radu. Statistical support was provided by Pedro Arevalo and Nicola Gagliardi. Secretarial support and layout was provided by Laura Crapanzano.

Comments on the report would be gratefully received and may be sent to:

DG ECFIN – Unit C2

European Commission, Directorate-General for Economic and Financial Affairs,

Directorate C: Macroeconomic policies, Unit C2: Sustainability of public finances and public expenditure trends

Office CHAR 12/053 B-1049 Brussels

E-mail: ECFIN-Secretariat-C2@ec.europa.eu

or

Stéphanie Pamies

European Commission, Directorate-General for Economic and Financial Affairs

Directorate C: Macroeconomic policies, Unit C2: Sustainability of public finances and public expenditure trends

Office CHAR 12/048

B-1049 Brussels

E-mail: Stephanie.Pamies@ec.europa.eu

FOREWORD

The Commission *Fiscal Sustainability Report* (FSR) 2021, the sixth edition of this report introduced in 2006, provides an update of fiscal sustainability challenges faced by the Member States. Government debt has significantly increased as a result of the pandemic across the EU. Financing conditions, which have largely improved over the past decades, remain favourable. Yet, uncertainties prevail regarding future macro-financial developments, not least following the invasion of Ukraine by Russia. Structural trends, including population ageing and climate change, are expected to put additional pressures on public finances going forward. In this context, assessing fiscal sustainability risks appears particularly critical at the current juncture.

As in previous editions, fiscal sustainability challenges faced by the Member States are evaluated according to a comprehensive horizontal assessment framework. This framework brings together in a synthetic way results on debt sustainability analysis (DSA) and fiscal sustainability indicators. It presents an overview of fiscal sustainability challenges across different time horizons (short, medium and long term), and allows for the identification of the scale, nature and timing of fiscal sustainability risks. The Commission sustainability framework also considers additional risk factors to further qualify the overall assessment.

This edition of the report benefits from some important methodological improvements and explores new topics. The baseline assumptions have been refined, notably to reflect the substantial positive impact expected from NextGenerationEU over the medium-term. The approach to assess medium-term fiscal sustainability risks has also been adapted, reflecting the new post-COVID-19 crisis environment, and latest advances in DSA frameworks. Moreover, the potential fiscal challenges raised by climate change are explored through stylised simulations to illustrate fiscal risks due to extreme weather events.

The Commission analysis of fiscal sustainability challenges presented in this report contributes to the monitoring and coordination of Member States' fiscal policies. It plays a key role in the context of the Stability and Growth Pact (SGP) and of the European Semester, the EU integrated surveillance framework, including for the formulation of structural-fiscal country-specific recommendations and for post-programme surveillance. These results also provide the starting point for the assessment of debt sustainability in the framework of financial assistance.

The FSR 2021 shows the presence of fiscal sustainability risks in several countries, calling, once economic conditions allow, for prudent fiscal policies. *Short-term* vulnerabilities are identified in two countries (Greece and Cyprus), notably reflecting current substantial fiscal deficits and macroeconomic imbalances. *Over the medium-term*, eleven countries (Belgium, Greece, Spain, France, Croatia, Italy, Malta, Portugal, Romania, Slovenia and Slovakia) are classified at high risk, given baseline projected high and / or increasing debt ratios, along with elevated uncertainty surrounding these projections in some cases. *Over the long-term*, nine Member States (Belgium, Czechia, Spain, Italy, Luxembourg, Hungary, Malta, Slovenia and Slovakia) appear at high risk, driven by the notable projected increase of ageing costs by 2070 according to the Ageing Report 2021. These results call to pursue, once economic conditions allow, fiscal policies aimed at achieving prudent medium-term fiscal positions and ensuring debt sustainability, while enhancing investment, not least to meet the green and digital transition.

Maarten Verwey

Director General

Economic and Financial Affairs

CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF BOXES

EXECUTIVE SUMMARY

1. MONITORING DEBT SUSTAINABILITY RISKS REMAINS ESSENTIAL

The EU economy has closed the gap with its pre-pandemic output levels in 2021 on the back of successful vaccination campaigns and decisive policy support, though exceptional uncertainties and downside risks loom ahead

After a severe recession in 2020 prompted by an unprecedented pandemic, the EU economy strongly rebounded in 2021, with a GDP growth rate of 5%, higher than expected in earlier Commission forecast. ([1]) This vigorous rebound was largely driven by the successful vaccination campaigns in many EU countries, allowing a progressive easing of restrictions since last spring. In early November, economic activity in the EU was projected to expand solidly in 2022, notably supported by the full deployment of the Recovery and Resilience Facility (RRF). In 2023, real GDP growth was expected to remain robust at 2½%. Thanks to the strong and well-coordinated EU crisis response, the damage to the EU economy so far appears considerably less than initially feared. This report is based on the Commission Autumn forecast. Since then, the invasion of Ukraine by Russia has been a watershed moment, increasing risks surrounding the economic outlook. Specifically, the strength of the recovery remains dependent on future developments related to the COVID-19 and, importantly, to the geopolitical situation. Amid high uncertainty, economic risks notably relate to the aggravating and protracted supply constraints and bottlenecks, as well as surging energy and food prices constraining growth and fuelling inflationary pressures.

Public finances took a serious hit

In 2020, the sharp economic downturn and forceful fiscal policy response led to an unprecedented increase in headline deficit and debt ratios in the EU. In particular, the EU aggregate government deficit increased from a historically low of around 0.5% of GDP in 2019 to around 7% in 2020. It is forecast to have narrowed marginally in 2021, notwithstanding continued discretionary fiscal measures to shelter households, workers and firms from the impact of the COVID-19. On the basis of the Commission Autumn forecast, the aggregate budget deficit in the EU is forecast to halve in 2022, and on an unchanged policy basis, further decrease to 2.2% in 2023. The aggregate government debt-to-GDP ratio of the EU rose by over 13 pps. in 2020, reaching around 92%, mirroring the spike in deficits, as well as temporary unfavourable interest-growth rate differential (snowball) effect. The EU aggregate debt ratio in the EU is expected to only slightly decline by 2023, but it should remain (well) above 100% of GDP in six Member States (Belgium, Greece, Spain, France, Italy, and Portugal). The invasion of Ukraine by Russia significantly increased risks surrounding this outlook, with an expected increase of defence spending and necessary accompanying measures to cushion the impact of the crisis (e.g. heightened energy prices) and support energy diversification.

NextGenerationEU is expected to improve the quality of public finances and lift potential growth over the short- and medium term

NextGenerationEU (NGEU) allows supporting all Member States, in particular those hardest hit by the COVID-19, with a €806.9 billion fund. ([2]) Its centre piece, the Recovery and Resilience Facility (RRF), which entered into force in February 2021, provides financing support to reforms and investments in Member States until end 2026. In particular, the RRF aims at making European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. This joint, coordinated action at the European level, benefits all

([1]) European Commission (2021a).
([2]) In current (2021) prices, representing more than 5½% of 2021 GDP.

Member States, not least due to significant spillover effects across countries. ([3]) In particular, the RRF is expected to strengthen the quality of public finances, and to lift potential growth over the short- and medium-term, thus contributing to reducing debt sustainability risks.

Favourable financing conditions have allowed sustaining higher levels of debt than in the past

Financing conditions have dramatically improved over the past decades, consistently with a trend decline of interest rates. They temporarily deteriorated at the onset of the COVID-19 outbreak. Thus, despite historically elevated debt ratios, interest payments have continued to decrease, with the interest-growth rate differential ('r-g') turning negative before the COVID-19 crisis on average and for most EU countries. While future macro-financial developments remain uncertain, the low interest rate environment is the result of several factors: ageing societies, lower trend productivity growth and excess savings on the one hand; 'unconventional' monetary policies of central banks on the other hand. This differential is expected to remain negative going forward, but the COVID-19 crisis, the Russian war of aggression against Ukraine and exceptional uncertainty on the economic outlook make it extraordinarily difficult to predict the future development of the interest-growth rate differential.

Future macro-financial developments are uncertain

In this context, some leading economists have argued that higher debt levels can be more easily sustained than in the past. ([4]) Yet, historically, a negative 'r-g' has not prevented the occurrence of debt sustainability problems or debt crises. ([5])Importantly, neither the growth rate of the economy, nor prevailing interest rates are independent from the level of debt. ([6]) As debt increases, the convenience value of public debt is expected to decrease. The rise in the cost of servicing debt would then shrink the value of future deficits that the private sector is willing to finance indefinitely, meaning that higher debt must be repaid by taxation. ([7]) This needs to be borne in mind in a context where population ageing and climate change are expected to put additional pressures on public finances. Hence, a negative 'r-g' reduces fiscal sustainability challenges at a given level of debt, but does not eliminate them. In this context, assessing fiscal sustainability risks appears particularly critical at the current juncture.

2. FSR 2021: METHODOLOGY AND USE

The report updates the assessment of fiscal sustainability risks compared with the DSM 2020

This edition of the Fiscal Sustainability Report (FSR 2021) provides an update of fiscal sustainability risks faced by Member States, previously assessed in the Debt Sustainability Monitor (DSM) 2020. It offers a snapshot of the situation, based on the latest available Commission macroeconomic and fiscal forecast (Autumn 2021). ([8]) The assessment also relies on the Economic Policy Committee (EPC) commonly agreed methodology to project medium-term GDP growth, ([9]) adjusted for the expected impact from NextGenerationEU (NGEU) investment (see below). Last, it reflects agreed

([3]) Pfeiffer et al. (2021).
([4]) Blanchard (2019).
([5]) Mauro. and Zhou (2020).
([6]) Pamies et al. (2021).
([7]) Reis (2021).
([8]) The Winter forecast published by the European Commission in February is an interim forecast, only providing an update of GDP growth and inflation forecast.
([9]) The so-called T+10 methodology commonly agreed with the Output Gap Working Group (OGWG), see Havik et al. (2014).

long-term economic and budgetary projections from the joint European Commission - EPC 2021 Ageing Report.

Fiscal sustainability risks faced by Member States are assessed according to the comprehensive horizontal fiscal sustainability framework used in the previous reports, ([10]) including some methodological improvements. This framework brings together in a synthetic way results on debt sustainability analysis (DSA) and fiscal sustainability indicators. It allows gaining a horizontally consistent overview of fiscal sustainability risks across time horizons (short, medium and long term) and across countries, based on a set of transparent criteria.

The report benefits from some important methodological improvements

The FSR 2021 contains some important methodological improvements. *First*, the baseline assumptions have been refined, in particular, by increasing the consistency between assumptions for interest rates and inflation rates (both of which now reflect financial market expectations). Moreover, owing to the substantial expected impact from NGEU over the medium-term, the standard 'T+10' GDP growth projections have been adjusted to reflect the NGEU investment spending profile over 2024-26. ([11]) *Second*, some adjustments have been brought to the DSA tool, notably reflecting the post-COVID-19 crisis environment, and latest advances in DSA frameworks in other international institutions. ([12]) The set of stress tests has been refined, to better account for risks linked to possible financial stress and to a moderate increase of the 'r-g' differential. The DSA risk classification has also been revised to further reflect the importance of the debt trajectory, of 'fiscal consolidation space' (comparing the current fiscal position with the historical performance of each Member State), ([13]) and the uncertainty surrounding baseline projections through an increased role given to stochastic projections in the assessment. Last, but not least, contrary to previous editions, the results for Greece included in the report are based on the same horizontal approach used for other countries.

The FSR 2021 also explores new topics

In this edition of the FSR, several new topics are discussed in thematic chapters. A *first* thematic chapter discusses how the expected impact of NGEU investment on GDP growth and debt projections is integrated in the medium-term analysis. A *second* chapter presents a framework and some first stylised simulations to illustrate fiscal risks due to extreme weather and climate-related events, which are expected to increase in frequency and severity in the next decades as a result of climate change. ([14]) Lastly, a *third* chapter summarises the debate and discusses the latest developments in the 'r-g' differential, as well as the implications of a moderate reversal of (pre-crisis) favourable trends.

([10]) In particular, as in the FSR 2018 and the DSM 2019, the baseline relies on a 'no-fiscal policy change' scenario, whereby the structural primary balance is assumed to remain constant at its last forecast value (2023), being only modified by projected ageing costs over the medium- and long-term. On the other hand, due to the exceptional crisis circumstances, the DSM 2020 assumed a gradual return of the structural primary balance to the pre-crisis forecast level. This round, as EU economies are expected to have fully recovered by 2023 to their pre-pandemic GDP levels, the standard baseline fiscal assumption is applied.
([11]) This adjustment is based on the Quest model (see thematic Chapter 1 of the report).
([12]) See IMF (2021).
([13]) So far, the projected debt level played a major role in the overall medium-term fiscal risk assessment.
([14]) This analysis is meant to complement the assessment of fiscal sustainability challenges, but is not incorporated at this stage in the horizontal assessment framework (notably in the risk classification).

The FSR results are used in the context of EU regular surveillance, ranging from standard monitoring to financial assistance

The Commission analysis of fiscal sustainability challenges presented in this report contributes to the monitoring and coordination of Member States' fiscal policies. It plays a key role in the context of the SGP ([15]) and of the European Semester, the EU integrated surveillance framework, including for the formulation of structural-fiscal country-specific recommendations and for post-programme surveillance. These results also provide the starting point for the assessment of debt sustainability in the framework of financial assistance. ([16])

3. KEY RESULTS

Short-term fiscal risks have receded, but vulnerabilities remain in few countries

Still significant fiscal deficits in 2021 and a halt in the correction of macroeconomic imbalances, as a result of the COVID-19 crisis, ([17]) imply that short-term risks of fiscal stress are identified in few countries. According to the early-warning indicator used by the European Commission, the S0 indicator, Greece and Cyprus are found to face such short-term vulnerabilities, due to both fiscal and macro-financial variables. Nonetheless, the overall situation appears decidedly less critical than during the Global Financing Crisis (GFC). In 2009, S0 flagged short-term risks of fiscal stress in as many as seventeen countries, notably due to severe macroeconomic imbalances. The extraordinary monetary policy interventions put into place since March 2020, together with decisive EU policy actions, including the adoption of NextGenerationEU in 2020, have contributed to stabilising sovereign financing conditions so far, lessening risks of short-term fiscal stress. Such favourable support should remain significant going forward, notwithstanding a gradual winding down of Eurosystem asset purchases dependent on the evolving assessment of the outlook (see Chapter 1).

Government debt is expected to remain fairly high over the medium term at unchanged policies

In the EU as a whole, *at unchanged fiscal policy*, ([18]) government debt is projected to decline as a ratio to GDP until the mid-2020s, when the rising cost of ageing would reverse the trend. Hence, by 2032, the debt ratio would remain close to its 2023 forecast value (around 90% of GDP). The 'r-g' differential is assumed to remain negative over the next decade, ([19]) supporting the initial debt reduction and dampening the projected increasing pressure of ageing costs on public finances. At the same time, the debt paths envisaged in the baseline assume the persistence of the current negative structural primary balance (SPB), low by historical standards, suggesting sizeable 'fiscal consolidation space' in most countries. ([20]) Alternative

([15]) See FSR 2018 for a detailed description of the multiple roles of this analysis in the context of the SGP. Moreover, according to the 'general escape clause', "in periods of severe economic downturn for the euro area or the Union as a whole, Member States may be allowed temporarily to depart from the adjustment path towards the medium-term budgetary objective, *provided that this does not endanger fiscal sustainability in the medium term*". (see https://ec.europa.eu/info/sites/info/files/economy-finance/2_en_act_part1_v3-adopted_text.pdf).

([16]) See European Commission - ESM (2021): https://ec.europa.eu/info/sites/default/files/economy-finance/swp_on_dsa_financial_assistance.pdf.

([17]) However, the narrowing of macroeconomic imbalances, observed prior to the COVID-19 crisis, is expected to resume going forward with the recovery during 2021.

([18]) In this report, the baseline 'no-fiscal policy change' scenario assumes that the structural primary balanced is only modified by projected (net) ageing costs beyond the last forecast year (i.e. 2023).

([19]) This assumption does not take into account the latest developments related to the war in Ukraine, notably the rise in inflation and interest rates. On the other hand, over the long term, financing conditions are assumed to normalise, with an 'r-g' differential converging to 0.5 pp. of GDP in line with the commonly agreed assumptions of the 2021 Ageing Report.

([20]) This can be seen by plotting the projected SPB level against country-specific SPB values observed in the last decades. Most countries have often recorded higher SPBs than the level assumed in the baseline and can therefore plausibly aim to move again towards such levels in the coming decade, improving sustainability compared to the baseline.

scenarios show in fact that debt could fall back to its pre-crisis level by 2032 if the structural primary balance converged back to the slight surplus observed on average in the past 15 years. *Conversely*, a weaker fiscal position, a less favourable ‘r-g’ differential or – to a lesser extent – temporary financial stress would worsen debt dynamics. In general, stochastic projections point to considerable uncertainty over the debt trajectory in the euro area as a whole and in many Member States.

Compared to the DSM 2020, the projected government debt ratio is broadly unchanged over the medium-term, with significant cross-country differences however. On the one hand, the debt position in 2022 is generally more favourable than forecasted a year ago, notably reflecting the stronger-than-expected recovery, while the integration of the NGEU investment has a favourable impact on medium-term GDP growth and debt projections. On the other hand, the lower level of the (structural) primary balance expected by 2023, compared with the pre-crisis forecast, ([21]) weighs on the projected debt dynamic. This reflects the higher government expenditure ratio, resulting from permanent discretionary measures in some countries (see Chapter 2).

Medium term risks are high in eleven EU countries, medium in eight and low in eight

In terms of medium-term risk classification, the debt sustainability analysis points to ten countries being at high fiscal sustainability risk (Belgium, Greece, Spain, France, Croatia, Italy, Malta, Portugal, Slovenia and Slovakia). The results are driven by high and / or increasing baseline debt ratios (Belgium, Greece, Spain, France, Italy, Slovenia and Slovakia), ([22]) along with elevated uncertainty surrounding the baseline projections, as highlighted by the stochastic analysis (Portugal) and vulnerability to more adverse macro-financial conditions (Croatia), or a weaker fiscal position (Malta). The S1 indicator ([23]) results generally confirm this assessment, with only one additional country (Romania) classified at high risk according to this indicator. Five additional countries appear at medium risk according to the DSA (including Bulgaria, Czechia, Cyprus, Hungary and the Netherlands), with overall consistent signals across the different scenarios considered. In Bulgaria and Hungary, the DSA risk classification reflects large uncertainty (as captured by stochastic simulations). The S1 indicator points at medium risk also in Germany, Austria and Finland. Eight countries (Denmark, Estonia, Ireland, Latvia, Lithuania, Luxembourg, Poland and Sweden) are classified at low risk both according to the DSA and the S1 indicator results. ([24])

Long term risks are high in nine EU countries, medium in thirteen and low in five

Over the long-term, the S2 indicator ([25]) points to seven Member States being at high fiscal sustainability risks (Belgium, Czechia, Luxembourg, Hungary, Malta, Slovenia and Slovakia). This risk classification is driven by a sharp projected increase of ageing costs by 2070, weighed down in most cases by the initial budgetary position. High risks over the long-term are identified in

([21]) In the DSM 2020, the structural primary balance was assumed to converge back to its pre-crisis forecast level (as per the DSM 2019), as exceptional measures adopted as a response to the COVID-19 crisis were expected to be phased-out or financed by public revenue increases.

([22]) For Greece, the high projected *level* plays an important role in the classification, while the debt *trajectory* is declining. For Slovakia, the increasing debt *trajectory* contributes to the result (despite the moderated projected debt *level*). For other countries, both the level and the increasing trend drive the classification.

([23]) The S1 indicator measures the required fiscal adjustment to bring the government debt-to-GDP ratio to 60% in the medium-term.

([24]) In the case of Ireland however, when scaling government debt with GNI, a more accurate measure of repayment capacity in this country, medium term vulnerabilities appear more important than suggested according to the standard GDP metric.

([25]) The S2 indicator measures the fiscal adjustment required to stabilise government debt in the long term.

another two countries (Spain and Italy), notably due to debt vulnerabilities. Eight further Member States are found to be at medium fiscal sustainability risk according to the S2 indicator (including Bulgaria, Germany, Ireland, the Netherlands, Austria, Poland, Romania and Finland). Medium risks over the long-term are found in another five Member States (Greece, France, Croatia, Cyprus and Portugal), reflecting vulnerabilities of the debt positions. The remaining five Member States (Denmark, Estonia, Latvia, Lithuania and Sweden) are classified at low long-term risk, on the back of projected decrease of ageing costs (Estonia and Latvia), and / or a favourable initial budgetary position (notably Denmark and Sweden). Long-term ageing cost projections are surrounded by considerable uncertainty and risks, including policy risks such as possible reform reversals or the need for measures to counteract a projected decline in pension adequacy.

Medium- and long-term fiscal sustainability risks remain elevated compared with last year

Compared with the DSM 2020, an important improvement is observed *in the short term* risk classification, notably supported by the economic recovery in 2021 - with now only two countries at risk of fiscal stress in the upcoming year (2022), against eleven countries in the DSM 2020.

Over the medium term, the number of high-risk countries has slightly increased compared with last year's assessment, with two additional countries in this category this year (at constant perimeter, considering that no classification was provided for Greece last year): Croatia (mainly on account of its debt dynamics under the 'adverse r-g' scenario) and Malta (due to the significantly worse forecast structural primary balance in 2023). Concerning the medium risk category, a net total of two more countries are classified at medium risk compared to the DSM 2020, with some changes in the composition of countries in this risk category. In particular, Bulgaria, Czechia and Germany moved from low to medium risk (notably due to the worsened fiscal assumption in the baseline), while Croatia moved from medium to high risk. As a result, four less countries are classified at low risk in the FSR 2021 compared with last year.

Over the long term, a net total of four additional countries are now deemed to face high long-term risks. Czechia, Spain, Italy, Hungary and Malta went from the medium to the high risk category, while Romania moved from high to medium risk. The deterioration for the former countries is driven by an increase of the S2 indicator, and largely reflects a worsening of the initial budgetary position (due to worsened fiscal assumptions). ([26]) For Romania, the improvement in the risk classification also reflects a reduction of the long-term fiscal gap indicator. Three less countries are classified at medium risk, while the same number of countries is deemed at low risk in this FSR. These results largely reflect the commented downgrade from medium to high risk of five countries, another country (Poland) having moved from low to medium risk, while two further countries upgraded (Romania from high to medium risk, and Sweden from medium to low risk).

([26]) The revision of ageing costs (2021 Ageing Report projections versus 2018 Ageing Report projections used in the 2020 DSM) generally contributes to a more limited extent to the changes in the risk classification over the long term.

Several additional factors need to be considered in the overall assessment

Beyond the debt projections and the risk classification provided in this report, additional risk factors are analysed and considered in the overall assessment. On the downside, risks are related to the presence of contingent liabilities, notably related to government guarantees to the private sector, which have been part of the necessary policy response to the COVID-19 crisis, but also represents a source of additional vulnerability. These contingent liabilities amounted to about 14% of GDP in 2020 for the EU as a whole, with large differences across Member States. Any possible future impact on public debt and deficit crucially depends on the extent to which these guarantees are taken up by the private sector and eventually called. In the banking sector, risk reduction indicators point to further improvement up to mid-2021, in particular, regarding the level of non-performing loans' ratios. While a later increase of non-performing loans cannot be excluded, the ability of the banking sector to absorb the shock appears overall higher than during the global financial crisis. At the same time, simulations based on the Symbol model, show that in case of a more severe deterioration of the macro-financial situation, some countries would remain vulnerable to contingent liabilities' risk stemming from the banking sector (see Chapter 4).

However, on the upside, many factors contribute to mitigating debt sustainability risks across the EU, notably the lengthening of debt maturities in recent years, relatively stable financing sources (with a diversified and large investor base), and still historically low borrowing costs, supported by the Eurosystem' interventions. Moreover, the implementation of the *structural reforms* under the NGEU/RRF, not taken into account in the medium-term projections (which reflect only the investment impact), is likely to have a positive and persistent impact on overall EU GDP growth in the coming years, contributing to further mitigating debt sustainability risks of Member States.

Table 1: **Fiscal sustainability risk classification by Member States (in brackets, risk classification in the DSM 2020 whenever the risk classification has changed)**

	Overall SHORT-TERM risk category	**Overall MEDIUM-TERM risk category**	S1 indicator - overall risk assessment	Debt sustainability analysis - overall risk assessment	S2 indicator - overall risk assessment	**Overall LONG-TERM risk category**	
BE	LOW (HIGH)	HIGH	HIGH	HIGH	HIGH (MEDIUM)	HIGH	BE
BG	LOW	MEDIUM (LOW)	LOW	MEDIUM (LOW)	MEDIUM	MEDIUM	BG
CZ	LOW	MEDIUM (LOW)	MEDIUM (LOW)	MEDIUM (LOW)	HIGH (MEDIUM)	HIGH (MEDIUM)	CZ
DK	LOW	LOW	LOW	LOW	LOW	LOW	DK
DE	LOW	MEDIUM (LOW)	MEDIUM (LOW)	LOW	MEDIUM	MEDIUM	DE
EE	LOW	LOW	LOW	LOW	LOW	LOW	EE
IE	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	IE
EL	HIGH	HIGH	HIGH	HIGH	LOW	MEDIUM	EL
ES	LOW (HIGH)	HIGH	HIGH	HIGH	MEDIUM (LOW)	HIGH (MEDIUM)	ES
FR	LOW (HIGH)	HIGH	HIGH	HIGH	LOW	MEDIUM	FR
HR	LOW (HIGH)	HIGH (MEDIUM)	MEDIUM (LOW)	HIGH (MEDIUM)	LOW	MEDIUM	HR
IT	LOW (HIGH)	HIGH	HIGH	HIGH	MEDIUM (LOW)	HIGH (MEDIUM)	IT
CY	HIGH	MEDIUM	MEDIUM (LOW)	MEDIUM	LOW	MEDIUM	CY
LV	LOW (HIGH)	LOW	LOW	LOW	LOW	LOW	LV
LT	LOW	LOW	LOW	LOW	LOW	LOW	LT
LU	LOW	LOW	LOW	LOW	HIGH	HIGH	LU
HU	LOW	MEDIUM	MEDIUM (LOW)	MEDIUM	HIGH (MEDIUM)	HIGH (MEDIUM)	HU
MT	LOW	HIGH (LOW)	MEDIUM (LOW)	HIGH (LOW)	HIGH (MEDIUM)	HIGH (MEDIUM)	MT
NL	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	NL
AT	LOW	MEDIUM	MEDIUM (LOW)	LOW (MEDIUM)	MEDIUM	MEDIUM	AT
PL	LOW	LOW	LOW	LOW	MEDIUM (LOW)	MEDIUM (LOW)	PL
PT	LOW (HIGH)	HIGH	HIGH (MEDIUM)	HIGH	LOW	MEDIUM	PT
RO	LOW (HIGH)	HIGH	HIGH	MEDIUM (HIGH)	MEDIUM (HIGH)	MEDIUM (HIGH)	RO
SI	LOW	HIGH	HIGH (MEDIUM)	HIGH	HIGH (MEDIUM)	HIGH	SI
SK	LOW (HIGH)	HIGH	HIGH	HIGH	HIGH	HIGH	SK
FI	LOW (HIGH)	MEDIUM	MEDIUM	LOW (MEDIUM)	MEDIUM	MEDIUM	FI
SE	LOW	LOW	LOW	LOW	LOW (MEDIUM)	LOW (MEDIUM)	SE

(1) The overall short-term risk category is based on the S0 indicator results, the overall medium term risk category is based on the DSA and the S1 indicator's results, and the overall long-term risk category is based on the S2 indicator and the DSA results.
Source: Commission services.

Table 2: **Summary heat map of fiscal sustainability challenges**

	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
Heat map for short-term risks in EU countries																											
S0 overall index	0.31	0.32	0.24	0.18	0.31	0.22	0.36	0.48	0.34	0.45	0.38	0.28	0.47	0.26	0.17	0.30	0.34	0.31	0.32	0.18	0.22	0.40	0.31	0.18	0.24	0.26	0.27
Overall SHORT-TERM risk category	LOW	LOW	LOW	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Heat map for medium-term risks in EU countries																											
S1 indicator in EU countries	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
S1 indicator - Baseline scenario	8.4	-1.4	2.5	-5.3	0.3	-3.1	-0.6	6.8	6.2	6.3	1.6	10.3	1.0	-0.9	-1.4	-3.6	1.3	1.8	1.4	2.0	-0.6	6.7	3.9	6.0	3.2	0.0	-5.7
S1 indicator - overall risk assessment	HIGH	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW
Debt sustainability analysis: Sovereign-debt sustainability risks in EU countries	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
Baseline ('no-policy change' scenario)	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	133.6	36.4	67.1	15.6	61.6	25.7	45.7	154.7	126.1	122.3	76.7	161.6	77.8	48.8	39.4	18.2	68.1	73.2	62.8	76.3	48.3	126.2	76.9	95.2	72.2	63.9	11.2
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2021	2032	2021	2022	2023	2021	2021	2032	2032	2021	2021	2021	2032	2032	2032	2021	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	98%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	81%	97%	48%	94%	60%
Stochastic projections	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	HIGH	HIGH	LOW	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	MEDIUM	LOW	LOW	LOW	LOW
Probability of debt in 2026 greater than in 2021 (%)	66%	54%	79%	7%	27%	98%	22.2%	18%	57%	59%	21%	41%	16%	52%	38%	31%	31%	76%	44%	26%	14%	36%	71%	60%	41%	35.0%	0%
Difference of the 10th and 90th percentile in 2026 (p.p. of GDP)	37.4	50.7	28.8	19.9	26.9	9.0	31.4	64.7	40.3	21.7	28.9	42.7	43.7	34.6	30.4	28.2	43.9	27.6	28.3	32.3	17.5	58.7	42.3	27.8	31.7	24.5	9.1
Historical SPB scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	LOW	LOW
Debt level (2032)	109.7	23.7	52.1	16.4	49.5	17.0	52.8	143.0	116.7	114.3	75.7	137.2	67.8	48.1	45.3	11.1	60.7	51.5	54.7	68.9	51.2	121.0	66.4	77.4	69.5	54.5	11.6
Debt trajectory (debt peak year)	2026	2024	2032	2021	2021	2024	2021	2021	2027	2027	2021	2021	2021	2022	2023	2021	2021	2025	2021	2021	2021	2021	2032	2027	2032	2021	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	86%	79%	33%	65%	38%	66%	77%	22%	73%	85%	48%	48%	29%	69%	53%	73%	59%	52%	83%	73%	75%	52%	75%	72%	45%	68%	60%
Adverse 'r-g' differential scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	143.0	38.6	71.6	17.5	66.8	27.2	48.8	165.6	136.1	131.4	82.6	174.8	83.6	52.5	42.4	19.5	73.7	78.4	67.5	81.8	51.7	136.3	82.0	101.6	76.4	68.2	12.4
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2032	2032	2021	2032	2023	2021	2021	2032	2032	2021	2021	2032	2032	2032	2032	2023	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	86%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	100%	97%	48%	94%	60%
Financial stress scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	135.6	36.7	67.6	15.9	62.2	25.8	45.9	159.0	128.9	124.5	77.2	167.9	78.1	49.3	39.7	18.3	68.7	73.9	63.4	76.8	48.6	128.5	77.4	95.8	72.6	64.3	11.3
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2021	2032	2021	2022	2023	2021	2021	2032	2032	2021	2021	2032	2032	2032	2032	2022	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	98%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	100%	97%	48%	94%	60%
Lower SPB scenario	HIGH	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	MEDIUM	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM	LOW	LOW
Debt level (2032)	141.3	39.1	76.6	34.2	79.6	33.7	59.8	184.0	126.7	134.1	78.5	173.2	90.3	77.4	52.9	18.4	82.0	94.5	75.2	86.6	50.0	127.8	83.1	103.7	84.5	70.2	16.2
Debt trajectory (debt peak year)	2032	2032	2032	2023	2032	2032	2032	2021	2032	2032	2021	2032	2021	2032	2032	2021	2032	2032	2032	2032	2021	2021	2032	2032	2032	2023	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	100%	95%	91%	96%	96%	98%	80%	51%	92%	100%	50%	95%	75%	100%	64%	83%	74%	99%	100%	98%	70%	58%	100%	100%	65%	97%	70%
Debt sustainability analysis - overall risk assessment	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Overall MEDIUM-TERM risk category	HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW
Heat map for long-term risks in EU countries	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
S2 indicator - Baseline scenario	7.8	3.4	7.7	-0.5	2.6	0.5	5.7	-2.5	2.2	1.8	1.3	2.1	1.9	0.7	1.7	7.1	6.1	10.2	5.3	3.5	3.5	0.0	4.7	12.1	10.6	3.0	0.8
Debt sustainability analysis - overall risk assessment	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Overall LONG-TERM risk category	HIGH	MEDIUM	HIGH	LOW	MEDIUM	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH	MEDIUM	LOW

Source: Commission services.

Table 3: **Fiscal sustainability challenges in EU Member States**

Member State	*Fiscal sustainability risk assessment*
BE	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks. Gross financing needs are high in the short term, though financing conditions should remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks are high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 113% of GDP, is projected to continue rising, reaching 134% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks confirms this assessment. **Long-term risks: high.** Over the long term, both the sustainability gap indicator S2 and the DSA point to high risks. The S2 indicator mainly captures vulnerabilities linked to the high debt burden and to budgetary pressures stemming from population ageing.
BG	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks. Gross financing needs should still be contained in the short term. Yet, sovereign financing conditions are expected to remain favourable. **Medium-term risks: medium.** Over the medium term, fiscal sustainability risks appear to be medium overall, based on low risks from the sustainability gap indicator S1 and medium risks from a debt sustainability analysis (DSA) perspective. Government debt, currently at 27% of GDP, is projected to continue rising, reaching around 36% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Over the long term, medium risk from the sustainability gap indicator S2, combined with medium vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to the unfavourable initial budgetary position and costs of ageing.
CZ	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Czechia, according to the S0 indicator. However, gross financing needs have significantly increased compared with the pre-crisis situation. Sovereign financing conditions are expected to remain favourable. **Medium-term risks: medium.** Medium-term fiscal sustainability risks appear medium overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 42% of GDP, is projected to rise, reaching around 67% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: high.** Long-term fiscal sustainability risks appear high overall, combining the high risk according to the sustainability gap indicator S2 and the medium risk from a DSA perspective. The S2 long-term sustainability gap indicator points to risk linked to budgetary pressures stemming from population ageing and the initial budgetary position.

(Continued on the next page)

Table (continued)

DK	**Short-term risks: low.** Overall, no short-term vulnerabilities are identified for Denmark, according to the S0 indicator. Gross financing needs should be low in the short term. Sovereign financing conditions are expected to remain favourable. **Medium-term risks: low.** Over the medium term, fiscal sustainability risks appear to be low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 41% of GDP, is projected to decrease in the baseline, to reach less than 20% of GDP in 2032 under unchanged policies. The limited sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: low.** Over the long term, low risks from the sustainability gap indicator S2 as well as from the DSA contribute to the overall assessment. The S2 indicator reflects the favourable initial budgetary position which more than covers projected increases in ageing costs.
DE	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Germany, according to the S0 indicator. However, gross financing needs remain large in the short term. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions and continued high demand for German government bonds. **Medium-term risks: medium.** Medium-term fiscal sustainability risks appear medium overall, combining the medium risk according to the sustainability gap indicator S1 and the low risk from a debt sustainability analysis (DSA) perspective. Government debt, currently at 71% of GDP, is projected to decline to around 62% of GDP in 2032 in the baseline. **Long-term risks: medium.** Long-term fiscal sustainability risks appear medium overall, combining the medium risk according to the sustainability gap indicator S2 and the low risk from a DSA perspective. The S2 long-term sustainability gap indicator points to risk linked to budgetary pressures stemming from population ageing.
EE	**Short-term risks: low.** Estonia does not have major short-term vulnerabilities according to the S0 indicator. Gross financing needs are expected to stay very manageable, also considering that financing conditions should remain favourable. **Medium-term risks: low.** Over the medium term, fiscal sustainability risks are low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 19% of GDP, is projected to continue rising in the baseline, but to remain at modest levels, at 26% of GDP in 2032. Alternative and stress-test scenarios confirm this assessment. **Long-term risks: low.** Over the long term, both the sustainability gap indicator S2 and the DSA point to low risks, considering the low debt burden and the projected decline in age-related spending.

(Continued on the next page)

Table (continued)

IE	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Ireland, according to the S0 indicator. Gross financing needs should remain limited in the short term. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: low.** Medium-term fiscal sustainability risks appear low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, projected at 56% of GDP in 2021, is projected to decline, reaching around 46% of GDP in 2032 in the baseline. Alternative and stress-test scenarios confirm this assessment. **Long-term risks: medium.** Long-term fiscal sustainability risks appear medium overall, combining the medium risk according to the sustainability gap indicator S2 and the low risk from a DSA perspective. The S2 long-term sustainability gap indicator points to risk linked to budgetary pressures stemming from population ageing.
EL	**Short-term risks: high.** Overall, short-term vulnerabilities are identified for Greece, according to the S0 indicator. Moreover, gross financing needs remain substantial in the short term. However, sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions, while a large share of debt is held by the official sector. **Medium-term risks: high.** Medium-term fiscal sustainability risks appear high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at more than 202% of GDP, is projected to substantially decline, yet remaining relatively high at 155% of GDP in 2032 in the baseline. The relative sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Long-term fiscal sustainability risks appear medium overall, combining the low risk according to the sustainability gap indicator S2 and the high risk from a DSA perspective.
ES	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks. Gross financing needs should still be large in the short term. Yet, sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks are high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 120% of GDP, is projected to continue rising, reaching 126% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: high.** Over the long term, medium risks from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to the unfavourable initial budgetary position.

(Continued on the next page)

Table (continued)

FR	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks for France. Although declining in the short term, gross financing needs should remain high. Yet, sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks are high, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. In the baseline, debt – currently at around 115% of GDP – is projected to increase over the medium term, exceeding 120% of GDP in 2032. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Low risks from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA, contribute to the overall long-term assessment. S2 captures challenges linked to the large initial deficit, while ageing-related spending is expected to decline over the long term.
HR	**Short-term risks: low.** No short-term vulnerabilities are identified for Croatia, according to the S0 indicator. Gross financing needs should decline in the short term, and sovereign financing conditions are expected to remain favourable. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks are high overall, based on medium risks from the sustainability gap indicator S1 and high vulnerabilities from a debt sustainability analysis (DSA) perspective. In the baseline, debt – currently at 82% of GDP – is overall projected to decline compared to its 2021 level, reaching 77% of GDP in 2032. Similar dynamics obtained under possible macro-fiscal shocks also contribute to this assessment. **Long-term risks: medium.** Low risks from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA, contribute to the overall long-term assessment. The low value of S2 reflects the fact that the projected decline in ageing costs partially offsets the initial deficit.
IT	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks However, gross financing needs remain large. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks appear to be high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently around 155% of GDP, is projected to continue rising, reaching around 161% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: high.** Over the long term, medium risk from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to the unfavourable initial budgetary position.

(Continued on the next page)

Table (continued)

CY	**Short-term risks: high.** Overall short-term vulnerabilities are identified for Cyprus, according to the S0 indicator. However, after the peak recorded in 2020, gross financing needs should revert to low levels in the short term. Also, sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: medium.** Over the medium term, fiscal sustainability risks appear to be medium overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 104% of GDP, is projected to substantially decrease in the baseline, yet remaining above the 60% of GDP threshold in 2032. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Over the long term, low risks from the sustainability gap indicator S2, combined with medium vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures budgetary pressures stemming from population ageing.
LV	**Short-term risks: low.** Latvia does not display major short-term vulnerabilities according to the S0 indicator. Yet, government gross financing needs are expected to remain well above their pre-crisis levels in 2022. Financing conditions should remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: low.** Over the medium term, fiscal sustainability risks are low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 48% of GDP, is projected to linger at just below 50% of GDP over the next decade. Sensitivity tests show that some uncertainty surrounds the baseline projections. **Long-term risks: low.** Over the long term, both the sustainability gap indicator S2 and the DSA point to low risks, considering the limited debt level and the projected decline in age-related spending.
LT	**Short-term risks: low.** The S0 indicator does not detect major short-term vulnerabilities. Gross financing needs have come down from their peak in 2020 and financing conditions should remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: low.** Over the medium term, fiscal sustainability risks are low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 45% of GDP, is projected to decrease to 39% of GDP over the next decade. Sensitivity tests show that some uncertainty surrounds the baseline projections. **Long-term risks: low.** Over the long term, both the sustainability gap indicator S2 and the DSA point to low risks, despite the projected increase in spending linked to population ageing.

(Continued on the next page)

Table (continued)

LU	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Luxembourg, according to the S0 indicator. Moreover, gross financing needs should remain modest in the short term. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions and the country's AAA-rating. **Medium-term risks: low.** Medium-term fiscal sustainability risks appear low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 26% of GDP, is projected to decline, reaching around 18% of GDP in 2032 in the baseline. Low sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: high.** Long-term fiscal sustainability risks appear high overall, combining the high risk according to the sustainability gap indicator S2 and the low risk from a DSA perspective. The S2 long-term sustainability gap indicator points to risk linked to budgetary pressures stemming from population ageing.
HU	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Hungary, according to the S0 indicator. However, gross financing needs remain large in the short term (and relatively high beyond the short term). Sovereign financing conditions are relatively unfavourable. **Medium-term risks: medium.** Medium-term fiscal sustainability risks appear medium overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 79% of GDP, is projected to decline, reaching around 68% of GDP in 2032 in the baseline. However, significant sensitivity to possible macro-fiscal shocks contributes to the medium risk assessment. **Long-term risks: high.** Long-term fiscal sustainability risks appear high overall, combining the high risk according to the sustainability gap indicator S2 and the low risk from a DSA perspective. The S2 long-term sustainability gap indicator points to risk linked to budgetary pressures stemming from population ageing and the initial budgetary position.
MT	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks for Malta. Gross financing needs should decline in 2022, and sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks are high overall, based on medium risks from the sustainability gap indicator S1 and high vulnerabilities from a debt sustainability analysis (DSA) perspective. Government debt, currently at 61% of GDP, is projected to increase steadily, reaching around 73% of GDP in 2032 in the baseline. The main driver of this assessment is the high initial deficit, with sensitivity to possible macro-fiscal shocks also contributing. Reverting to past fiscal positions would reduce risks. **Long-term risks: high.** High risks from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA, contribute to the overall long-term assessment. S2 captures challenges linked to budgetary pressures stemming from population ageing and to the high initial deficit.

(Continued on the next page)

Table (continued)

NL	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks. Gross financing needs should decline after their surge in 2020-2021. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: medium.** Over the medium term, fiscal sustainability risks appear to be medium overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 57% of GDP, is projected to rise, reaching close to 63% of GDP in 2032 in the baseline scenario. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Over the long term, medium risk from the sustainability gap indicator S2, combined with medium vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to the unfavourable initial budgetary position and the projected increase in ageing costs.
AT	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Austria, according to the S0 indicator. Gross financing needs should decline in the short term, and sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: medium.** Over the medium term, fiscal sustainability risks appear to be medium overall, based on medium risk from the sustainability gap indicator S1 and low vulnerabilities from a debt sustainability analysis (DSA) perspective. Government debt, currently at 83% of GDP, is projected to decline over the projection horizon, reaching around 76% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Medium risks from the sustainability gap indicator S2, combined with low vulnerabilities from the DSA contribute to the overall long-term assessment. The S2 indicator mainly captures risks linked to budgetary pressures stemming from population ageing.
PL	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Poland, according to the S0 indicator. Gross financing needs should decline in the short term. **Medium-term risks: low.** Over the medium term, fiscal sustainability risks are low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. In the baseline, debt — currently at 55% of GDP — is projected to remain at a relatively low level despite a rebound as from 2027, staying below 50% of GDP in 2032. The low sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Medium risks from the sustainability gap indicator S2, combined with low vulnerabilities from the DSA, contribute to the overall long-term assessment. S2 captures challenges linked to budgetary pressures stemming from population ageing and the high initial structural deficit.

(Continued on the next page)

Table (continued)

PT	**Short-term risks: low.** No overall short-term vulnerabilities are identified for Portugal, according to the S0 indicator. However, gross financing needs remain large in the short term. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Medium-term fiscal sustainability risks appear high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, projected at 128% of GDP in 2021, is expected to rise as from 2027 in the baseline, after a temporary decline. It would reach around 126% of GDP in 2032, still below its current level. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Long-term fiscal sustainability risks appear medium overall, combining the low risk according to the sustainability gap indicator S2 and the high risk from a DSA perspective.
RO	**Short-term risks: low.** Overall, no short-term vulnerabilities are identified for Romania, according to the S0 indicator. Gross financing needs should be moderate in the short term. **Medium-term risks: high.** Over the medium-term, fiscal sustainability risks appear to be high overall, high according to the sustainability gap indicator S1 and medium from a debt sustainability analysis (DSA) perspective. Government debt, currently at close to 50% of GDP, is projected to increase in the baseline and exceed the 60% of GDP threshold by 2032. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Over the long term, medium risks from the sustainability gap indicator S2, combined with medium vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to the unfavourable initial budgetary position.
SI	**Short-term risks: low.** Overall, no short-term vulnerabilities are identified for Slovenia, according to the S0 indicator. Gross financing needs should be moderate in the short term. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium-term, fiscal sustainability risks appear to be high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at close to 78% of GDP, is projected to substantially increase in the baseline to reach about 95% of GDP by 2032. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: high.** Over the long term, high risks from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to budgetary pressures from population ageing and vulnerabilities associated to the unfavourable initial budgetary position.
SK	**Short-term risks: low.** Overall, the S0 indicator does not signal major short-term fiscal risks. Gross financing needs should remain low in the short term. Sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: high.** Over the medium term, fiscal sustainability risks appear to be high overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently around 62% of GDP, is projected to continue rising, reaching around 72% of GDP in 2032 in the baseline. The sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: high.** Over the long term, medium risk from the sustainability gap indicator S2, combined with high vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator mainly captures risks linked to the unfavourable initial budgetary position and the projected increase in ageing costs.

(Continued on the next page)

Table (continued)

FI	**Short-term risks: low.** No short-term vulnerabilities are identified for Finland, according to the S0 indicator. Gross financing needs should decline in the short term, and sovereign financing conditions are expected to remain favourable, notably supported by the Eurosystem's interventions. **Medium-term risks: medium.** Over the medium term, fiscal sustainability risks are medium overall, based on medium risk from the sustainability gap indicator S1 and low vulnerabilities from a debt sustainability analysis (DSA) perspective. In the baseline, debt — currently at 71% of GDP — is projected to be on a steady downward trend, approaching 60% of GDP in 2032. The low sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: medium.** Medium risk from the sustainability gap indicator S2, combined with low vulnerabilities from the DSA, contribute to the overall long-term assessment. The S2 indicator mainly captures vulnerabilities linked to budgetary pressures stemming from population ageing.
SE	**Short-term risks: low**. Overall, no short-term vulnerabilities are identified for Sweden, according to the S0 indicator. Gross financing needs should be low in the short term. Sovereign financing conditions are expected to remain favourable. **Medium-term risks: low.** Over the medium term, fiscal sustainability risks are low overall, both according to the sustainability gap indicator S1 and from a debt sustainability analysis (DSA) perspective. Government debt, currently at 37% of GDP, is projected to decrease in the baseline, reaching a very modest level in 2032 under unchanged policies. The reduced sensitivity to possible macro-fiscal shocks also contributes to this assessment. **Long-term risks: low.** Over the long term, low risks from the sustainability gap indicator S2, combined with low vulnerabilities from the DSA contribute to the overall assessment. The S2 indicator is supported by the favourable initial budgetary position which partly mitigates projected increases in ageing costs.

(1) This table presents an overview of the main findings described in volume 2 of the FSR 2021.
Source: Commission services.

INTRODUCTION

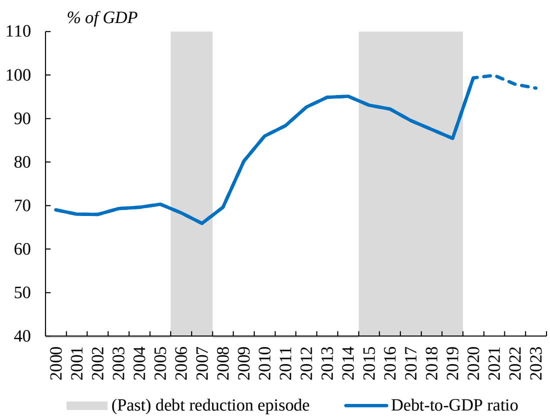
1. PUBLIC FINANCES IN THE WAKE OF THE COVID-19 CRISIS

After the major COVID-19 shock, the word and EU economies strongly rebounded in 2021, notably supported by decisive policy response. The COVID-19 pandemic that erupted in 2020 caused an economic crisis across the World, unique in its severity. The EU GDP diminished by close to 6% in 2020. Despite this recession, forceful policy actions, both at national and EU levels, allowed to avoid mass lay-offs, preserve incomes and protect businesses. Moreover, the successful vaccination campaigns in many EU countries, enabled a progressive easing of restrictions since spring 2021. In early November, economic activity in the EU was projected to expand solidly in 2022 (European Commission 2021a), notably supported by the full deployment of the Recovery and Resilience Facility.

Public finances took a serious hit as a result of the crisis. The EU aggregate government deficit increased from a historically low of around 0.5% of GDP in 2019 to around 7% in 2020. On the basis of the Autumn Commission forecast 2021, it is forecast to have narrowed marginally in 2021, due to continued discretionary fiscal measures to shelter households, workers and firms from the impact of the COVID-19. The aggregate budget deficit in the EU is forecast to halve in 2022, and further decrease to 2.2% in 2023. After declining between 2014 and 2019, the EU aggregate government debt-to-GDP ratio rose by over 13 pps. in 2020, reaching around 92%, mirroring the spike in deficits, as well as unfavourable interest-growth rate differential (snowball) effects. Similar developments are observed at EA aggregate level (see Graph 1). The EU aggregate debt ratio is expected to only slightly decline by 2023, but should remain (well) above 100% of GDP in six Member States (Belgium, Greece, Spain, France, Italy, and Portugal).

Going forward, exceptional uncertainties remain on the economic outlook, with repercussions on public finances. The report is based on the Commission Autumn forecast. However, since then, the invasion of Ukraine by Russia has been a watershed moment, increasing risks surrounding the economic outlook. Specifically, the strength of the recovery remains dependent on future developments related to the COVID-19 pandemic and, importantly, to the geopolitical situation. Amid high uncertainty, economic risks notably relate to the aggravating and protracted supply constraints and bottlenecks, as well as surging energy and food prices constraining growth and fuelling inflationary pressures. Such developments will be critical for the ability of Member States to continue phasing-out temporary emergency measures as planned in their Draft Budgetary Plans (see European Commission, 2021b). At the same time, the Ukraine crisis creates further risks, notably with an expected increase of defence spending and necessary accompanying measures to cushion the impact of the crisis (e.g. heightened energy prices) and support energy diversification.

Graph 1: **General government debt EA aggregate (% of GDP), developments and debt reduction episodes since 2000**



Source: Commission services.

Going forward, NextGenerationEU (NGEU) is expected to lift potential growth over the short- and medium-term, thus contributing to reducing debt sustainability risks. NGEU allows supporting all Member States, in particular those hardest hit by the COVID-19, with a €750 billion fund. Its centre piece, the Recovery and Resilience Facility (RRF), which entered into force in February 2021, will provide financing support to reforms and investments in Member States until end 2026. In particular, the RRF aims at making European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. This joint, coordinated action at the European level, will benefit all Member States, not least due to significant spillover effects across countries (see Pfeiffer et al., 2021).

Against this background, this edition of the Fiscal Sustainability Report (FSR) provides an update of fiscal sustainability challenges faced by Member States. The FSR 2021 offers a snapshot of the situation, based on the latest available Commission macroeconomic forecast (Autumn 2021). The assessment also relies on the Economic Policy Committee (EPC) commonly agreed methodology to project medium-term GDP growth, adjusted for the expected impact from NextGenerationEU investment (see section 2). Last, it reflects agreed long-term macroeconomic and budgetary projections from the joint European Commission - EPC 2021 Ageing Report. The FSR 2021 is the sixth edition of this report (following the FSR 2018 published in January 2019). ([27]), ([28])

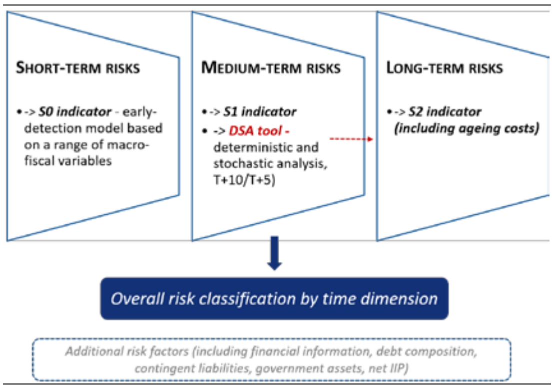
2. THE COMMISSION FISCAL SUSTAINABILITY ANALYSIS FRAMEWORK

2.1. Main features

A multi-dimensional approach is used to assess and differentiate fiscal sustainability risks in the short-, medium- and long-term. Fiscal sustainability risks faced by Member States are assessed according to the comprehensive horizontal fiscal sustainability framework used in the previous reports, ([29]) notwithstanding few methodological improvements. This framework brings together in a synthetic way results on debt sustainability analysis (DSA) and fiscal sustainability indicators. It allows gaining a horizontally consistent overview of fiscal sustainability risks across time horizons (short-, medium- and long-term) and across countries, based on a set of transparent criteria. In particular, key results are summarised in an overall summary heat map of fiscal sustainability risks per time dimension. This framework is meant to allow identifying the scale, nature and timing of fiscal sustainability challenges. Such a comprehensive and multidimensional assessment framework is key to design appropriate policy responses.

A wealth of tools and scenarios support the assessment along the different time dimensions. S*hort-term risks* are assessed by the S0 indicator, which allows for an early detection of short-term risks of fiscal stress (within the upcoming year) stemming from the fiscal and / or the macro-financial and competitiveness sides of the economy. Fiscal sustainability challenges over *the medium term* are captured through the joint use of the debt sustainability analysis (DSA) toolkit and the medium-term fiscal sustainability indicator S1. ([30]) Challenges over *the long term* are identified through the joint use of the long-term fiscal sustainability indicator S2 ([31]) and the DSA. The joint use of these two indicators allows for an identification of long-term challenges deriving from population ageing, while capturing potential vulnerabilities stemming from high debt levels. ([32])

Graph 2: **Commission fiscal sustainability analysis framework at glance**



(1) The additional risk factors are considered in the assessment to further qualify the results, but are not factored-in in the risk classification.
Source: Commission services.

Assessing fiscal sustainability remains admittedly subject to particularly large

([27]) The Debt Sustainability Monitor 2019 and 2020 provided intermediate yearly updates of the previous Fiscal Sustainability Report 2018.
([28]) The cut-off date for the projections presented in this report was 25 October 2021, in line with the Commission Autumn forecast 2021. However, for some additional indicators, more recent information has been used.
([29]) This framework was notably introduced with the FSR 2015.
([30]) The S1 indicator shows the required fiscal adjustment (in terms of cumulated improvement in the government structural primary balance) to bring the debt-to-GDP ratio to the 60% of GDP reference value in the medium-term.
([31]) The S2 indicator shows the required fiscal adjustment (to the government structural primary balance) to stabilise the debt ratio over the infinite horizon.
([32]) A thorough description of the Commission multi-dimensional approach can also be found in Chapters 1-3 and in annex A1 of the report.

uncertainty this year. The current significant degree of uncertainty implies that the set of sensitivity tests and alternative scenarios, routinely included in the FSR, is particularly relevant at the current juncture. *For the DSA*, different deterministic scenarios and stress tests are performed to complement the traditional baseline, including for instance the assumption of reversal to historical averages for fiscal variables, or more stringent macroeconomic and financial conditions. Additionally, other scenarios assume a fiscal adjustment path in line with Member States' Stability and Convergence Programmes. Stochastic projections are an important complement to this analysis, whereby a very large number of shocks are jointly simulated, based on the historical volatility of each economy and correlation of shocks (see Chapter 2). Furthermore, some alternative calculations – to the baseline - are also computed for the long-term *fiscal sustainability indicators*, including stress testing the results to alternative productivity growth developments, or non-demographic drivers of health-care and long-term care spending (see Chapter 3).

In the same manner, the qualifying additional risk factors considered in the analysis (either aggravating or mitigating) remain of particular importance for a balanced assessment of overall fiscal sustainability risks. The quantitative results and ensuing risk classification based on this horizontal framework need, more than ever, to be complemented by considering complementary qualifying factors. To this end, a number of additional aggravating and mitigating risk factors are also considered, as a complement to model-based quantitative results, and inform the overall assessment of fiscal sustainability challenges (see Chapter 4 and country fiches in the volume 2 of the FSR). The importance of such factors – sometimes more qualitative in nature (such as institutional factors) and / or country specific, and a prudent application of judgment to reach a final assessment of fiscal sustainability risks is a key feature of the Commission DSA framework since 2014, and is in line with other international institutions' practices.

2.2. Novelties of the report

The FSR 2021 contains a number of important methodological improvements compared with past reports. In particular:

– *The baseline assumptions have been refined*, in particular, by increasing the consistency between assumptions for interest rates and inflation rates (both of which now reflect financial market expectations). ([33]) Moreover, owing to the substantial expected impact from NGEU over the medium-term, the standard 'T+10' GDP growth projections have been adjusted to reflect the NGEU investment spending profile over 2024-26. ([34]) Importantly, the baseline relies on a standard 'no-fiscal policy change' assumption. ([35]) Box 1 provides a comprehensive presentation of the baseline assumptions.

– *The DSA tool has also been revised*, notably reflecting the new post-COVID-19 crisis environment, and latest advances in DSA frameworks in other international institutions (IMF, 2021). The set of stress tests has been refined, to better account for risks linked to possible financial stress and to a moderate increase of the interest-growth rate differential (see Box 1). ([36]) The DSA risk classification has also been revised to further reflect the importance of the debt trajectory, 'fiscal consolidation space' (i.e. comparing the assumed fiscal position with the historical performance of each Member State) ([37]) and the uncertainty surrounding baseline projections, through an increased role given to stochastic projections in the assessment (see Chapter 2, Box I.2.).

– Last, but not least, contrary to previous editions, *the results for Greece included in the report are based on the same horizontal approach used for other countries*.

([33]) See Chapter 2, Box I.2.1.
([34]) This adjustment is based on the Quest model (see thematic Chapter 1 of the report).
([35]) In particular, in line with the FSR 2018 and the DSM 2019, the structural primary balance is assumed to remain constant at its last forecast value (2023), being only modified by projected ageing costs over the medium- and long-term. This differs from the DSM 2020 whereby, due to the exceptional crisis circumstances, a gradual return of the structural primary balance to the pre-crisis forecast level (as per the DSM 2019) was assumed. This round, as EU economies are expected to have fully recovered by 2023 to their pre-pandemic GDP levels, the standard baseline fiscal assumption is applied.
([36]) This issue is discussed in the thematic Chapter 3 of the report.
([37]) So far, the projected debt level played a major role in the overall medium-term fiscal risk assessment.

Additionally, in this edition of the FSR, several new topics are discussed in thematic chapters. A *first* thematic chapter discusses how the expected impact of NGEU investment on GDP growth and debt projections is integrated in the medium-term analysis. A *second* chapter presents a framework and some first stylised simulations to illustrate fiscal risks due to extreme weather and climate-related events, which are expected to increase in frequency and severity in the next decades as a result of climate change. Lastly, a *third* chapter summarises the debate and discusses the latest developments in the interest-growth rate differential (the 'r-g'), and the implications of a moderate reversal of (pre-crisis) favourable trends.

2.3. Role of the Commission fiscal sustainability analysis in EU surveillance

The Commission analysis of fiscal sustainability challenges presented in this report contributes to the monitoring and coordination of Member States' fiscal policies. It plays a key role in the context of the SGP ([38]) and of the European Semester, the EU integrated surveillance framework, including for the formulation of structural-fiscal country-specific recommendations and for post-programme surveillance. These results also provide the starting point for the assessment of debt sustainability in the framework of financial assistance. ([39])

The remainder of the report is organised as follows. *In the first part of the report,* Chapter 1 presents the short-term fiscal sustainability analysis. Chapter 2 covers the medium-term fiscal sustainability analysis, notably based on the DSA results. Chapter 3 present the long-term fiscal sustainability analysis, in particular, linked to population ageing challenges. Chapter 4 reviews additional aggravating and mitigating risk factors. *The second part of the report* features three thematic chapters related to the consideration of NGEU investment in the medium-term analysis; fiscal risks due to extreme weather and climate-related events; as well as latest debates on the 'r-g' differential and implications for debt sustainability risks. Importantly, a companion volume 2 of the FSR 2021 includes detailed country analysis.

([38]) See FSR 2018 for a detailed description of the multiple roles of this analysis in the context of the SGP. Moreover, according to the 'general escape clause', "in periods of severe economic downturn for the euro area or the Union as a whole, Member States may be allowed temporarily to depart from the adjustment path towards the medium-term budgetary objective, *provided that this does not endanger fiscal sustainability in the medium term"*. (see https://ec.europa.eu/info/sites/info/files/economy-finance/2_en_act_part1_v3-adopted_text.pdf).

([39]) See European Commission - ESM (2021): https://ec.europa.eu/info/sites/default/files/economy-finance/swp_on_dsa_financial_assistance.pdf.

Box 1: **Deterministic debt projection scenarios: the main assumptions**

Government debt projections provide stylised trajectories for debt over the next 10 years (currently until 2032). They rely on assumptions about key macroeconomic, financial and fiscal variables. Importantly, the Commission baseline debt projections rest to a large extent on assumptions and methodologies agreed with EU Member States represented in different Council formations ([1]). This ensures that the results are comparable across countries and consistent with other EU processes, in particular the European Semester and fiscal surveillance under the Stability and Growth Pact (SGP).

The baseline

The baseline constitutes the starting point for the debt sustainability analysis and the central scenario around which alternative scenarios and sensitivity tests are built. The assumptions under the baseline ([2]) are as follows:

- **Real GDP growth rates** are those of the Commission 2021 autumn forecasts for the first two years, i.e. until 2023 in this report. Beyond that, the EPC/OGWG 'T+10 methodology' projections are used between T+3 and T+10 ([3]), adjusted for the impact of investment under the Next Generation EU package ([4]). Actual GDP growth is derived from potential growth and a standard assumption for the closure of the output gap ([5]).

- **Inflation (as measured by the GDP deflator)** converges linearly from current country-specific values to market-based euro inflation expectations by T+10 ([6]). Beyond T+10, inflation converges to 2% (the ECB target) by T+30 ([7]) and remains constant thereafter (for more details see Chapter 2, Box I.2.1).

- The **primary balance** is projected as follows:

– Assuming 'no-fiscal-policy change', the ***structural primary balance*** (SPB) ***before costs of ageing*** is assumed to remain constant at its value in the last forecast year (currently 2023) over the remainder of the projection period. ***Ageing-related expenditures*** (pension, health-care, long-term care and education) projected in the joint Commission - Council *Ageing Report 2021*, as well as ***property income*** on state financial and non-financial assets ([8]), are added to the former to obtain the overall ***SPB***.

– The ***cyclical component*** reflecting the effect of automatic stabilisers is calculated as the product of the output gap and country-specific budget balance semi-elasticities agreed with the Member States and used for budgetary surveillance under the SGP ([9]). The cyclical component is, by construction, equal to zero once the output gap closes.

– ***One-off and other temporary measures*** are set to zero beyond T+2.

- **Interest rates** are projected as follows:

– ***Long-term interest rates*** on new and rolled-over debt converge linearly from country-specific current values to country-specific market-based forward nominal rates by T+10 ([10]). Beyond that, they converge to 2% in

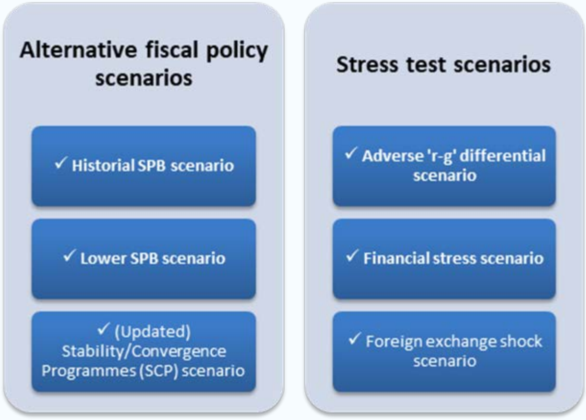
([1]) Notably the Economic Policy Committee (EPC)'s technical Output gap working group (OGWG) and Ageing working group (AWG).
([2]) For a detailed description of the debt dynamic equation and the impact of macro variables on the debt ratio projections, see Annex A3.
([3]) The estimates of potential GDP growth are based on a production function methodology agreed with the Member States in the OGWG (see Havik et al. (2014) for more details).
([4]) For more details, see Part II Chapter 1.
([5]) In line with the EPC/OGWG methodology, the output gap is generally assumed to close after 3 years, after which actual and potential GDP growth coincide.

([6]) For non-euro area countries targeting an inflation rate other than 2% (i.e. Poland, Romania and Hungary), half of the inflation spread vis-à-vis the euro area observed in T+2 is applied to the T+10 target (i.e. the market-based euro inflation expectation).
([7]) For non-euro area countries targeting inflation, national central bank targets are used, namely 2% for Czechia and Sweden, 2.5% for Poland and Romania, and 3% for Hungary.
([8]) For details, see Annex A3.4.
([9]) The budget semi-elasticities (for taxes and expenditure) are as reported in Mourre et al. (2019).
([10]) In line with the Commission forecast approach.

(Continued on the next page)

Box (continued)

Map 1: **Deterministic debt projection scenarios: alternative fiscal policy and stress test scenarios**



real terms by T+30 (4% in nominal terms for most EU countries) and remain constant thereafter ([11]).

– ***Short-term interest rates*** on new and rolled-over debt converge linearly from current values to market-based forward nominal rates by T+10 ([12]). Beyond that, they converge to 1% in real terms by T+30, assuming a yield curve coefficient of 0.5 ([13]).

– ***Implicit interest rates*** are derived endogenously in the debt projection model based on the above assumptions on market interest rates, the maturity structure of government debt and projected financing needs ([14]).

- **The exchange rate** for non-euro area countries is the Commission forecast for T+2 (currently 2023), with no appreciation or depreciation thereafter.

- The **stock-flow adjustment (SFA)** is set to zero beyond the T+2 forecast horizon (see Chapter 2 Box I.2.3).

In addition to the baseline, this report includes six additional deterministic scenarios. They reflect alternative assumptions for two types of factors that affect debt paths, namely discretionary fiscal policy decisions and changes in macroeconomic conditions (see Chart 1).

Alternative fiscal policy scenarios

This report includes three fiscal policy scenarios. These scenarios incorporate a feedback effect of fiscal policy on GDP growth via a fiscal multiplier of 0.75, meaning that a fiscal consolidation of 1 pp. of GDP reduces GDP growth by 0.75 pp in the same year compared to the baseline – and, conversely, a fiscal expansion raises it by 0.75 pp. ([15]).

1. **The historical SPB scenario** uses the Commission forecasts until T+2, after which it assumes that the SPB converges gradually to its historical average in 4 years, i.e. by 2027. The historical average is based on available data for 2006-2020. This scenario helps assessing whether the baseline (or other policy scenarios) is realistic, given past fiscal performance.

2. **The lower SPB scenario** assumes that the SPB level is reduced by half of the cumulative

([11]) Nominal long-term interest rates converge to 4.5% for Poland and Romania, and 5% for Hungary, given these countries' higher inflation targets.
([12]) For more details, see Box 3.1 in the 2019 DSM (European Commission (2020a)).
([13]) This factor of 0.5 reflects the standard slope of the euro area yield curve. It was revised down from 0.83 previously, to better reflect the level observed before the financial crisis, when the euro area output gap was broadly closed (and yields were not affected by unconventional monetary policy measures).
([14]) For a detailed discussion, see Annex A3.2.
([15]) Carnot and de Castro (2015).

(Continued on the next page)

Box (continued)

forecast change (over 2021-23) in the Commission 2021 autumn forecast. The SPB remains at that reduced value afterwards.

3. **The updated Stability or Convergence Programme (SCP) scenario** uses only the year 2022 of the Commission forecast as a basis and modifies the fiscal policy assumptions as from 2023. For 2023 and 2024, it assumes that governments implement their fiscal plans fully in line with their 2021 SCPs or more recent medium-term plans, if available. The SPB is then assumed to remain unchanged at its 2024 level, except for the impact of the cost of ageing.

Stress test scenarios

Three stress tests indicate how shocks to macro-financial variables may affect debt trajectories compared to the baseline. The shocks affect real GDP growth, interest rates and exchange rates.

1. **The adverse 'r-g' scenario** assumes an interest–growth rate differential permanently higher than in the baseline, by 1 pp., as of 2022. This higher differential is obtained by applying simultaneous adverse shocks to (short- and long-term) market interest rates and economic growth. This scenario illustrates the risk of a (moderate) worsening or reversal of the interest–growth rate differential, while the baseline currently rests on the assumption of favourable financing conditions (in line with markets' expectations). The scenario is discussed in depth in Part II, Chapter 3.

2. **The financial stress scenario** assumes a temporary increase in the interest rates, by 1 pp. in 2022, for all countries. Moreover, a risk premium is added for those countries with a debt-to-GDP ratio exceeding 90% of GDP in 2021, in line with the findings in Pamies et al. (2021) ([16]).

3. **The sensitivity test on nominal exchange rate** applies a shock – equal to the maximum annual change in the country's exchange rate observed over the last 10 years – for first two years (2022 and 2023), after which the baseline assumption prevails.

([16]) The risk premium is equal to 0.06 times the excess of the 2021 debt level over 90%, in those countries where debt exceeded 90% of GDP in 2021.

Part I

Fiscal sustainability analysis

1. SHORT-TERM FISCAL SUSTAINABILITY ANALYSIS

Still deteriorated public finances in 2021 and an aggravation of macroeconomic imbalances, as a result of the COVID-19 crisis, imply that short-term risks of fiscal stress are identified in some countries*. According to the early-warning indicator used by the European Commission, the S0 indicator, Greece and Cyprus are found to face such short-term vulnerabilities (see section 1.1). Nonetheless, the overall situation appears less critical than during the Global Financial Crisis (GFC), and improved compared with last year. In 2009, S0 flagged short-term risks of fiscal stress in as many as seventeen countries, notably due to severe macroeconomic imbalances. Last year, short-term fiscal risks were identified in eleven countries (see Debt Sustainability Monitor 2020).*

2021-22 government gross financing needs (GFN) are set to fall compared to the outbreak of the pandemic, as the crisis' effects subside, though remaining sizeable in some countries*. In 2021, aggregate GFN for the EU as a whole are estimated to have receded by some 3 pps. of GDP compared to 2020, being now estimated at around 19% of GDP (see section 1.2). According to the latest Commission autumn forecast 2021, liquidity pressures would further moderate in 2022 by some 3 pps. of GDP. Yet, in 2022, GFN would remain sizeable, at levels above the high-risk threshold in seven countries, including Italy, Spain, France, Belgium, Portugal, Hungary and Greece.*

The ECB's Pandemic emergency purchase programme (PEPP) and Asset purchase programmes (APP) have helped preserving favourable financing conditions for the euro area governments*. Looking at highly indebted countries, purchases of euro area government bonds through these programmes represented between some 30% of GFN in Italy, Belgium, France and Spain and around 50% in Greece to over 70% in Portugal and more than 100% in Cyprus in 2021. In 2022, Eurosystem asset purchases will continue, but they are expected to gradually wind down, reflecting the evolving assessment of the outlook, though they will remain significant. Additionally, NextGenerationEU should also contribute to favourable financing conditions for EU sovereigns, going forward.*

An analysis of the ease of (re-)financing government debt, based on different indicators of financial markets' perceptions of sovereign risk confirms the current favourable outlook*. Sovereign yield conditions have overall remained benign in the EU in 2021. The ECB indicator of sovereign bond markets' stress (SovCISS indicator) shows that stress temporarily surged following the onset of the COVID-19 pandemic, but is now subdued in euro area sovereign debt markets, with low divergence in trends. The EU average sovereign ratings are high and have not been adversely affected by the COVID-19 crisis.*

1.1. SHORT-TERM FISCAL SUSTAINABILITY INDICATOR: THE S0 INDICATOR

Still deteriorated public finances in 2021 and an aggravation of macroeconomic imbalances, as a result of the COVID-19 crisis, imply that short-term risks of fiscal stress are identified in few countries. Based on 2021 values, two countries had values of S0 above its critical threshold, signalling risk of fiscal stress in the upcoming year (see Box I.1.1 for a description of the S0 indicator). This concerns Greece and Cyprus (see Graph I.1.1). These results are driven by both fiscal and macro-financial variables. As a comparison, before the COVID-19 crisis, no EU country was deemed to be at short term risk of fiscal stress (see Debt Sustainability Monitor 2019).

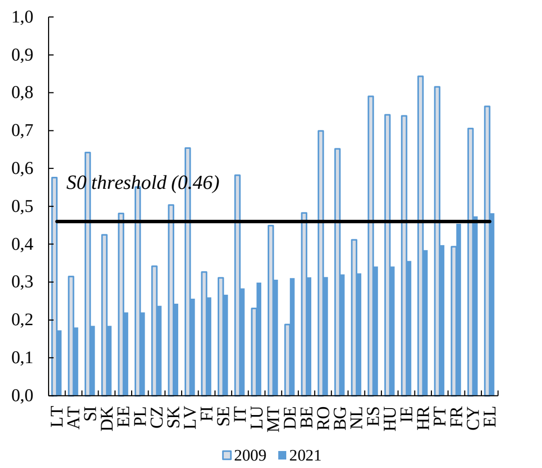
Nonetheless, the overall situation appears less critical than during the Global Financial Crisis, and improved compared with last year. In 2009, S0 flagged short-term risks of fiscal stress in as many as seventeen countries, notably due to severe macroeconomic imbalances. Last year, short-term fiscal risks were identified in eleven countries (see Debt Sustainability Monitor 2020). Moreover, the extraordinary monetary policy interventions put into place since March 2020, together with decisive EU actions, including the adoption of *NextGenerationEU* in 2020, ([40]) contributed to

([40]) Earlier decisive actions include the creation of the SURE in 2020, as well as the activation of the ESM Pandemic Crisis Support facility.

stabilising sovereign financing conditions, lessening risks of short-term fiscal stress.

While there are no signs of a possible risk reassessment by markets, the S0 indicator identifies some vulnerabilities in the short-term, notably in countries with sizeable government gross financing needs and / or with aggravated macroeconomic imbalances (see more details below and in section 1.2.).

Graph I.1.1: **The S0 indicator for EU countries, 2009 and 2021**

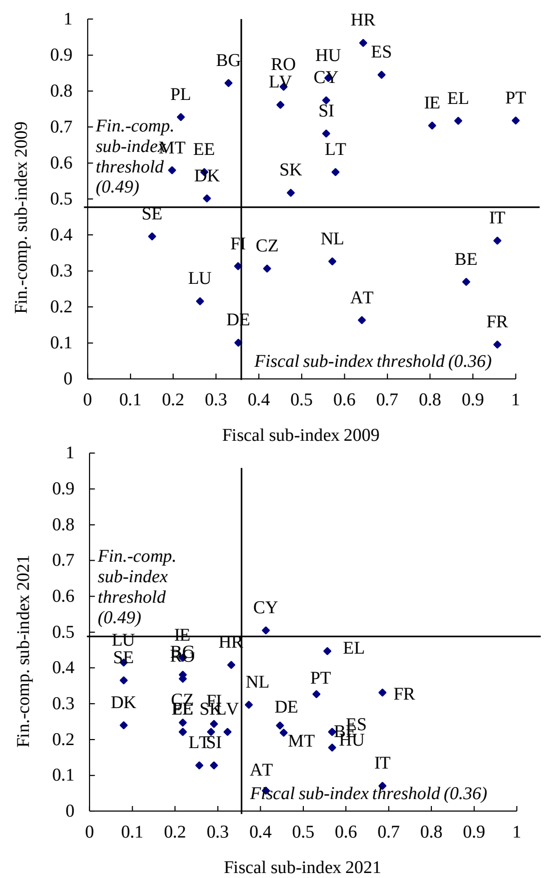


(1) For more methodological explanations, see Box I.1.1 and Berti et al. (2012) and Pamies Sumner and Berti (2017).
Source: Commission services.

The thematic sub-indices allow identifying significant vulnerabilities on the fiscal side in many countries. Based on 2021 data, vulnerabilities are clearly identified on the fiscal side in twelve Member States (see Graph I.1.2). Despite the economic recovery, this is explained by the continued discretionary fiscal measures to shelter households, workers and firms from the impact of the COVID-19 crisis (see Table I.1.1). In some Member States, deteriorated fiscal balances compound existing high levels of government debt (e.g. Greece, Italy, Portugal, Spain, France, Belgium and Cyprus). As a result, government gross financing needs were still large in some countries in 2021, also representing an important driver of identified risks (in particular, in Italy, Spain, France, Greece, Belgium and Hungary). ([41])

However, the lengthening of average debt maturities over the past years contributes to mitigate risks of fiscal stress, with a ratio of short-term debt (as a share of GDP) above its critical threshold only in few cases (Portugal, Italy and France). Moreover, despite the recent increase due to the Ukraine crisis, the still historically low level of market interest rates helps containing government interest payments and budgetary balances compared with the developments observed during the Global Financial Crisis in several countries.

Graph I.1.2: **Fiscal and financial-competitiveness sub-indices, 2009 and 2021**



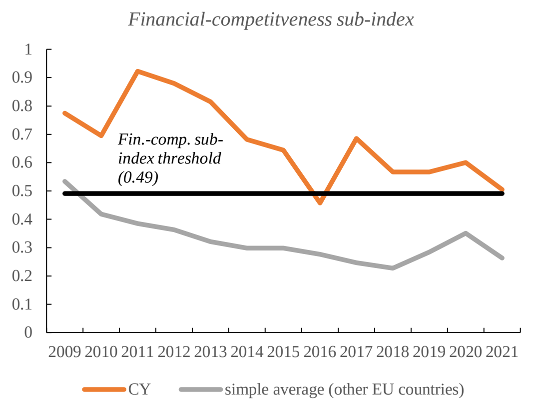
(1) For more methodological explanations, see Box I.1.1 and Berti et al. (2012) and Pamies Sumner and Berti (2017).
Source: Commission services.

The thematic sub-indices highlight limited additional vulnerabilities coming from the financial-competitiveness side, except in the case of Cyprus. This country is identified as facing high short-term risks stemming from the macro-financial side of the economy (a financial-

([41]) In Hungary, large financing needs also reflect the relative short average maturity of public debt compared to its European peers.

competitiveness sub-index above its critical threshold, see Graph I.1.2). The current account deficit, the large negative net international investment position, and the low level of households' saving rate contribute to this result, as well as some financial variables (short-term debt of households and , private debt, see Table I.1.2). In all other countries, the financial-competitiveness sub-index is below its critical threshold, suggesting overall sounder private and external positions compared with the situation observed in 2009 (see Graph I.1.2). ([42])

Graph I.1.3: **Financial-competitiveness sub-index since 2009, CY and (other) EU simple average**



Source: Commission services.

([42]) In few countries, the yield curve variable, considered in the S0 indicator (and financial-competitiveness sub-index) signals risks. However, this variable needs to be carefully interpreted at the current juncture, notably given the extraordinary monetary policy interventions that took place since March 2020.

Table I.1.1: **Fiscal variables used in the S0 indicator, 2021**

	Balance (%GDP)	Primary balance (%GDP)	Cycl. adj. balance (%GDP)	Stabil. primary balance (%GDP)	Gross debt (%GDP)	Change gross debt (%GDP)	Short-term debt (%GDP)	Net debt (%GDP)	Gross financing need (%GDP)	Interest growth rate diff.	Change expend. gen. govt (%GDP)	Change consumpt. gen. govt (%GDP)
BE	-7.8	-6.1	-7.0	-6.7	112.7	0.0	9.1	99.6	21.9	-6.5	-2.5	-0.5
BG	-3.6	-3.0	-3.0	-1.2	26.7	2.0	0.0	15.1	4.5	-5.2	0.4	-0.1
CZ	-7.0	-6.2	-5.5	-1.7	42.4	4.7	0.6	31.1	11.2	-4.9	0.1	-0.2
DK	-0.9	-0.2	0.4	-1.4	41.0	-1.1	9.0	15.8	8.6	-3.5	-1.2	0.5
DE	-6.5	-5.9	-4.9	-3.0	71.4	2.7	8.1	54.4	18.3	-4.6	1.4	0.0
EE	-3.1	-3.1	-2.6	-2.0	18.4	-0.6	1.7	5.8	2.5	-11.9	-2.4	-0.5
IE	-3.2	-2.4	-4.9	-6.5	55.6	-2.8	9.0	50.2	6.3	-12.8	-2.4	-0.9
EL	-9.9	-7.3	-7.1	-10.9	202.9	-3.4	12.1	:	22.4	-5.6	-1.9	-0.2
ES	-8.1	-5.9	-4.5	-4.8	120.6	0.6	8.9	104.5	24.7	-4.2	-1.6	-0.2
FR	-8.1	-6.9	-6.6	-6.8	114.6	-0.4	13.9	103.3	23.1	-6.3	-1.6	-0.6
HR	-4.1	-2.4	-3.4	-6.7	82.3	-5.0	5.4	:	13.0	-8.5	-3.3	-0.7
IT	-9.4	-5.9	-7.4	-7.3	154.4	-1.3	22.2	142.2	30.0	-5.0	-0.9	-0.8
CY	-4.9	-3.0	-4.7	-6.5	104.1	-11.3	7.5	63.2	3.8	-6.1	-0.2	0.4
LV	-9.5	-8.9	-8.4	-2.7	48.2	4.9	1.4	39.3	12.8	-6.8	4.5	1.7
LT	-4.1	-3.7	-4.0	-3.6	45.3	-1.3	0.2	42.3	6.3	-8.6	-1.7	0.6
LU	-0.2	0.0	0.6	-1.7	25.9	1.2	0.7	-1.3	3.3	-7.6	-2.6	-0.3
HU	-7.5	-5.1	-6.7	-6.5	79.2	-0.8	6.6	69.6	20.3	-9.2	-3.1	-0.5
MT	-11.1	-10.0	-8.8	-2.3	61.4	8.0	8.4	50.5	18.4	-4.6	1.2	1.1
NL	-5.3	-4.8	-4.4	-2.9	57.5	3.2	8.0	47.1	16.2	-5.6	0.1	0.5
AT	-5.9	-4.7	-4.1	-3.8	82.9	-0.3	7.5	61.9	13.5	-4.9	-2.1	-0.1
PL	-3.3	-2.2	-2.6	-4.0	54.7	-2.8	1.1	43.4	7.3	-7.7	-3.5	-0.3
PT	-4.5	-1.9	-2.6	-4.6	128.1	-7.0	22.5	121.8	15.0	-3.6	-0.3	0.0
RO	-8.0	-6.4	-6.9	-3.1	49.3	1.9	1.7	41.8	10.3	-7.2	-1.0	-0.8
SI	-7.2	-5.8	-7.7	-4.5	77.7	-2.1	2.0	50.2	15.3	-6.2	-0.4	0.1
SK	-7.3	-6.1	-6.3	-1.8	61.8	2.1	2.1	55.5	7.2	-3.1	2.0	0.3
FI	-3.8	-3.3	-2.7	-3.0	71.2	1.7	10.8	36.6	11.6	-4.5	-0.4	0.0
SE	-0.9	-0.8	0.2	-2.2	37.3	-2.3	12.2	9.7	7.0	-5.9	-1.6	-0.3
Threshold	-9.6	0.2	-2.5	2.3	68.4	8.1	13.2	59.5	15.9	4.8	1.9	0.6
Safety	>	>	>	<	<	<	<	<	<	<	<	<

Source: Commission services.

Table I.1.2: **Financial-competitiveness variables used in the S0 indicator, 2021**

	Yield curve (pps.)	Real GDP growth (%)	GDP per capita PPP (% US level)	L.Net Intern. Invest. Position (% GDP)	L.Net savings households (% GDP)	L.Private debt (% GDP)	L.Private credit flow (% GDP)	L.Short debt Non-fin. corp. (% GDP)	L.Short debt households (% GDP)	L.Construction (% value added)	L.Current account (% GDP)	L.Change real eff. exchange rate (pps.)	L.Change nom. Unit Labour Costs (pps.)
BE	0.7	6.0	83.6	44.4	8.0	194.4	1.1	35.2	1.4	5.5	0.1	1.2	7.5
BG	0.2	3.8	38.6	-26.3	:	94.3	4.2	12.7	1.6	4.9	0.8	3.6	20.4
CZ	0.3	3.0	64.9	-12.5	9.3	81.9	2.4	12.7	1.0	5.7	1.5	1.0	19.2
DK	0.4	4.3	94.4	68.8	2.8	220.9	4.8	34.3	2.6	6.1	8.1	5.6	6.2
DE	0.3	2.7	83.7	61.7	9.7	120.1	6.0	15.5	1.6	5.8	7.4	0.7	11.1
EE	0.7	9.0	62.1	-21.5	6.7	104.4	3.6	6.4	1.0	6.7	1.0	1.3	17.1
IE	0.8	14.6	162.5	-174.0	2.4	188.9	-1.8	20.5	0.5	2.2	-5.8	0.3	-6.3
EL	1.5	7.1	45.7	-175.0	-3.2	125.3	5.4	10.7	4.9	1.9	-3.7	-5.3	6.4
ES	1.0	4.6	59.8	-85.5	6.8	146.4	4.4	7.4	2.8	6.2	1.6	0.5	11.0
FR	0.8	6.5	74.0	-30.2	5.5	173.7	13.0	28.2	1.8	5.2	-1.0	0.4	4.6
HR	0.3	8.1	47.5	-47.8	4.8	98.0	1.3	4.8	3.0	6.1	1.6	-0.3	13.7
IT	1.5	6.2	66.9	2.4	6.5	118.9	4.1	12.7	2.5	4.4	3.2	1.6	5.5
CY	0.9	5.4	62.3	-136.7	1.2	260.5	-2.6	14.9	4.9	6.1	-6.6	1.0	5.8
LV	0.7	4.7	50.9	-34.7	5.6	66.5	-1.8	5.7	1.0	7.0	0.7	2.7	18.4
LT	0.7	5.0	61.9	-15.8	5.8	54.7	0.3	3.7	0.6	7.3	3.7	-0.9	18.3
LU	0.4	5.8	184.9	39.9	6.8	316.8	44.1	59.9	2.1	5.9	4.5	4.9	11.1
HU	1.7	7.4	53.7	-48.1	5.9	76.4	7.7	12.2	2.2	5.5	-0.7	-5.2	13.2
MT	1.2	5.0	67.9	60.3	:	139.1	9.0	11.7	2.9	4.6	3.0	4.0	19.7
NL	0.4	4.0	92.2	113.9	9.1	233.7	-1.3	35.7	1.9	5.4	9.1	-0.7	14.0
AT	0.6	4.4	86.8	9.3	8.5	131.2	4.7	9.6	2.1	7.0	1.6	0.0	12.2
PL	2.0	4.9	53.6	-44.5	4.2	75.9	1.5	6.6	1.9	7.2	0.7	2.7	12.3
PT	0.9	4.5	53.5	-106.4	2.3	163.7	4.4	13.5	2.4	4.8	0.0	-0.3	16.2
RO	2.7	7.0	51.7	-48.3	:	48.5	1.3	8.3	0.7	7.3	-4.9	2.2	26.1
SI	0.7	6.4	63.9	-15.2	9.7	69.7	-0.9	7.3	1.8	6.0	6.4	0.1	14.9
SK	0.7	3.8	49.8	-65.7	3.2	95.3	3.7	11.9	1.4	6.5	-1.8	-1.4	16.4
FI	0.6	3.4	78.8	-5.3	2.6	155.2	6.5	13.9	3.8	7.5	-0.4	-0.3	6.1
SE	0.5	3.9	85.4	16.4	9.1	215.7	11.6	37.6	16.0	6.7	4.6	-3.2	9.4
Threshold	0.6	-0.7	72.7	-19.8	2.6	164.7	11.7	15.4	2.9	7.5	-2.5	9.7	7.0
Safety	>	>	>	>	>	<	<	<	<	<	>	<	<

(1) Variable names preceded by L are taken in lagged values.
Source: Commission services.

1.2. SHORT-TERM GROSS FINANCING NEEDS

Among the S0 fiscal variables, government gross financing needs (GFN) are the strongest predictor of fiscal stress events. This property warrants a closer examination of GFN results, including this variable's definition (for the latter, see Box I.1.2).

The COVID-19 crisis put GFN at the core of short-term fiscal analysis. At the start of the pandemic, the large expected increase in governments gross financing needs emphasised the importance of estimating GFN in real time.

In 2020, gross financing needs of all EU governments soared as a result of the COVID-19 crisis. At EU/EA aggregate level, gross financing requirements increased by some 10 pps of GDP in 2020. This upsurge happened on the back of important fiscal stimulus and liquidity support governments provided to different economic agents, paired with the need to roll over large amounts of existing debt and the toll the recession took on growth. Specifically, government deficits and, in some cases, other net debt-creating flows widened as a result of automatic stabilisers and following discretionary measures to support firms and households during the pandemic.

In 2021 and 2022, GFN are set to fall compared to the outbreak of the pandemic, as the crisis' effects subside. In 2021, aggregate gross financing needs for the EU/EA are estimated to have receded by some 3 pps of GDP compared to 2020, being estimated at around 19/20% of GDP, respectively, against around 22 / 23% of GDP in 2020. According to the latest Commission autumn forecast 2021, liquidity pressures would further moderate in 2022 by some 3 pps. of GDP (see Table I.1.3).

A similar pattern is expected in most individual countries. In 2021, GFN are estimated to have visibly fallen compared to 2020 in most countries, in some cases with large drops comprised between 22 and 7 pps of GDP (CY, LT, PL, HR, EE, FI, SK, and HU). Only in a few countries (LV, EL, MT, NL and CZ), would 2021 GFN exceed their 2020 levels, but pressure should start correcting thereafter. Over 2021-22, GFN would (further) decline in most countries, except in PT, EE, CY and RO, where they would rebound by between 3.0 and 0.5 pps of GDP; in all the latter cases, 2022 GFN would remain, however, below their 2020 values (see Table I.1.3).

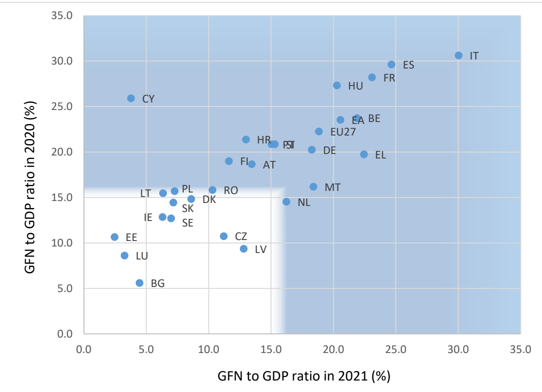
Table I.1.3: **Gross Financing Needs (% of GDP), (2019-2023), by country**

	2019	2020	2021	2022	2023
BE	15.6	23.7	21.9	19.8	19.9
DE	10.9	20.3	18.3	14.9	13.8
EE	1.3	10.6	2.5	4.1	3.3
IE	6.3	12.9	6.3	4.4	5.8
EL	16.3	19.7	22.4	17.8	15.1
ES	15.6	29.6	24.7	22.6	21.6
FR	16.6	28.2	23.1	20.6	19.4
IT	20.3	30.6	30.0	26.2	25.8
CY	5.8	25.9	3.8	5.1	5.8
LV	4.6	9.4	12.8	11.1	7.1
LT	6.1	15.5	6.3	5.2	7.8
LU	3.1	8.6	3.3	3.2	3.0
MT	5.4	16.2	18.4	13.4	13.1
NL	8.1	14.5	16.2	12.1	11.1
AT	8.7	18.7	13.5	10.7	9.9
PT	11.0	20.9	15.0	18.2	17.4
SI	6.9	20.9	15.3	14.3	14.3
SK	3.7	14.4	7.2	6.1	5.0
FI	7.4	19.0	11.6	10.0	9.7
EA	**13.7**	**23.5**	**20.6**	**17.7**	**16.9**
BG	1.0	5.6	4.5	2.9	2.7
CZ	5.3	10.8	11.2	9.4	9.3
DK	6.7	14.8	8.6	5.5	6.2
HR	14.0	21.4	13.0	12.2	12.2
HU	18.1	27.3	20.3	17.6	16.8
PL	4.6	15.7	7.3	6.5	6.6
RO	7.6	15.8	10.3	10.8	10.3
SE	5.5	12.7	7.0	5.3	3.5
EU27	**12.6**	**22.3**	**18.8**	**16.2**	**15.4**

(1) GFN estimates / forecasts are calculated as the sum of the budgetary deficit, redemption of main debt instruments (securities and loan principal repayments), as well as stock-flow adjustments. (2) For post-programme surveillance countries (such as EL, IE, CY and PT), figures take into account official loans' repayment schedule.
Source: Ameco, ECB, Eurostat, ECFIN desks.

Short-term GFN are estimated to have remained significant in 2021, at levels continuing to flash for nine EU countries. Concretely, in IT, ES, FR, EL, BE, HU, MT, DE and NL short-term GFN flag risks, with levels above the associated threshold. The highest estimated levels range between 30% of GDP in Italy and around 20% of GDP in Hungary, while more limited excesses of the threshold would be present in the NL, DE and MT, where GFN would range between about 16% and 18% of GDP, respectively. In all of these countries with short-term GFN flashing in 2021, this variable was also close to or above the threshold in 2020 (see Graph I.1.4).

Graph I.1.4: **Short-term GFN (% of GDP) vis-a-vis threshold, 2020 and 2021, EU countries**



(1) GFN 2020 and 2021 figures are calculated as per Table 1 in Box I.1.2. The threshold of around 16% of GDP has been derived based on the signalling approach (see section 2.1).
(2) Blue quadrants depict countries where GFN exceeded this threshold in 2020 and /or 2021.
Source: Ameco, ECB, Eurostat, ECFIN desks.

Significant financing needs in 2021 derived in most cases from important debt redemptions and/or budget deficits, while stock-flow adjustments also played a role in some countries. As a result of the Covid-19 crisis, most governments accumulated large amounts of debt. In this context, the need to fund and roll over large(r) amounts of maturing debt (*debt redemptions*) weight on GFN, with debt redemptions representing important shares of GFN in many countries (CY, PT, SE, DK, SI, EL, HR, PL, ES, IT, FR, DE, AT, BE, HU, NL, LT and FI). Additionally, *headline budget deficits* continued in 2021 to contribute to GFN substantially, in nearly all EU countries except LU, SE and DK, where deficits were below 1% of GDP. This GFN component required significant funding especially for governments whose deficits were particularly sizeable in 2021 (MT, LV, IT, FR, ES, RO, BE, HU, SK, SI, and CZ where deficits ranged between around 10% and 7% of GDP). Not least, relatively larger *stock-flow adjustments* (SFA) were still estimated in 2021 for some countries, with either positive (debt-increasing) values exceeding 1 pp of GDP (in LU, IE, FI and NL) or negative (debt-reducing) values, comprised between close to -8 and around -1 pps of GDP (in CY, PT, SI, SK, RO, EE, LT, PL, LV and AT) (see Table I.1.4.). In many countries, SFA became more important in the context of the Covid-19 crisis, when governments granted substantial tax deferrals, increasing the importance of cash-accrual differences or when they have accumulated or drawn cash deposits (financial assets). ([43])

Table I.1.4: **Gross Financing Needs Components (% of GDP), 2021 estimations, by country**

	Budget Deficit	Maturing Debt	SFA	GFN
BE	7.8	13.5	0.6	21.9
DE	6.5	12.0	-0.2	18.3
EE	3.1	0.9	-1.6	2.5
IE	3.2	1.8	1.3	6.3
EL	9.9	12.3	0.2	22.4
ES	8.1	17.0	-0.4	24.7
FR	8.1	15.5	-0.5	23.1
IT	9.4	20.6	0.1	30.0
CY	4.9	6.6	-7.7	3.8
LV	9.5	4.5	-1.2	12.8
LT	4.1	3.6	-1.3	6.3
LU	0.2	0.2	2.9	3.3
MT	11.1	7.0	0.3	18.4
NL	5.3	9.7	1.2	16.2
AT	5.9	8.7	-1.1	13.5
PT	4.5	14.9	-4.3	15.0
SI	7.2	11.4	-3.3	15.3
SK	7.3	2.0	-2.1	7.2
FI	3.8	6.3	1.5	11.6
EA	**7.1**	**13.6**	**-0.2**	**20.6**
BG	3.6	0.6	0.2	4.5
CZ	7.0	3.9	0.3	11.2
DK	0.9	7.5	0.2	8.6
HR	4.1	9.3	-0.4	13.0
HU	7.5	12.2	0.6	20.3
PL	3.3	5.2	-1.2	7.3
RO	8.0	3.9	-1.6	10.3
SE	0.9	6.7	-0.5	7.0
EU-27	**6.6**	**12.4**	**-0.2**	**18.8**

(1) See notes to Table I.1.3 (2).
Source: Ameco, ECB, Eurostat, ECFIN desks.

In 2022, GFN should remain sizeable, at levels above the high-risk threshold in seven countries. GFN should remain above the threshold in 2022 in IT, ES, FR, BE, PT, HU and EL, being forecasted to exceed 20% of GDP in the first 3

([43]) In countries such as LU and FI, SFA have been regularly positive due to surpluses run by public pension funds (net acquisitions of financial assets) that cannot be used for central government financing. See Box I.2.3 for more information on these cases. For more details on SFA components of in a crisis, see Part II: Special issue 3. 'r-g' differentials: latest developments and implications for public debt sustainability.

countries (see Table I.1.3). They should remain sizeable as important deficits should persist in 2022, as well as significant debt amortisations falling due (see GFN breakdown graphs in the statistical country annexes). On the deficit side, budget deficit-to-GDP ratios are expected to remain high given increased permanent current expenditure in many countries, above the temporary emergency support deployed to tackle the COVID-19 crisis.

A close monitoring of financing needs and risks of financing gaps in real time remains key also in 2022. Such monitoring appears particularly warranted in the most vulnerable EU countries (high debt, high deficits), but is also relevant more in general, as long as the response to the pandemic still echoes, high uncertainties remain and given that the crisis' effects on countries' public finances will be long-lived.

GFN monitoring is important especially as the exceptional monetary policy support provided so far is expected to gradually wind down. Since the start of the Covid-19 crisis, the ECB's monetary policy actions and EU initiatives have contributed to stabilising sovereign financing conditions. In 2021, most governments continued to access markets relatively smoothly despite significant financing needs remaining (see Table I.1.5). The ECB's Pandemic emergency purchase programme (PEPP) and Asset purchase programmes (APP) have helped preserve favourable financing conditions for the euro area governments. Looking at highly indebted countries, purchases of euro area government bonds through these programmes ([44]) represented between some 30% of GFN in Italy, Belgium, France and Spain and around 50% in Greece to 74% in Portugal and over 100% in Cyprus in 2021 ([45]) (see Table I.1.5). In 2022, Eurosystem asset purchases should continue, but they are expected to gradually wind down, though they should remain significant (see Table I.1.5). Additionally, recent EU initiatives such as the NGEU/RRF should also contribute to favourable financing conditions for EU sovereigns, going forward (see thematic Chapter 1 for a discussion of the expected impacts of the NGEU/RRF).

([44]) These refer only to net asset purchases and so do not take into account reinvestments of maturing securities held by the Eurosystem.

([45]) While GFN refer to the financing needs in 2021, the eligible bonds that the Eurosystem could purchase under its asset purchase programmes included bonds issued in 2021 and bonds issued in previous years. Hence, a ratio above 100% is possible.

Table I.1.5: **Government GFN and possible total acquisitions of sovereign bonds by the Eurosystem, 2021 and 2022 estimates, by country**

	2021			2022		
	GFNs, EUR bn	Public sector asset purchases under APP and PEPP, EUR bn	Public sector asset purchases under APP and PEPP, % of GFNs 2021	GFNs, EUR bn	Expected public sector asset purchases under APP and PEPP, EUR	Expected Public sector asset purchases under APP and PEPP, % of
BE	108.0	33.1	31%	102.7	11.6	11%
DE	647.9	260.6	40%	566.9	84.0	15%
EE	0.7	0.2	24%	1.3	0.9	67%
IE	26.9	16.7	62%	20.2	5.4	27%
EL	39.7	18.6	47%	33.4	2.7	8%
ES	293.7	105.6	36%	289.1	38.0	13%
FR	571.1	187.1	33%	535.2	65.1	12%
IT	533.1	150.9	28%	491.6	54.2	11%
CY	0.9	1.8	205%	1.2	0.7	55%
LV	4.1	1.3	31%	3.8	1.2	32%
LT	3.4	1.8	51%	3.0	1.8	61%
LU	2.3	1.5	68%	2.4	1.1	44%
MT	2.6	0.4	14%	2.0	0.3	16%
NL	138.2	54.1	39%	108.3	18.7	17%
AT	54.3	27.0	50%	46.3	9.3	20%
PT	31.8	23.4	74%	41.2	7.5	18%
SI	7.8	4.3	55%	7.7	1.5	20%
SK	6.9	5.0	72%	6.5	3.7	56%
FI	28.9	19.6	68%	26.0	5.9	22%

(1) The cut-off date for this table is 16 December 2021. (2) These estimates are based on net asset purchases (excluding reinvestments) conducted under the Asset Purchase Programme (APP) and Pandemic Emergency Purchase Programme (PEPP). (3) GFN estimates are calculated as previously specified in this section. (4) 2021 net asset purchases under the APP are outturn data. 2021 net asset purchases under the PEPP are based on outturn data between December 2020 and November 2021 as the exact composition of PEPP purchases in December 2021 is not available. (5) The estimated asset purchases for 2022 do not include reinvestments. They are estimated based on the following assumptions: (i) net asset purchases under the APP will stand at a monthly pace of EUR 20bn in Q1, EUR 40bn in Q2, EUR 30bn in Q3 and EUR 20bn in Q4 (ii) net asset purchases under the PEPP will end at the end of March 2022 iii) in Q1 2022, net asset purchases under the PEPP are assumed to allow for a linear decrease in the pace of total net asset purchases (i.e. APP+PEPP) between the outturn pace observed in Q4 2021 and the expected pace of purchases in Q2 2022, which, according to the ECB's December monetary policy decisions, should stand at EUR 40bn per month. (6) Computations for possible Eurosystem purchases by country in 2022 also rely on the following additional assumptions: (i) the public sector purchase program (PSPP) would continue to represent 70% of the overall purchases under the APP, in line with the composition of asset purchases in previous years; (ii) public sector securities would account for 100% of purchases under the PEPP; iii) the government bonds and recognised agencies would make up for around 90% of the total pubic sector securities purchases under the APP and the PEPP, while securities issued by international organisations and multilateral development banks would account for the remaining 10%; (iv) the distribution of government bonds purchases is based on the ECB's capital key as of 1 January 2019, including for purchases under the PEPP, but Greek sovereign bonds are not eligible for purchases under the APP (7) In December 2021, the ECB decided that it would possibly use some flexibility in PEPP reinvestments, including for purchasing bonds issued by the Hellenic Republic above rollovers of redemptions in order to avoid an interruption of purchases in that jurisdiction. As the estimated purchases for 2022 do not take into account reinvestments, purchases of Greek sovereign bonds might be underestimated.
Source: Commission services, based on ECB data.

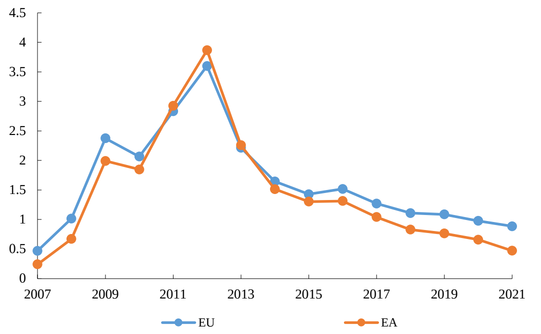
1.3. SOVEREIGN FINANCING CONDITIONS

This section provides an analysis of the ease of (re-)financing government debt, based on different indicators of financial markets' perceptions of sovereign risk. Such information complements debt projection based DSA results, notably to identify, early on, signs of sustainability risks over the short term. In practice, high frequency financial data allows monitoring emergence of potentially self-reinforcing adverse fiscal sustainability developments ([46]). While assessing the nature of such developments in real-time calls for caution, financial data provide an important source of information to monitor market's perception, a driver of short-term debt dynamics and, potentially, of self-reinforcing debt dynamics.

Sovereign yield conditions have remained overall benign in the EU, reflecting perceived creditworthiness, but also the low interest rate environment, notably supported by the accommodative monetary policy stance (see section 1.2). Low financing costs continue to contribute to mitigating rollover risks across the EU, which continues to post low sovereign yield spread development (see Chart I.1.5). However, some countries face higher financing costs (see Chart I.1.6), such as Romania. Other countries, such as Italy, which experienced some financial stress in 2018, have instead benefited from a moderation of spreads.

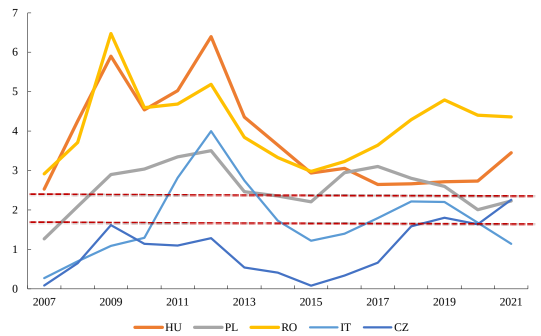
([46]) For discussion of the market expectations on sovereign debt default and risks of self-fulfilling crisis channel, see Calvo (1988). For an application of the EU sovereign crisis event see Miller and Zhang (2014).

Graph I.1.5: **10-year government bond yield spreads to the German bund - EU and EA aggregates**



(1) Yield spreads are as of September 2021.
(2) Aggregates represent unweighted averages.
Source: ECB LTIR database, Commission services.

Graph I.1.6: **10-year government bond yield spreads to the German bund - Selected countries**



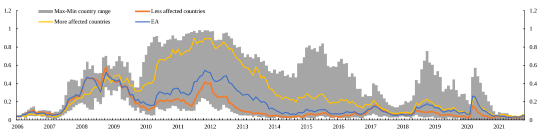
(1) Countries are those whose spreads are (or have recently been) above the lower risk threshold: 184.8 bps. Upper threshold: 231 bps.
Source: ECB LTIR database, Commission services.

The SovCISS indicator ([47]) shows that stress temporarily surged following the onset of the COVID-19 pandemic but is now subdued in euro area sovereign debt markets, while divergence in trends is low according to most recent data. This indicator of systemic stress for euro area sovereign bond markets continues to post a moderate average level and the gap between countries with the lowest and the highest score appears low, notably compared to the degree of

([47]) The SovCISS (Composite Indicator of Systemic Sovereign Stress) measures the level of stress in euro area sovereign bond markets, following the CISS (Composite Indicator of Systemic Stress) methodology developed in Hollo et al. (2012). In the SovCISS, stress symptoms are measured along three dimensions: (i) risk spreads; (ii) yield volatilities; and (iii) bid-ask spreads. For details, see Garcia-de-Andoain and Kremer (2018).

divergence seen by the end of 2017 (see Chart I.1.7). At the country level, notable developments include a decline in the indicator for Italy following a peak in October 2018. The increase in the gap between the minimum and the maximum (i.e. the country range) seen during the COVID outbreak was driven by a temporary surge in the indicator in March 2020, which affected countries to a different extent.

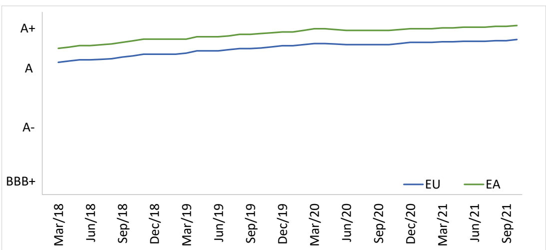
Graph I.1.7: **Composite indicator of Systemic Stress (SovCISS) in euro area sovereign bond markets**



(1) The SovCISS focuses on stress in sovereign bond markets. It is available for the euro area and for 11 euro area countries (AT, BE, FI, FR, DE, EL, IE, IT, NL, PT, ES). Countries more affected by the crisis include EL, IE, IT, PT, ES. Less affected countries include AT, BE, FI, FR, DE, NL.
Source: ECB, Commission services.

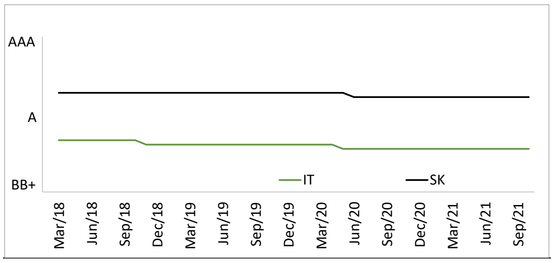
The EU and EA average sovereign ratings are high and have not been adversely affected by the COVID-19 crisis (see Graph I.1.8). This reflects stable or improving ratings in most countries, with some exceptions, with Italy and Slovakia posting relatively recent ratings deterioration (see Graph I.1.9, Graph I.1.10, and Table I.1.6).

Graph I.1.8: **Sovereign debt ratings - EU and EA aggregates**



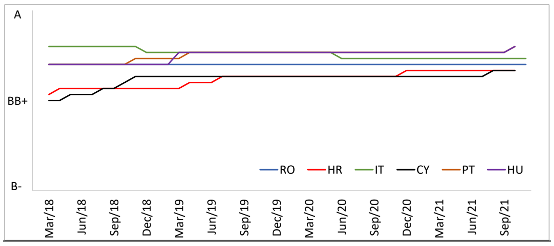
(1) Ratings are computed as simple average (using an alphanumeric conversion table) of long-term foreign currency ratings, assigned by the major rating agencies.
Source: Commission services, based on Bloomberg data.

Graph I.1.9: **Countries posting a recent rating deterioration**



(1) Ratings are computed as simple average (using an alphanumeric conversion table) of long-term foreign currency ratings, assigned by the major rating agencies.
Source: Commission services, based on Bloomberg data.

Graph I.1.10: **Countries with the lowest ratings as of January 2021**



(1) Ratings are computed as simple average (using an alphanumeric conversion table) of long-term foreign currency ratings, assigned by the major rating agencies.
Source: Commission services, based on Bloomberg data.

In sum, markets' perception of EU sovereign risks remains overall benign, contributing to favourable short-term debt dynamics. However, a premature withdrawal of fiscal support, also with respect to other large economies, or a departure from the commitment to preserve fiscal sustainability in the medium term may expose the fiscal sustainability risks identified in the short-term for a number of countries.

Table I.1.6: **Long-term foreign currency sovereign ratings (at November 2, 2021)**

	Moody's			S&P			Fitch		
	Rating	Since	Outlook	Rating	Since	Outlook	Rating	Since	Outlook
Euro area MS									
AT	Aa1	24/06/2016	STABLE	AA+	13/01/2012	STABLE	AA+	13/02/2015	STABLE
BE	Aa3	16/12/2011	STABLE	Aau	13/01/2012	STABLE	AA-	23/12/2016	STABLE
CY	Ba1	23/07/2021	STABLE	BBB-	14/09/2018	POS	BBB-	19/10/2018	STABLE
EE	A1	23/04/2009	STABLE	AA-	13/01/2012	POS	AA-	05/10/2018	STABLE
FI	Aa1	03/06/2016	STABLE	AA+	10/10/2014	STABLE	AA+	11/03/2016	STABLE
FR	Aa2u	18/09/2015	STABLE	AAu	08/11/2013	STABLE	AA	12/12/2014	NEG
DE	Aaau	05/07/2000	STABLE	AAAu	13/01/2012	STABLE	AAA	10/08/1994	STABLE
EL	Ba3	06/11/2020	STABLE	BB	23/04/2021	POS	BB-	24/01/2020	STABLE
IE	A2	15/09/2017	POS	AA-	29/11/2019	STABLE	A+	15/12/2017	STABLE
IT	Baa3u	19/10/2018	STABLE	BBBu	27/10/2017	POS	BBB-	28/04/2020	STABLE
LV	A3	13/02/2015	STABLE	A+	21/02/2020	STABLE	A-	20/06/2014	STABLE
LT	A2	12/02/2021	STABLE	A+	21/02/2020	STABLE	A	31/01/2020	STABLE
LU	Aaa	20/09/1989	STABLE	AAA	13/01/2012	STABLE	AAA	10/08/1994	STABLE
MT	A2	19/07/2019	NEG	A-	14/10/2016	STABLE	A+	11/08/2017	STABLE
NL	Aaau	20/07/1999	STABLE	AAAu	20/11/2015	STABLE	AAA	10/08/1994	STABLE
PT	Baa2	17/09/2021	STABLE	BBBu	15/03/2019	STABLE	BBB	15/12/2017	STABLE
SK	A2	13/02/2012	STABLE	A+	31/07/2015	STABLE	A	08/05/2020	STABLE
SI	A3	02/10/2020	STABLE	AA-	14/06/2019	STABLE	A	19/07/2019	STABLE
ES	Baa1	13/04/2018	STABLE	Au	20/09/2019	NEG	A-	19/01/2018	STABLE
Non-euro area MS									
BG	Baa1	09/10/2020	STABLE	BBB-	29/11/2019	STABLE	BBB	01/12/2017	POS
HR	Ba1	13/11/2020	STABLE	BBB-	22/03/2019	STABLE	BBB-	07/06/2019	STABLE
CZ	Aa3	04/10/2019	STABLE	AA-	24/08/2011	STABLE	AA-	03/08/2018	STABLE
DK	Aaau	23/08/1999	STABLE	AAAu	27/02/2001	STABLE	AAA	10/11/2003	STABLE
HU	Baa2	24/09/2021	STABLE	BBB	15/02/2019	STABLE	BBB	22/02/2019	STABLE
PL	A2	12/11/2002	STABLE	A-	12/10/2018	STABLE	A-	18/01/2007	STABLE
RO	Baa3	06/10/2006	STABLE	BBB-	16/05/2014	STABLE	BBB-	04/07/2011	NEG
SE	Aaa	04/04/2002	STABLE	AAAu	23/01/2014	STABLE	AAA	08/03/2004	STABLE

Source: Commission services, based on Bloomberg data.

Box I.1.1: S0 indicator: conceptual elements

The S0 indicator allows an identification of risks of potential fiscal stress in the upcoming year, based on a number of fiscal and structural variables. S0 is more precisely an early - detection indicator of fiscal stress over a one year horizon (Berti et al., 2012). Fiscal stress designates situations ranging from a credit event, a request of large official financing, to an implicit domestic government default (when high inflation) and a loss of market confidence (the latter has been the most common situation of fiscal stress during the global financial crisis in the case of European countries, see Pamies Sumner and Berti, 2017).

The S0 indicator is a composite indicator of fiscal stress stemming from fiscal variables and structural features of the economy. It is based on a wide range of variables that have proven to perform well in the past in detecting situations of upcoming fiscal stress. Thus, unlike the traditional medium- and long-term fiscal sustainability indicators (the S1 and S2 indicators presented in Chapters 2 and 3), the S0 indicator is not a fiscal gap indicator (i.e. it does not quantify the required fiscal adjustment to ensure sustainable public finances over a specific time horizon). The S0 indicator is neither a financial markets' based indicator of sovereign risk (see section 2.3 for an analysis of the latter).

More precisely, the measurement of S0 is based on 25 fiscal and financial-competitiveness variables. Table 1 provides the list of the 12 fiscal and 13 financial-competitiveness variables that are used to construct the S0 indicator. This reflects the existing rich evidence, also from recent experience in the EU, of the role played by developments in the financial sector and the competitiveness of the economy in generating fiscal risks (Cerovic et al., 2018; Pamies Sumner and Berti, 2017; Bruns and Poghosyan, 2016; Berti et al., 2012).

The S0 indicator is computed based on an empirical method, the so-called signalling approach. This method involves setting out endogenously critical risk thresholds, by analysing the behaviour of a large number of variables ahead of past fiscal stress events. More precisely, these critical thresholds are determined for each individual variable entering the S0 indicator, by minimising the proportion of missed crises and false alarms (or by maximising the 'signalling power'). Then, S0 is computed as the weighted proportion of variables that have reached their critical thresholds, with weights given by their 'signalling power', and the critical threshold for S0 itself endogenously derived. The same method applies for the two thematic sub-indices that reflect either the fiscal or the financial-competitiveness sides of the economy. The higher the proportion of individual variables with values at or above their specific threshold, the higher the value of S0 (and the sub-indices). The predictive performance of the S0 indicator fares well compared to other studies (Cerovic et al., 2018).

S0's identification of short-term fiscal risks is threefold. First, S0 is a measure of overall short-term risks to fiscal sustainability. Secondly, the fiscal and financial-competitiveness sub-indices help identifying vulnerabilities coming from one of the two thematic areas, though not necessarily at the aggregate level. Additionally, they also give insights into specific areas for those countries where high values of S0 already flag overall sustainability risks. Finally, individual variables of S0 allow for identifying specific sources of vulnerability. Overall, this detailed identification of sources of short-term fiscal risk enables identifying precise areas calling for policy action at the Member State and/or the Union level.

(Continued on the next page)

Box (continued)

Table 1: **Thresholds and signalling power of S0 indicator, fiscal and financial-competitiveness sub-indices and individual variables**

Variables	safety	threshold	signaling power	type I error	type II error	crisis number	no-crisis number
Balance, % GDP	>	-9.61	0.07	0.04	0.89	44	1080
Primary balance, % GDP	>	0.23	0.13	0.47	0.40	43	1058
Cyclically adjusted balance, % GDP	>	-2.50	0.23	0.52	0.25	40	981
Stabilizing primary balance, % GDP	<	2.34	0.08	0.13	0.79	38	983
Gross debt, % GDP	<	68.44	0.12	0.23	0.65	40	1047
Change in gross debt, % GDP	<	8.06	0.12	0.06	0.82	39	1018
Short-term debt gen. gov., % GDP	<	13.20	0.20	0.14	0.67	21	430
Net debt, % GDP	<	59.51	0.20	0.18	0.62	26	586
Gross financing need, % GDP	<	15.95	0.26	0.24	0.50	26	621
Interest rate-growth rate differential	<	4.80	0.08	0.11	0.82	38	977
Change in expenditure of gen. government, % GDP	<	1.90	0.11	0.13	0.76	41	1051
Change in final consumption expend. of gen. governm	<	0.61	0.07	0.17	0.76	38	972
Fiscal index	<	0.36	0.28	0.30	0.42	45	1083
L1.net international investment position, % GDP	>	-19.80	0.29	0.47	0.24	25	500
L1.net savings of households, % GDP	>	2.61	0.33	0.42	0.25	28	699
L1.private sector debt, % GDP	<	164.70	0.18	0.22	0.60	20	418
L1.private sector credit flow, % GDP	<	11.70	0.37	0.28	0.35	20	409
L1.short-term debt, non-financial corporations, %	<	15.40	0.20	0.54	0.26	19	403
L1.short-term debt, households, % GDP	<	2.90	0.21	0.52	0.26	19	403
L1.construction, % value added	<	7.46	0.22	0.27	0.51	43	1006
L1.current account, 3-year backward MA, % GDP	>	-2.50	0.34	0.35	0.31	42	983
L1.change (3 years) of real eff. exchange rate, based o	<	9.67	0.11	0.18	0.71	24	460
L1.change (3 years) in nominal unit labour costs	<	7.00	0.18	0.64	0.18	38	967
Yield curve	>	0.59	0.37	0.34	0.29	35	813
Real GDP growth	>	-0.67	0.10	0.09	0.81	48	1124
GDP per capita in PPP, % of US level	>	72.70	0.22	0.44	0.33	51	1129
Financial-competitiveness index	<	0.49	0.55	0.32	0.13	52	1158
Overall index	<	0.46	0.55	0.22	0.23	52	1158

(1) Variable names preceded by L1 are taken in lagged value. (2) The signalling power is defined as (1 - type I error - type II error). See Annex A4 for more details.
Source: Commission services.

The interpretation of risk assessment results based on the S0 analysis should be made with some caution:

– First, although the framework described above is rather comprehensive, additional dimensions that are relevant for the analysis of short-term sustainability risks are necessarily left aside. For instance, factors of a more qualitative nature or variables for which data availability is limited are not reflected by S0.

– Then, the S0 indicator is based on yearly outturn values of the different variables. This reflects the fiscal stress identification approach underpinning the S0 indicator (whereby the build-up of fiscal and structural imbalances in the past and current years can lead to fiscal stress in the next year). While it allows complementing the traditional forward-looking perspective of the DSA, it can present some limitations in cases where real-time or foreseen developments change rapidly. ([1])

– Last, a high short-term risk signal, as highlighted by S0, does not mean that fiscal stress is inevitable (it is not a prediction), but rather that there are significant vulnerabilities that need to be addressed by appropriate policy responses.

Hence, a broader analysis of country-specific contexts should supplement the interpretation of S0 results.

([1]) For example, the announcement of the NGEU/RRF is deemed to have contributed to mitigate short-term risks, while not being fully reflected yet in outturn data.

Box I.1.2: Gross financing needs (GFN): Definition and measurement

While debt stock indicators capture *solvency* risks, GFN is primarily a flow concept informing mainly about the liquidity of government finances in the short to medium term ([1]). A given debt stock may be associated to very different schedules of repayment flows and thus financing needs, depending on the specific borrowing terms, such as term-to-maturity structure, amortisation schedules for principal and interest. GFN are usually defined as the flow of payment or financing obligations the government faces to service its debt and cover its budget deficit, if any, over the next period:

GFN = Headline deficit
+ Debt redemptions + SFA
or
GFN = Primary deficit + Interest payments + Debt redemptions + SFA

To capture additional changes in a government's balance sheet, such as those that affect gross government debt, but do not affect the budget deficit, stock-flow adjustments (SFA) also enter the GFN formula. SFA are net debt-creating flows that comprise three categories: *i) Other debt creating / reducing flows (ODF),* essentially 'below the line' items (not affecting the deficit) constituting a net acquisition of financial assets ([2]), *ii) the cash-accrual difference* ([3]) *to the ESA fiscal deficit, since the latter is* accounted on an accrual basis and *iii) other adjustments and discrepancies* ([4]).

GFN may be measured using different data sources and approaches, in both backward- and forward-looking manner. Contrary to government debt, which is an indicator well defined in the EU and measured by national statisticians using harmonised definitions set by Eurostat, GFN is an indicator built for practical or analytical purposes, which falls outside of the scope of government finance statistics ([5]). For outturn data, such as the GFN used under S0, different sources exist to estimate GFN components, among them national statistical institutes (NSIs), national central banks (NCBs), national authorities (ministries), debt management offices (DMOs) or large data providers such as Bloomberg. For forward-looking data, a few institutions provide GFN projections, among them the European Commission and the IMF ([6]).

Therefore, GFN are versatile metrics, useful for a variety of analytical purposes. GFN estimates are a particularly valuable concept in the case of programme countries or more generally in a crisis context, to define accurately the financing requirements and the necessary sources to cover those needs, including when calibrating the size of

([1]) GFN's mixed nature notably in terms of potential adjustments from contingent liabilities' realizations or variation of assets makes it also informative about solvency-related risks.
([2]) Examples: *i)* cash / deposits (e.g. accumulation/draw-down), *ii)* equity (nationalisation/privatisation, below-the-line financial sector recapitalisations), *iii)* other financial assets (e.g. participation in a common financial instrument at EU level).
([3]) The cash-accrual adjustment (or difference) to the ESA fiscal deficit commonly includes *i)* the difference between interest paid (+) and accrued (-), e.g. deferred interest payments on certain (official) loans, *ii)* changes in accounts payable (e.g. tax refunds not yet settled, trade credits granted by government suppliers, grants received from the EU but not yet paid to the final beneficiary, prepayments for mobile phone licences) or *iii)* accounts receivable (e.g. tax receivable, military receivable, revenue from EU (structural) funds that is not yet received / disbursed, healthcare expenditure claw-back) or changes in arrears or clearance of called guarantees (applicable for instance when called guarantees accrue to year t, but will be paid only in the subsequent year(s)).
([4]) include valuation effects, statistical discrepancies and other changes in volumes due to reclassification of units, all of which affect debt (and gross financing needs) ex-post.
([5]) See for example Eurostat, ESA 2010, "Chapter 20 – The government accounts", where no mention is made of this indicator.
([6]) The ESM (Gabriele et al. 2017) and the ECB (2017) also provided outturn estimations.

(Continued on the next page)

Box (continued)

the programme. They are also useful in regular fiscal surveillance to monitor potential market roll-over risks in the short to medium term.

International institutions and creditors are paying increased attention to GFN in their appraisal of fiscal risks. The same institution may use multiple GFN definitions, depending on the analytical purpose. Different financial instruments may be considered under the universe of GFN. Experts generally agree that a broader definition of GFN flows, mirroring the components of Maastricht debt stocks, seems appropriate. Such a definition would include currency and deposits, debt securities and loans, but the scope may vary depending on the purpose of the analysis.

In the European Commission's Fiscal Sustainability Reports and Debt Sustainability Monitors, GFN are regularly examined in the short- and medium-term fiscal sustainability sections. For the medium-term, chapter 3.3 shows GFN projections up to T+10.

Similarly to the DSM 2020, for the purpose of short-term analysis performed through S0, GFN are gauged like the medium-term measure, to evaluate all liquidity pressures EU countries are currently facing (see Table 1). Specifically, to reflect all needs that require market financing, short-term GFN are computed to include the redemption of all loans (official and commercial) reaching maturity, as well as other net debt-creating flows (stock-flow adjustments).

Table 1: **GFN definition - Components and debt instruments included**

GFN Components	Balance sheet items (liabilities) under government debt	Components and debt instruments included in the GFN definition
Budget (Headline) deficit		x
Maturing Debt	Currency and deposits	
	Debt securities	x
	Commercial loans	x
	Official loans	x
Stock-flow adjustments flows (SFA)		x

(1) Similarly to the DSM 2020, in this report, short and medium-term GFN are calculated in the same way, based on the definition previously used for medium-term GFN (see DSM 2019). (2) Consolidated data. (3) SFA are defined as described in the text.
Source: Commission services.

Looking ahead, a few approaches could help improve GFN estimates. Improved practices such as monitoring fiscal deficits in cash terms, identifying more accurately other debt creating / reducing flows of the stock-flow adjustment (SFA), and cooperating with national DMOs to follow more closely debt redemption and issuance plans could significantly improve GFN estimates, in real time.

2. MEDIUM-TERM FISCAL SUSTAINABILITY ANALYSIS

***The analysis of medium-term fiscal sustainability risks relies on a comprehensive toolkit based on the Commission's debt sustainability analysis (DSA) and the S1 indicator.** The DSA combines deterministic debt projections up to 2032 with stochastic projections covering a wide range of possible shocks. The deterministic projections include the impact of ageing-related expenditure. They consider alternative scenarios to the 'no-fiscal policy change' baseline, such as reverting to past fiscal behaviour, implementing only part of the forecast structural adjustment, benefiting from a less favourable interest-growth rate ('r-g') differential, and facing temporary turmoil on financial markets. This is complemented by an assessment of liquidity challenges based on governments' gross financing needs. Finally, S1 highlights challenges from a different angle by measuring the consolidation effort that would be needed to reduce debt to 60% of GDP in 15 years' time.*

***This report includes methodological changes that streamline the analysis and make it more relevant for the post-COVID environment.** The main change is a simplified decision tree that remains anchored on the projected debt level but gives more prominence than previous reports to the debt trajectory and to the plausibility of fiscal assumptions, in line with best practices (see Box* I.2.2*). Moreover, the assessment of the plausibility of fiscal assumptions and the feasibility of potential corrective measures (as measured by the available 'fiscal consolidation space') is based on country-specific rather than EU-wide past observations, making it more relevant for individual countries. Finally, the DSA risk classification gives more weight to stochastic projections in stress-testing the baseline, to better reflect the macroeconomic uncertainty around the baseline. As for specific variables, Box* I.2.1 *presents inflation projections and Box* I.2.3 *envisages possible paths to project stock-flow adjustments.*

***In the EU as a whole, at unchanged fiscal policy, debt is projected to decline as a ratio to GDP until the mid-2020s, when the rising cost of ageing would reverse the trend**. The 'r-g' differential is assumed to remain negative. This will support the initial debt reduction and then dampen the increasing pressure from ageing costs on public finances. An alternative scenario shows that debt could fall back to its pre-crisis level by 2032 if the structural primary balance converged back to the slight surplus observed on average in the past 15 years. Conversely, a more limited fiscal adjustment, a less favourable 'r-g' differential or temporary financial stress would worsen the debt dynamics.*

***The stochastic projections point to significant uncertainty around the baseline.** With an 80% probability, debt will lie between 85% and 108% in the euro area as a whole by 2026, coming below the 2021 level with a 69% probability. In 2026, the debt ratio could stand above or below 96% with equal probability. High uncertainty in some countries reflects volatile macro-financial and fiscal conditions.*

***Overall, 11 countries are found to be at high medium-term fiscal sustainability risk, 8 at medium risk and 8 at low risk.** The high-risk classification is mainly driven by high and/or increasing debt ratios under the baseline (Belgium, Greece, Spain, France, Italy, Slovenia and Slovakia), along with elevated uncertainty surrounding the baseline projections, as highlighted by the stochastic analysis (Portugal) and vulnerability to more adverse macro-financial conditions (Croatia) or a weaker fiscal position (Malta). The S1 indicator largely confirms the DSA classification, with only one additional country (Romania) classified at high risk according to this indicator alone. Furthermore, projected financing needs suggest that countries with the highest debt ratios may also face higher liquidity challenges.*

Table I.2.1: **Overview of S1, DSA and overall medium-term risk classifications.**

Legend: HIGH / MEDIUM / LOW

	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
S1	HIGH	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW
DSA	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Medium-term risk	HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW

Source: European Commission.

This chapter assesses fiscal sustainability risks over the medium term, based on the Commission's rich analytical toolkit. Going first through the various elements of the debt sustainability analysis (DSA) toolkit, the chapter starts with a baseline for debt trajectories over the next 10 years, along with a set of additional deterministic debt projections underpinned by alternative assumptions (Section 2.1). To assess how a broad range of possible shocks could affect debt in the coming years, the DSA also crucially relies on stochastic debt projections, highlighting the uncertainty around the baseline (Section 2.2). Finally, the DSA is complemented by projections of governments' gross financing needs over the next decade, which provide information on potential liquidity risks (Section 2.3). The chapter then moves on to the S1 indicator, which measures the fiscal consolidation effort needed to bring debt to 60% of GDP over the medium term (Section 2.4). The chapter concludes with an overall assessment of medium-term fiscal risks based on both the DSA and the S1 indicator, and a comparison with the 2020 DSM (Section 2.5).

This chapter also includes three boxes highlighting specific issues. In particular, Box I.2.1 presents the new inflation projections based on market expectations. Box I.2.2 describes the streamlined decision trees guiding the DSA risk classification. Finally, Box I.2.3 discusses possible paths to review the assumptions underlying stock-flow adjustment projections for certain countries.

2.1. DETERMINISTIC GOVERNMENT DEBT PROJECTIONS

The first component of the DSA consists in a set of deterministic projections based on various scenarios. Each deterministic projection provides a single path for debt until 2032 under certain assumptions for budgetary, macroeconomic and financial variables. In addition to the baseline, four other scenarios are taken into account for the medium-term risk classification. These are the 'historical structural primary balance (SPB)', 'lower SPB', 'adverse interest-growth rate differential (r-g)' and 'financial stress' scenarios. They highlight the impact on debt of alternative assumptions for fiscal policy, real GDP growth and interest rates (Table I.2.2). Finally, an additional policy scenario – the 'updated stability and convergence programmes' (SCP) scenario – also informs the overall assessment, although only in a qualitative manner.

Table I.2.2: **Debt projections in the deterministic scenarios**

			Difference to the baseline in 2032 (pps. of GDP)				
			DSA scenarios				Compl. scenario
	Baseline 2021	Baseline 2032	'Historical SPB' scenario	'Lower SPB' scenario	'Adverse r-g' scenario	'Financial stress' scenario	'Updated SCP' scenario
BE	112.7	133.6	-23.8	7.7	9.4	2.0	-3.7
BG	26.7	36.4	-12.7	2.7	2.2	0.3	-9.0
CZ	42.4	67.1	-14.9	9.5	4.5	0.5	-6.4
DK	41.0	15.6	0.8	18.6	1.9	0.3	-13.6
DE	71.4	61.6	-12.1	18.0	5.1	0.6	-9.3
EE	18.4	25.7	-8.7	8.0	1.5	0.1	-5.6
IE	55.6	45.7	7.2	14.1	3.2	0.2	8.3
EL	202.9	154.7	-11.8	29.2	10.9	4.3	0.2
ES	120.6	126.1	-9.4	0.5	10.0	2.8	-7.9
FR	114.6	122.3	-8.0	11.8	9.1	2.2	4.6
HR	82.3	76.7	-1.0	1.8	5.8	0.5	8.4
IT	154.4	161.6	-24.4	11.5	13.2	6.3	-1.8
CY	104.1	77.8	-10.0	12.5	5.7	0.3	-10.2
LV	48.2	48.8	-0.7	28.6	3.8	0.6	-0.2
LT	45.3	39.4	5.8	13.4	2.9	0.3	-9.9
LU	25.9	18.2	-7.1	0.2	1.4	0.1	-3.5
HU	79.2	68.1	-7.5	13.9	5.6	0.6	-3.3
MT	61.4	73.2	-21.6	21.3	5.2	0.7	-2.2
NL	57.5	62.8	-8.1	12.4	4.7	0.6	6.0
AT	82.9	76.3	-7.4	10.3	5.5	0.6	-5.9
PL	54.7	48.3	2.9	1.7	3.4	0.3	6.6
PT	128.1	126.2	-5.3	1.5	10.0	2.3	-3.6
RO	49.3	76.9	-10.5	6.2	5.1	0.4	-18.4
SI	77.7	95.2	-17.8	8.5	6.4	0.5	-13.8
SK	61.8	72.2	-2.7	12.3	4.2	0.4	-11.7
FI	71.2	63.9	-9.4	6.3	4.3	0.4	1.1
SE	37.3	11.2	0.3	5.0	1.2	0.1	17.1
EU	92.1	89.2	-10.0	11.4	6.9	1.8	-2.2
EA	100.0	99.0	-11.6	12.3	7.7	2.2	-2.8

Source: European Commission.

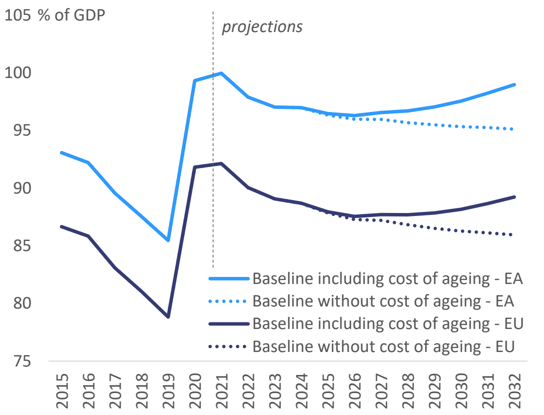
The deterministic projections feed into the medium-term risk classification using the debt level in 2032, the debt trajectory and the available 'fiscal consolidation space'. While a high level of debt is an obvious source of vulnerability, it is only a crude indicator of sustainability. That is why, compared to previous reports, the risk classification in this report gives increased weight to two criteria in addition to the debt level. The first one is the path followed by debt over the coming decade. The second one is the 'fiscal consolidation space'. This space is measured by how often more stringent fiscal positions than assumed in a given scenario were observed in the past in the country under consideration. This gives an indication of whether the country has plausible fiscal room for manoeuvre to take corrective measures if necessary. Therefore a high debt level or an increasing debt path in the baseline do not necessarily imply high sustainability risks, as long as the government has available 'consolidation space' to rein in debt ([48]). The decision tree applied along these three criteria is described more closely in Box I.2.2 and Annex A1.

This section focuses on the economic reading and main results of each scenario. It explains why the selected scenarios – some of which are new – are relevant in the current context, and it discusses the results both for the aggregate level and across countries. Box 1 in the introduction of this volume includes further technical information on the underlying assumptions, and detailed projection tables can be found in Annex A7.

2.1.1. Baseline: no fiscal policy change

The baseline for the medium-term debt projections assumes that structural primary budgetary positions remain at their 2023 level until 2032, except for the impact of ageing-related costs. The 2023 level is the one expected in the Commission 2021 autumn forecast (for the EU as a whole, a SPB of -1.4% of GDP), which includes the impact until 2023 of policy measures adopted by end October 2021 ([49]). As from 2024, the projections do not incorporate any new measures, and the SPB is only affected by changes in the cost of ageing as projected in the 2021 Ageing Report ([50]) (the EU's overall SPB would gradually decline to -2.1% by 2032). Therefore, the baseline does not necessarily present what is most likely to happen, but rather highlights what would happen in the absence of new measures, as a benchmark.

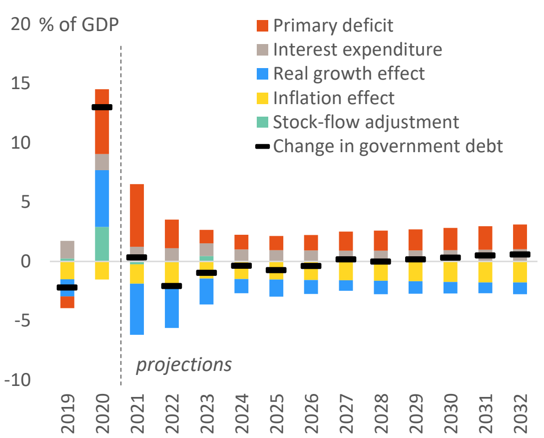
Graph I.2.1: **Gross government debt baseline projections, EU and euro area**



Source: European Commission.

The baseline points to an initial decline of the EU debt ratio from its 2021 peak, until the rising cost of ageing reverses the trend as from the mid-2020s. The projected debt for the euro area as a whole follows a parallel path (Graph I.2.1). The impact of the cost of ageing in the EU is visible in the worsening primary deficit (Graph I.2.2). At the same time, the still favourable snowball effect – reflecting the difference between interest payments and nominal GDP growth – would dampen the increase in debt throughout the projection horizon ([51]).

Graph I.2.2: **Drivers of the change in debt under the baseline, EU**



Source: European Commission.

The projected debt paths of individual Member States show contrasted situations. In a majority

([48]) This is in line with the definition of debt sustainability used by the IMF, the ECB and the Commission. Debt is deemed unsustainable only in cases when there is *no politically and economically feasible fiscal path that can at least stabilise debt over the medium term* (under the baseline and realistic shock scenarios), keeping rollover risk at an acceptably low level while preserving potential growth.

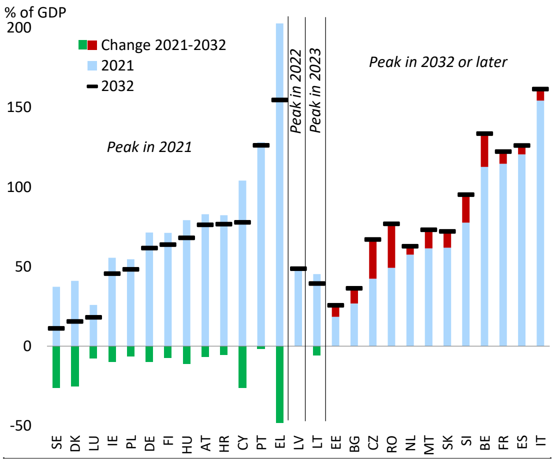
([49]) The projections include in particular the sizeable favourable impact on growth of Next Generation EU over the period it covers, i.e. until 2026. More specifically, it includes the impact of the investments under the Recovery and Resilience Facility (RRF), but not the likely positive impact of structural reforms under the RRF, as it is more difficult to quantify at this stage.

([50]) See https://ec.europa.eu/info/sites/default/files/economy-finance/ip148_en.pdf.

([51]) For further details on the breakdown of the change in debt, see the statistical annex, Tables A7.8 and A7.9.

of countries, the debt ratio projected for 2032 remains below the level of 2021 (Graph I.2.3). In most of these countries, debt started declining after the peak of 2021 (or is expected to do so one or two years later, in the case of Latvia and Lithuania) and is projected to either broadly stabilise after a few years or keep declining over the medium term. In Croatia and Portugal, however, debt would increase again in the last years of the projection period. By contrast, debt is projected to increase throughout the period in the remaining 12 Member States.

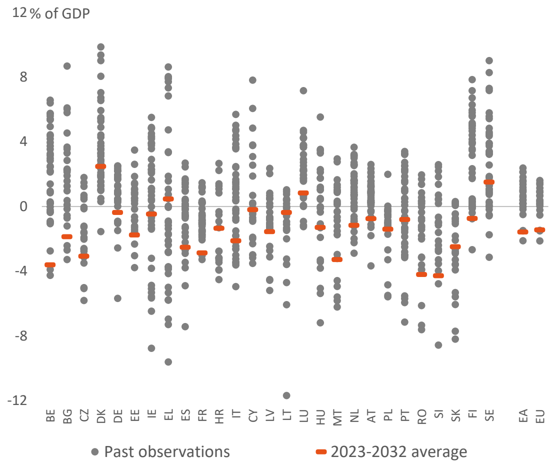
Graph I.2.3: **Gross government debt projections for EU Member States under the baseline, 2021-2032**



Source: European Commission.

The debt paths envisaged in the baseline rely on low SPB levels by historical standards, suggesting sizeable fiscal consolidation space in most countries. This can be seen by plotting the projected SPB level (before cost of ageing) against country-specific SPB values observed in the last decades (Graph I.2.4). As most countries have often recorded higher SPBs than the level assumed in the baseline, they can plausibly aim to move again towards such higher levels in the coming decade, improving sustainability compared to the baseline.

Graph I.2.4: **Structural primary balance projected under the baseline and past observations**



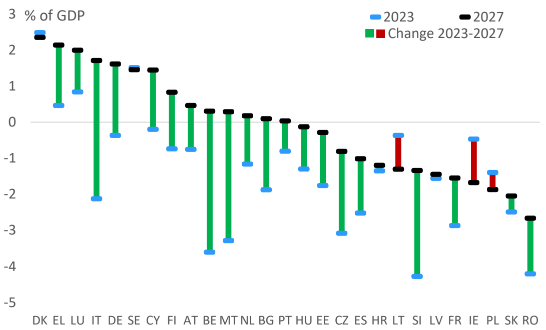
Notes: (1) The 2023-2032 average is the value in the baseline before cost of ageing. (2) Past observations start at the earliest in 1980, depending on the country, and end in 2020.
Source: European Commission.

2.1.2. Policy scenario: historical structural primary balance

The first alternative scenario assumes a change in fiscal policy over the medium term – namely that the SPB will gradually converge to its average past value. This scenario illustrates the prospect of countries reverting to past fiscal behaviour instead of keeping the SPB at its 2023 level. More specifically, by 2027, each country's SPB would reach the average value observed in the country over the past 15 years, i.e. in 2006-2020 (Graph I.2.5). For most Member States, this implies a tightening compared to the level forecast for 2023, although by 2027 there would still be a structural primary deficit, in some cases large, in nearly half of the Member States.

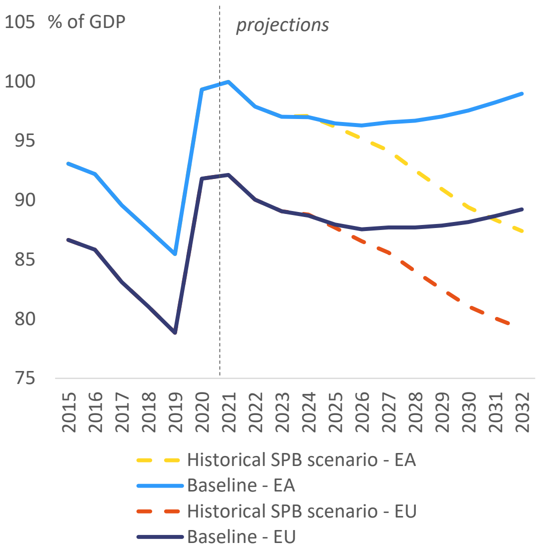
Reverting to past structural positions would put EU debt on a firm downward path. For the EU as a whole, this would mean that the SPB would improve from a deficit of 1.4% in 2023 to a surplus of 0.3% of GDP by 2027. With support from the favourable snowball effect, this would be sufficient to bring debt back to its pre-crisis level by 2032 (Graph I.2.6). The same would happen in the euro area if the structural primary deficit of 1.6% in 2023 gradually improved to a surplus of 0.3% of GDP.

Graph I.2.5: **'Historical SPB' scenario: structural primary balance in 2023 and 2027**



Note: The 'historical SPB' scenario assumes that the SPB gradually converges, from 2024 to 2027, to the SPB observed on average in the country in 2006-2020.
Source: European Commission.

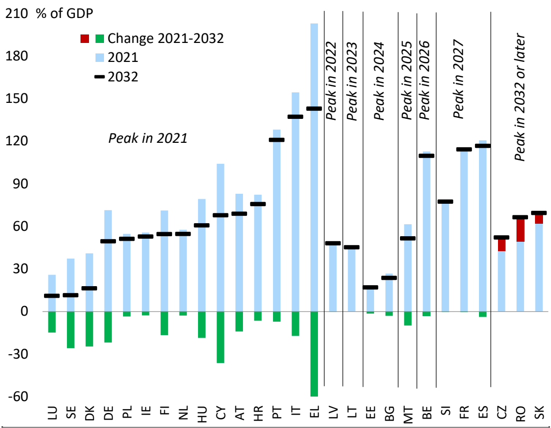
Graph I.2.6: **Debt projections: 'historical SPB' scenario vs. baseline, EU and euro area**



Note: The 'historical SPB' scenario assumes that the SPB gradually converges, from 2024 to 2027, to the SPB observed on average in 2006-2020.
Source: European Commission.

At the country level, the 'historical SPB' scenario generally leads to lower debt levels by 2032 compared to the baseline. In the 3 countries where this scenario implies a loosening compared to the baseline (Ireland, Lithuania and Poland), debt would still remain at a low level by 2032. In the other countries, debt would decline more and/or peak earlier, or at least not increase as much as in the baseline. This is particularly the case for Belgium, Spain, France and Italy.

Graph I.2.7: **Gross government debt projections under the 'historical SPB' scenario**



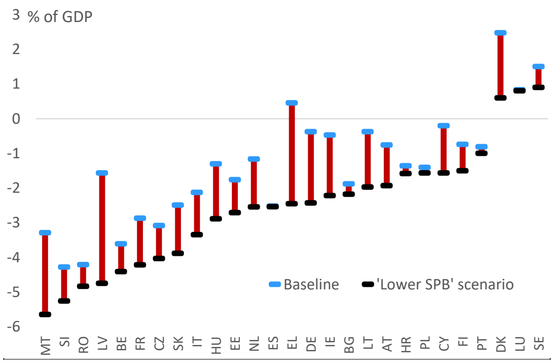
Source: European Commission.

2.1.3. Policy scenario: lower structural primary balance

The 'lower SPB' scenario assumes less fiscal consolidation (or more deterioration) than in the baseline. As in the baseline, this scenario keeps the SPB unchanged as from 2023, but at a lower level than in the baseline (Graph I.2.8). For the countries in which the Commission 2021 autumn forecast expects the SPB to tighten overall in 2022 and 2023, this scenario assumes that only half of the adjustment is delivered – and for the countries where the SPB is expected to deteriorate overall over these two years, the scenario assumes a 50% larger fall. This would be the case, for instance, if some governments decided to keep support measures in place for longer than expected.

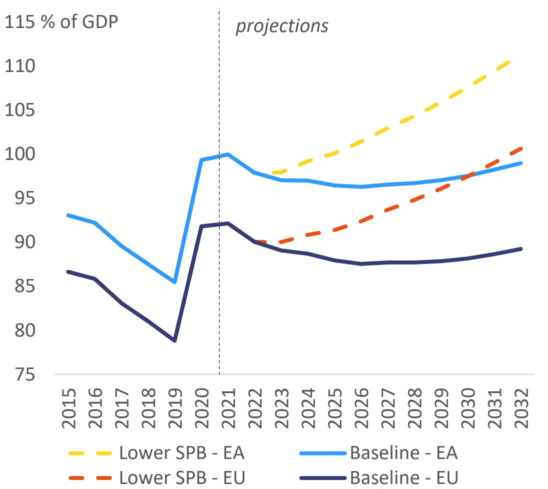
A smaller consolidation by 2023 than expected in the Commission 2021 autumn forecast, followed by no consolidation, would imply a steady increase in EU debt over the medium term. The same holds for the euro area (Graph I.2.9). In both cases, debt would be about 10 pps. of GDP higher than in the baseline by 2032, reaching around 100% of GDP in the EU as a whole.

Graph I.2.8: **Structural primary balance in 2023-2032 in the baseline and the 'lower SPB' scenario**



Note: The 'lower SPB' scenario assumes a smaller consolidation (or a larger deterioration) in the SPB in 2022 and 2023 than in the Commission 2021 autumn forecast. The SPB then remains constant as from 2023, except for the impact of the cost of ageing.
Source: European Commission.

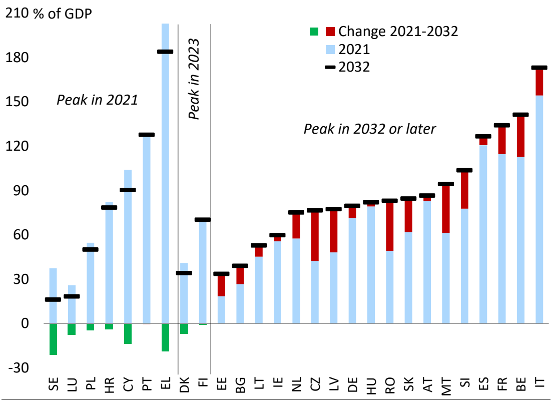
Graph I.2.9: **Debt projections: 'lower SPB' scenario vs. baseline, EU and euro area**



Note: The 'lower SPB' scenario assumes that the change in the SPB in 2022 and 2023 is half the change included in the Commission 2021 autumn forecast. The SPB then remains constant as from 2023, except for the impact of the cost of ageing.
Source: European Commission.

Under this scenario, debt would not peak by 2032 but exceed its 2021 level in a majority of Member States. The largest debt increases from 2021 to 2032 would be recorded in Czechia, Latvia, Malta and Romania. Among the countries with highest debt levels, the debt increase would be sizeably larger than in the baseline for Belgium, France and Italy.

Graph I.2.10: **Gross government debt projections under the 'lower SPB' scenario**



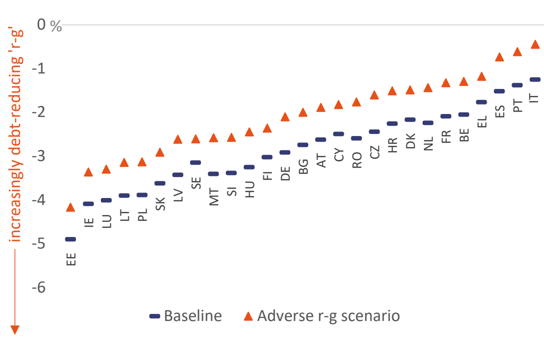
Source: European Commission.

2.1.4. Stress test: adverse 'r-g' differential

This new scenario captures risks related to a reversal or a reduction of the currently favourable interest-growth rate differential. It is motivated by the fact that, in most countries, the 'r-g' differential assumed in the baseline – extending the current environment of very low and often negative differentials – is lower than historical averages. Stress-testing this differential is therefore important to assess the consequences for debt sustainability risks of a possible structural correction of 'r-g'. To do so, the difference between *market* interest rates and nominal GDP growth is permanently increased by 1 pp. compared to the baseline. Depending on the debt structure, this shock gradually translates into a higher 'r-g' differential where r is the *implicit* interest rate (Graph I.2.11). This diminishes the debt-reducing impact of the snowball effect, resulting in an even higher debt increase in the last years of the projection horizon in Italy and Romania.

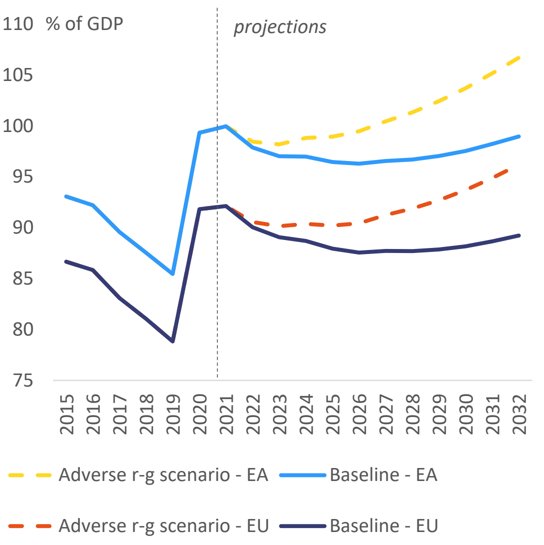
Both on aggregate and in individual countries, this scenario has adverse implications for debt developments. Debt would not decline in the first years of the projection period, unlike in the baseline, and it would grow faster in the outer years (Graph I.2.12). At the country level, debt would exceed its 2021 level by 2032 in more countries than in the baseline (Graph I.2.13).

Graph I.2.11: **Interest-growth rate differential in the baseline and the 'adverse r-g' scenario, 2022-2032 averages**



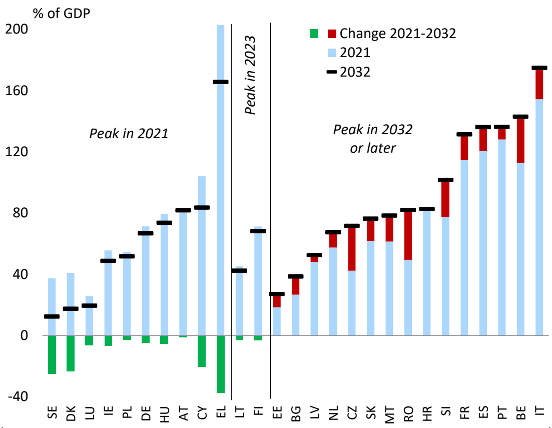
Note: The 'adverse r-g' scenario assumes that the differential between the market interest rate and nominal GDP growth is permanently 1 pp. higher than in the baseline from 2022 to 2032. This graph shows the impact on the differential between the implicit interest rate and nominal GDP growth, taking into account the debt structure.
Source: European Commission.

Graph I.2.12: **Debt projections: 'adverse r-g' scenario vs. baseline, EU and euro area**



Note: The 'adverse r-g' scenario assumes that the interest-growth rate differential is permanently 1 pp. higher than in the baseline from 2022 to 2032.
Source: European Commission.

Graph I.2.13: **Gross government debt projections under the 'adverse r-g' scenario**



Source: European Commission.

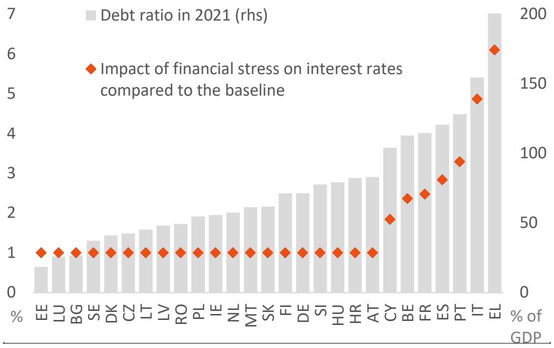
2.1.5. Stress test: financial stress

This new scenario aims to capture risks linked to stylised temporary turmoil on financial markets. It replaces the 'interest rate' shock scenario of the 2018 FSR, in which interest rates were uniformly and permanently higher than in the baseline throughout the projection horizon. Under the new scenario, the shock on market interest rates would last only one year, in 2022. Furthermore, the scenario assumes that financial turmoil hits high-debt countries harder: while a flat 1 pp. interest rate hike applies to all countries, it is augmented by a 'risk premium' for highly indebted countries ([52]) (Graph I.2.14).

Despite its temporary nature, the shock on interest rates has a persistent (although limited) adverse impact on debt dynamics. As can be seen for the EU and euro area as a whole, the debt path would be only slightly above the baseline, by less than 2% of GDP by 2026 (Graph I.2.15). The initial impact on debt would be limited, as the higher interest rates would only affect newly issued debt. The gap would however be persistent and increase over time, as the shock would keep affecting the service of debt newly issued in 2022 and make higher interest payments generate in turn new debt each year, compared to the baseline.

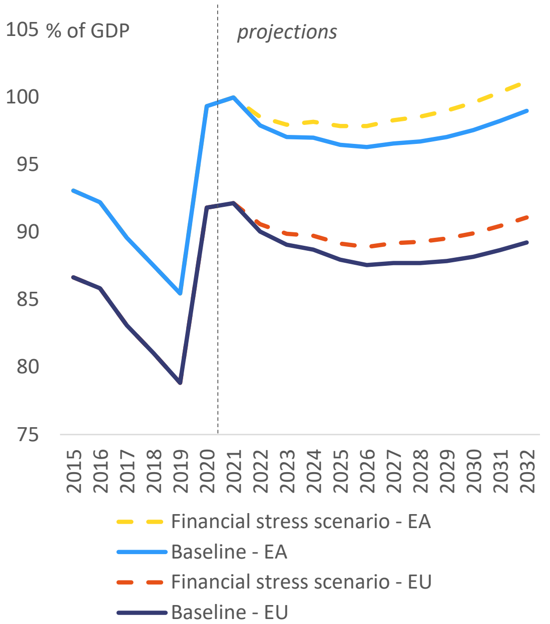
([52]) The risk premium is equal to 0.06 times the excess of debt over 90% of GDP based on Pamies et al. (2021) – see Box 1 in the introduction for more details. The level of long-term interest rates is capped at 7%.

Graph I.2.14: **Impact of the 'financial stress' scenario on interest rates in 2022**



Note: The 'financial stress' scenario assumes that the interest rate is temporarily raised by 1 pp., plus a risk premium in countries where debt exceeded 90% of GDP in 2021 (90% being the upper debt threshold used to identify high risk in the DSA classification). The risk premium is equal to 0.06 times the excess of debt over 90% of GDP.
Source: European Commission.

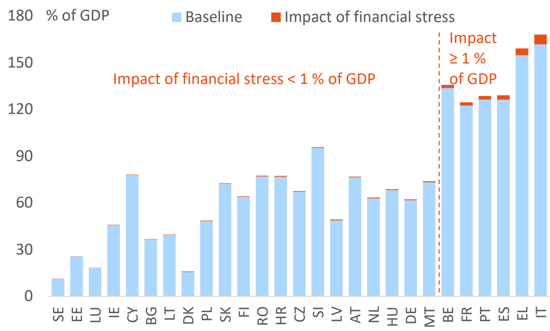
Graph I.2.15: **Debt projections: 'financial stress' scenario vs. baseline, EU and euro area**



Note: The 'financial stress' scenario assumes that the interest rate is temporarily raised by 1 pp., plus a risk premium in countries where debt exceeded 90% of GDP in 2021 (90% being the upper debt threshold used to identify high risk in the DSA classification).
Source: European Commission.

The impact of the simulated financial stress is concentrated in high-debt Member States. The 'financial stress' scenario increases debt by more than 1% of GDP by 2032 in only 6 countries, namely those with the highest projected debt ratios for 2032 in the baseline – Belgium, Greece, Spain, France, Italy and Portugal (Graph I.2.16). This is because higher interest rates affect interest payments more strongly if they apply to a high debt, and this effect is exacerbated by the assumption that high-debt countries get larger shocks on interest rates. To a lesser extent, the sensitivity of individual countries to the interest shock also depends on the maturity of their debt, because a relatively short maturity implies that the higher market rate is rapidly transmitted to the implicit interest rate.

Graph I.2.16: **Gross government debt projections for 2032, 'financial stress' scenario vs. baseline**



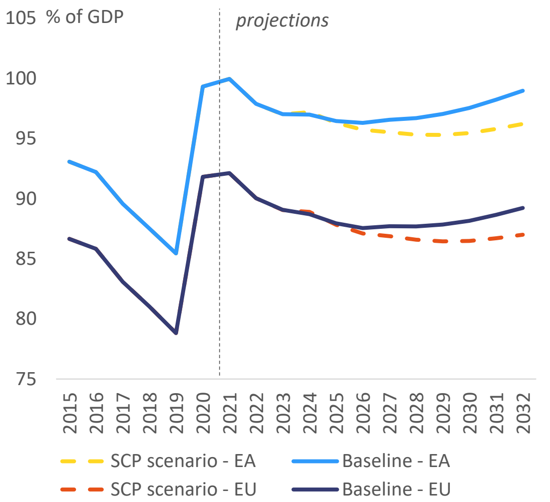
Note: Countries are ranked by increasing impact of financial stress.
Source: European Commission.

2.1.6. Additional scenarios

Two more scenarios provide additional information that qualifies sustainability risks, although without affecting the risk classification. The first one is a policy scenario: the 'updated SCP' scenario, as described below. The other one is a stress test, namely the 'exchange rate' scenario, which is mostly relevant for non-euro area countries and is therefore not discussed in detail in this chapter. Its assumptions are described in Box 1 in the introduction of this volume, and its outcome can be found in Volume 2 of this report.

The 'updated SCP' scenario assumes that governments fully implement their medium-term budgetary plans. The Commission 2021 autumn forecast – which underpins the first years of the baseline – incorporates government plans, but only to the extent that they have already translated into adopted measures. This usually implies more limited developments than those presented by governments in their SCPs. To assess the full impact of government plans, this scenario uses only the year 2022 of the Commission forecast as a basis and modifies the fiscal policy assumptions as from 2023. For 2023 and 2024, it assumes that governments implement their fiscal plans fully in line with their 2021 SCPs or more recent medium-term plans, if available. The SPB is then assumed to remain unchanged at its 2024 level, except for the impact of the cost of ageing.

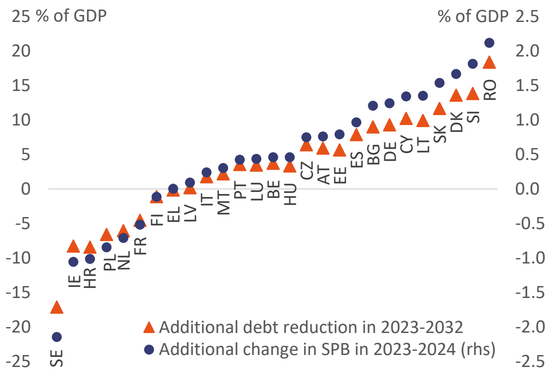
Graph I.2.17: **Debt projections: 'updated SCP' scenario vs. baseline, EU and euro area**



Note: The 'updated SCP' scenario assumes that Member States implement in 2023 and 2024 the budgetary measures described in their 2021 stability and convergence programmes or in more recent medium-term plans, if available, and that as from 2025 the SPB is only affected by the cost of ageing.
Source: European Commission.

Fully implementing governments' own medium-term budgetary plans would slightly curb debt paths compared to the baseline. For most cases, SCPs imply smaller structural primary deficits (or larger surpluses) than in the baseline and therefore lower debt levels by 2032 (Graph I.2.18). As a result, at the aggregate level, debt would keep declining over a few more years than in the baseline and pick up again only at the end of the projection period (Graph I.2.17).

Graph I.2.18: **Structural adjustment and debt projections, 'updated SCP' scenario vs. baseline**



Note: The blue dots show by how much SPBs would improve compared to the baseline if governments fully implemented their medium-term budgetary plans in 2023 and 2024. The red triangles show the impact in terms of additional debt reduction compared to the baseline up to 2032.
Source: European Commission.

2.2. STOCHASTIC GOVERNMENT DEBT PROJECTIONS

Stochastic debt projections account for wide-ranging uncertainty around the baseline. Unlike deterministic projections, the outcome of stochastic projections is not a single debt path under a specific scenario, but a distribution of debt paths resulting from a wide set of shocks. These projections aim to show the impact on debt dynamics of numerous possible shocks affecting governments' budgetary positions, economic growth, interest rates and exchange rates compared to the baseline ([53]). The shocks, applied in up to 2000 different simulations, are calibrated to capture country-specific conditions, namely the volatility observed over the past and the correlation between the different variables.

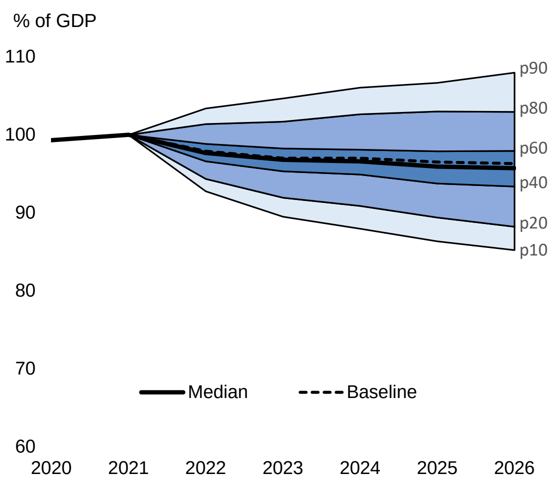
The results of stochastic projections are shown in a fan chart around the baseline. The cone covers 80% of all simulated debt paths over a 5-year horizon, with the lower and upper limits representing respectively the 10th and 90th percentiles of the distribution. This means that, if future shocks follow the same pattern as in the past, there is an 80% probability that debt will actually lie within that cone in the next 5 years. The chart excludes the debt paths derived from the

([53]) The methodology for stochastic debt projections is presented in Annex A7 of the 2020 DSM, and in Berti (2013).

20% most extreme shocks, or 'tail events'. The different shades within the cone represent different portions of the overall distribution of debt paths.

The stochastic projections point to significant uncertainty over the debt trajectory in the euro area. For 2026, they suggest that, with an 80% probability, the euro area debt ratio will lie between 85% and 108% of GDP, a range of 23 pps. (Graph I.2.19). The median debt ratio for 2026 is estimated at 96% of GDP, i.e. there is an equal probability that debt will be higher or lower than that level. Moreover, while the baseline points to a decline in the debt ratio over the next 5 years, the stochastic projections suggest with a 31% probability that debt might actually be higher in 2026 than it was in 2021.

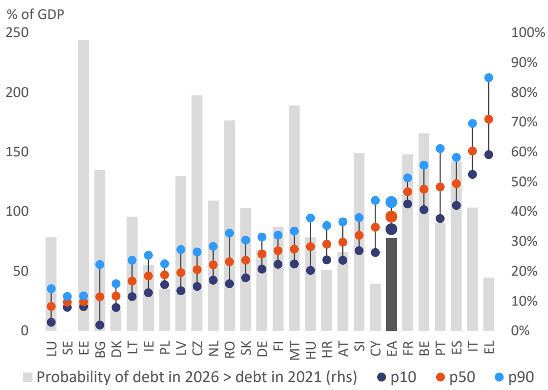
Graph I.2.19: **Stochastic debt projections, euro area, 2021-2026**



Source: European Commission.

The degree of uncertainty varies greatly across countries. The results for individual countries are summarised in Graph I.2.20. On the one hand, they indicate very low uncertainty for Estonia and Sweden, where the debt ratio is likely to lie within a narrow range of about 20% to 30% of GDP in 2026 – although with opposite dynamics. Indeed, debt in Estonia is projected to increase (hence the very high probability of debt in 2026 exceeding the 2021 level) while debt in Sweden is projected to fall (and accordingly, the probability of a higher debt in 2026 than in 2021 is very low). At the other end of the spectrum, uncertainty appears to be particularly elevated for Bulgaria, Greece and Portugal: in Bulgaria, for instance, debt could lie anywhere between 5% and 55% of GDP by 2026 and there is a broadly equal chance that it will increase or decrease from its current level. Such uncertainty around the baseline reflects a high volatility of macro-financial and fiscal conditions.

Graph I.2.20: **Stochastic debt projections for EU Member States**



Notes: How to read this graph: for each country, there is an 80% probability that debt in 2026 will lie between the dark blue dot (the 10th percentile of the debt distribution) and the pale blue dot (the 90th percentile). The more these two points are distant, the higher the uncertainty. The median debt level in 2026 is indicated by the red dot. The grey bars indicate the probability with which debt will be higher in 2026 than it was in 2021.
Source: European Commission.

2.3. MEDIUM-TERM GOVERNMENT GROSS FINANCING NEEDS

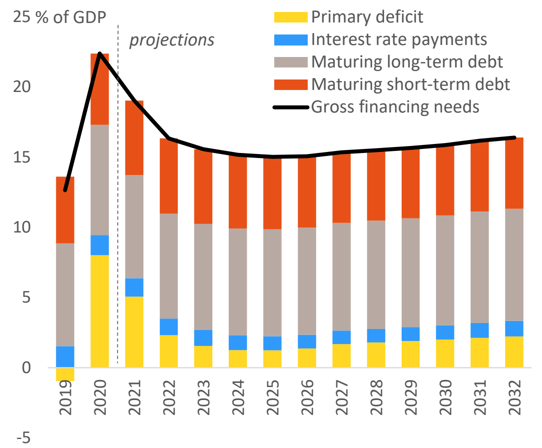
Projected gross financing needs (GFN) over the medium term serve as a measure of governments' upcoming liquidity challenges. While debt is a stock, GFN are a flow metric that provides complementary information. The projected trajectory of GFN indicates to what extent governments may need to use financial markets over the coming years to finance deficits, repay or roll over maturing debt and service their debt ([54]). Elevated GFN projections therefore suggest a higher vulnerability with regard to liquidity risks.

GFN in the EU are projected to remain above pre-crisis level and rise mildly in the coming decade. Once the impact of the COVID-19 crisis has abated, GFN should average 16% of GDP,

([54]) For a more elaborate description of GFN and their use for the assessment of short-term sustainability risks, see Chapter 1.

3 pps. above their 2019 level. The slowly upward trajectory projected for the next 10 years is driven by two trends: a rebound in primary deficits, reflecting mainly higher ageing-related expenditure, and the need to amortise a slightly larger amount of long-term debt. On the other hand, interest payments are projected to remain very low (at around 1% of GDP, less than half what they amounted to in the 2010s) and maturing short-term debt should keep ebbing to 5% of GDP, reflecting the recent lengthening of debt maturities.

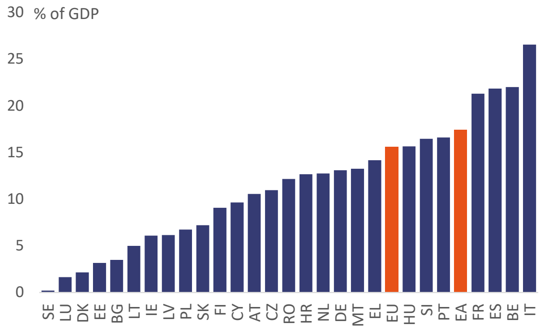
Graph I.2.21: **General government gross financing needs and their drivers, baseline, EU**



Source: European Commission.

The GFN projections indicate larger liquidity challenges in high-debt Member States than the euro area average. In 4 euro area countries – Belgium, Spain, France and Italy – GFN are projected to exceed 20% of GDP on average between 2023 and 2032 under the baseline, above the euro area average of about 17% of GDP (Graph I.2.22). As these countries are also projected to have high and increasing debt ratios, their potential vulnerability to liquidity risks adds to sustainability challenges. By contrast, for the 6 Member States with the lowest projected debt levels for 2032 under the baseline (Bulgaria, Denmark, Estonia, Lithuania, Luxembourg and Sweden), GFN would be limited to less than 5% of GDP.

Graph I.2.22: **General government gross financing needs under the baseline, 2023-2032 average**



Source: European Commission.

2.4. THE S1 INDICATOR

S1 provides additional information on medium-term fiscal challenges by measuring the consolidation effort that would be needed to reduce debt to 60% of GDP in 15 years' time. This effort, as measured by the additional improvement in the SPB compared to the baseline, is assumed to be concentrated over the 5 years that follow the forecasting period, i.e. from 2024 to 2028. Afterwards, the SPB would remain unchanged, except for the cost of ageing. The aim is to reach a 60% debt ratio in 2038. Consistently with the S2 indicator, S1 is calculated on the basis of both the baseline and alternative scenarios.

The risk classification based on S1 depends on the amount of consolidation required. A country with a high debt level, a weak initial SPB and/or a strong projected increase in the cost of ageing will need to make a demanding cumulative effort of more than 2.5 pps. of GDP, which classifies it at high risk. Conversely, if debt is projected to stand below 60% of GDP without requiring any further consolidation effort, S1 has a negative value and the country is deemed at low risk. Intermediate values of S1 of 0 to 2.5 pps. of GDP signal a medium risk.

2.4.1. Baseline results

According to the S1 indicator, 9 Member States face high fiscal risks in the long term, 9 face medium risks and 9 low risks. The high-risk countries are Italy, Belgium, Portugal, Greece, France, Spain, Slovenia, Romania and Slovakia, which would need to improve their SPB by more

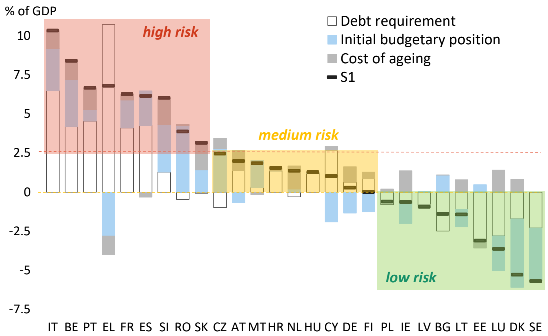
Table I.2.3: **S1: breakdown (% of GDP)**

S1		Initial budgetary position		Debt requirement	Cost of ageing	of which			
		Gap to debt-stabilising SPB	*Cost of delaying adjustment*			*Pensions**	*Healthcare*	*Long-term care*	*Education*
BE	8.4	2.0	1.0	4.2	1.2	0.9	0.2	0.3	-0.2
BG	-1.4	1.3	-0.2	-2.5	0.0	-0.2	0.1	0.0	0.1
CZ	2.5	2.5	0.3	-1.0	0.7	-0.1	0.3	0.3	0.2
DK	-5.3	-3.8	-0.6	-1.7	0.8	-0.3	0.2	1.0	-0.1
DE	0.3	-1.4	0.0	0.6	1.0	0.5	0.1	0.1	0.2
EE	-3.1	0.8	-0.3	-3.2	-0.4	-0.6	0.2	0.1	-0.1
IE	-0.6	-1.2	-0.1	-0.7	1.4	0.9	0.3	0.3	-0.1
EL	6.8	-3.6	0.8	10.7	-1.2	-1.0	0.2	0.0	-0.3
ES	6.2	1.5	0.8	4.3	-0.3	-0.5	0.4	0.1	-0.3
FR	6.3	1.0	0.7	4.1	0.4	0.2	0.2	0.2	-0.2
HR	1.6	-0.2	0.2	1.4	0.2	0.1	0.2	0.0	-0.1
IT	10.3	1.4	1.3	6.5	1.1	0.9	0.3	0.2	-0.2
CY	1.0	-2.0	0.1	2.7	0.3	0.4	0.1	0.1	-0.2
LV	-0.9	0.1	-0.1	-0.8	-0.2	-0.5	0.2	0.1	0.1
LT	-1.4	-1.0	-0.2	-1.1	0.8	0.4	0.2	0.2	0.1
LU	-3.6	-1.8	-0.4	-2.8	1.4	1.4	0.2	0.1	-0.3
HU	1.3	-0.1	0.1	1.2	0.0	-0.1	0.2	0.1	-0.2
MT	1.8	1.5	0.2	0.3	-0.2	-0.7	0.5	0.3	-0.3
NL	1.4	0.0	0.2	-0.3	1.5	0.6	0.3	0.8	-0.1
AT	2.0	-0.9	0.2	1.4	1.3	0.7	0.3	0.3	-0.1
PL	-0.6	0.1	-0.1	-0.8	0.2	-0.6	0.4	0.3	0.0
PT	6.7	-0.1	0.8	4.5	1.4	0.9	0.5	0.1	-0.1
RO	3.9	3.8	0.5	-0.5	0.1	-0.2	0.3	0.1	0.0
SI	6.0	2.4	0.7	1.3	1.7	1.1	0.4	0.2	0.0
SK	3.2	1.1	0.4	-0.1	1.8	0.8	0.5	0.3	0.2
FI	0.0	-1.3	0.0	0.9	0.4	-0.1	0.3	0.6	-0.4
SE	-5.7	-2.7	-0.6	-2.3	0.0	-0.4	0.2	0.4	-0.3
EU	3.1	0.0	0.4	2.0	0.7	0.3	0.3	0.2	-0.1
EA	4.1	0.1	0.5	2.7	0.8	0.4	0.2	0.2	-0.1

* Net of taxes on pensions and compulsory social security contributions paid by pensioners.
Source: European Commission.

than 2.5 pps. of GDP overall, compared to the baseline, to reach the 60% debt target in 2038 (Graph I.2.23). The medium-risk countries, which could reduce their debt to 60% of GDP with a smaller effort, are Czechia, Austria, Malta, Croatia, the Netherlands, Hungary, Cyprus, Germany and Finland. Finally, the low-risk countries, which have room to let their structural primary position deteriorate compared to the baseline without breaching the 60% of GDP debt threshold, are Poland, Ireland, Latvia, Bulgaria, Lithuania, Estonia, Luxembourg, Denmark and Sweden.

Graph I.2.23: **S1: baseline results**



Source: European Commission.

S1 depends on the initial budgetary position, the debt level and the projected increase in ageing costs. The contributions of these three drivers are reported in Table I.2.3. First, *the 'initial budgetary position' component* measures the effort due to the level of the SPB forecast for 2023 and has two subcomponents. One is the gap between the SPB in 2023 and the SPB that would stabilise debt. The other subcomponent, named 'cost of delaying adjustment', reflects the fact that the assumed adjustment of the SPB takes place over 5 years rather than immediately, implying that debt may keep increasing in the meantime. Second, *the 'debt requirement' component* measures the additional adjustment that is needed to reach the 60% of GDP debt target: the larger the excess of debt over 60% of GDP, the higher the 'debt requirement' component. Finally, *the 'cost of ageing' component* accounts for the need to absorb the projected change in ageing-related public expenditure.

For the EU and the euro area as a whole, S1 signals a need for a significant consolidation

effort to reduce the debt ratio to 60%, mainly because of the initial debt level. The aggregate SPB in the EU would need to improve by a total of 3.1 pps. of GDP in 5 years compared to the baseline, of which 2.0 pps. would stem from the high debt level, 0.7 pp. from the projected increase in the cost of ageing (nearly equally driven by pensions, healthcare and long-term care) and 0.4 pp. from spreading the adjustment over several years. For the euro area as a whole, S1 indicates a higher gap of 4.1 pps. of GDP mainly due to the larger ‘debt requirement’ component (2.7 pps.).

The main lessons from the breakdown of S1 for medium-term fiscal challenges are as follows.

– *For the countries with the six highest values of S1, the main driver is the high debt level*. In Belgium, Greece, Spain, France, Italy and Portugal, the debt ratio exceeds 100% of GDP and the ‘debt requirement’ component represents at least one half of S1.

– *In 10 of the 12 countries with the highest values of S1, S1 is at least partially driven by the need to bridge the gap between initial budgetary positions that cause debt to increase and debt-stabilising SPBs.* The reduced initial positions in the wake of the COVID-19 crisis, remaining below historical standards by 2023, play a particularly large role in Belgium, Czechia, Spain, Italy, Malta, Romania and Slovenia, and to a lesser extent in Portugal, France and Slovakia.

– *Ageing costs are projected to weigh on public debt in 19 Member States.* This affects countries at all levels of sustainability risks. Over the medium term, ageing costs are projected to decline and alleviate consolidation needs (if any) in only 5 countries: Estonia, Greece, Spain, Latvia and Malta.

– *Negative values of S1 are mainly explained by low debt levels and favourable initial budgetary positions.* This is the case for most of the 9 countries for which S1 signals a low risk.

2.4.2. Level and plausibility of the SPB implied by S1

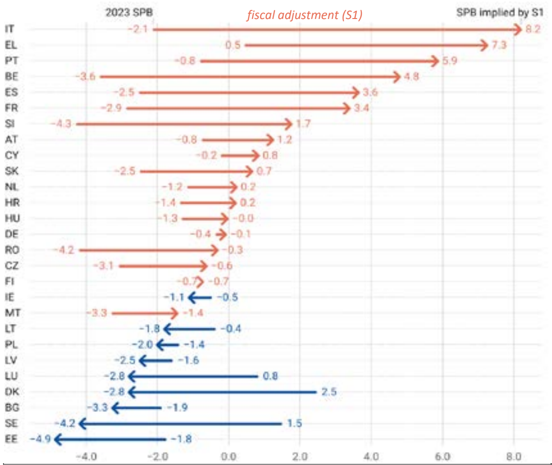
Adjusting SPBs by the amount implied by S1 would bring them to levels ranging from -5% of GDP to over 8% of GDP across Member States. For each country, this implied level of the SPB is the sum of the SPB in 2023 and the value of S1. In about half of the Member States, this would lead to a structural primary surplus, which would reach levels of more than 3% of GDP in 6 countries (Italy, Greece, Portugal, Belgium, Spain and France, see Graph I.2.24). At the other end of the spectrum, the low-risk countries could let their SPB deteriorate into (larger) deficits, in some cases very large, as in Estonia and Sweden (over 4% of GDP), given their (very) low forecast debt levels.

The SPBs implied by S1 can be compared with fiscal positions observed in the past. Technically, this consists in calculating the percentile rank of the required SPB within the distribution observed in the country since 1980 ([55]). This allows assessing how realistic the required fiscal position is, relative to the country’s past performance.

The adjustment required by S1 appears very demanding in some countries, especially those for which it implies a structural primary surplus of at least 1% of GDP. Graph I.2.25 orders the required SPBs according to their percentile ranks. Achieving – and sustaining – the required SPB appears unrealistic in Spain, France, Italy, Portugal and Slovakia, where no structural primary surplus ever reached the level currently required by S1 in the last four decades. In Slovenia, Greece, Austria, Belgium and Croatia, the SPB currently implied by S1 was achieved less than 25% of the time.

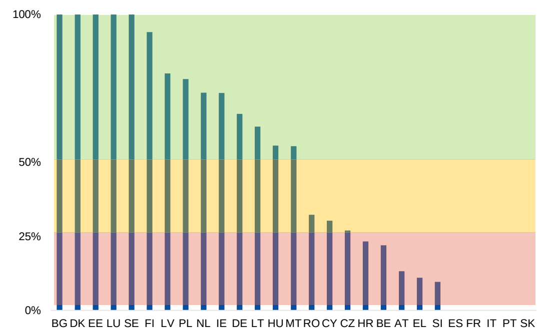
([55]) For some countries, data start after 1980.

Graph I.2.24: **SPB level implied by S1 (% of GDP)**



Source: European Commission.

Graph I.2.25: **Plausibility of the SPB implied by S1 (% of cases achieved in the past)**



Based on available data on SPBs in1980-2021.
Source: European Commission.

2.4.3. S1 – sensitivity analysis

As the S1 indicator is sensitive to changes in key assumptions, its results are tested under four sensitivity scenarios. These scenarios are the same as those used for the S2 indicator, namely the 'non-demographic risk' scenario, the 'lower productivity' scenario, the 'historical SPB' scenario and the 'adverse r-g' scenario (see Chapter 3 and Box I.3.2 for further details). Graph I.2.26 presents the results in terms of deviation from the baseline.

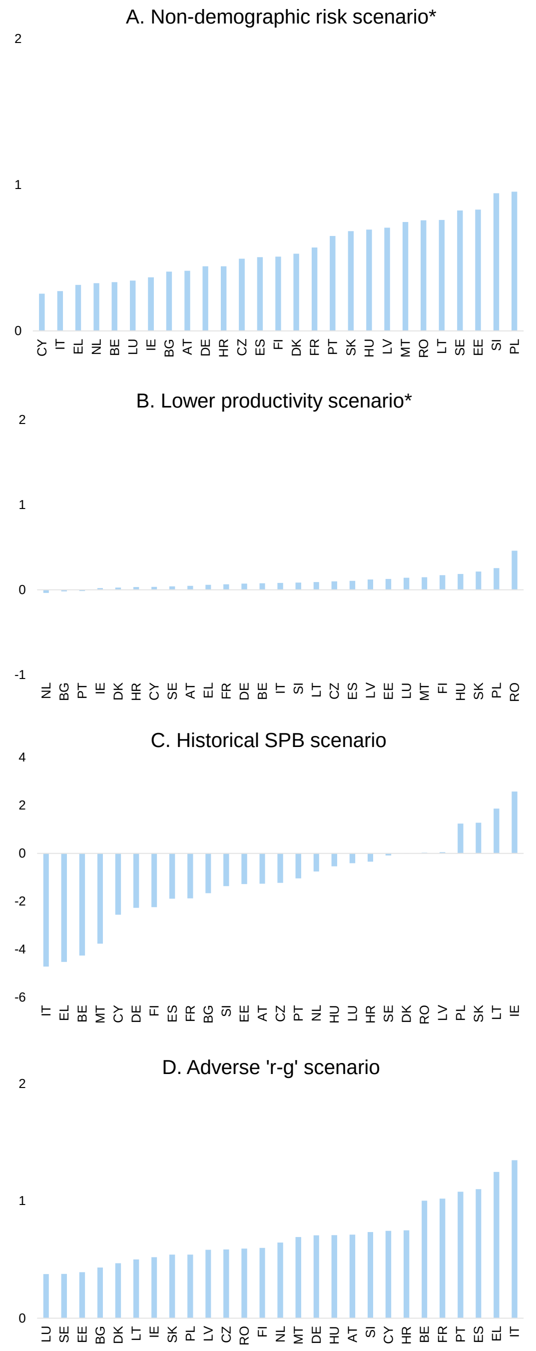
– **The non-demographic risk scenario**, which captures the impact of non-demographic factors on healthcare and long-term care expenditure, increases S1 by less than 1 pp of GDP for all Member States compared to the baseline (see Graph I.2.26-A). Poland, where the increase is the largest, would move from low to medium risk. Moreover, smaller increases in the case of Czechia and Malta would be sufficient to make them move from medium to high risk.

– **The lower productivity scenario**, which assumes that total factor productivity growth converges to 0.8%, only has a limited quantitative impact on S1, with a maximum of 0.5 pp of GDP in the case of Romania (see Graph I.2.26-B). While this scenario would keep the risk category unchanged for most countries, it would affect one borderline country: the 0.1 pp increase for Czechia would bring its S1 just above the high-risk threshold.

– **The historical SPB scenario** reduces the value of S1 in most cases, as for most countries the historical average is tighter than the SPB forecast for 2023. If SPBs were already to converge to their historical levels, the additional fiscal effort from there to bring debt to 60% of GDP would therefore fall – by more than 4 pps of GDP in the case of Italy, Greece and Belgium (see Graph I.2.26-C). This would improve the risk classification of 5 countries: Germany, Cyprus, Malta and Finland would move from medium to low risk, and Greece would move from high to medium risk. On the other hand, 3 countries would be worse off: Ireland, Lithuania and Poland, all from low to medium risk.

– **Finally, the adverse 'r-g' scenario** includes a less favourable snowball effect, so that a higher fiscal effort is needed to bring the debt ratio to 60%, especially for high-debt countries in which the snowball effect is more sizeable. The values of S1 for Belgium, France, Portugal, Spain, Greece and Italy would therefore increase the most (see Graph I.2.26-D), confirming their high-risk classification. For 3 countries (Czechia, Malta and Austria), the risk category would worsen from medium to high risk under that scenario.

Graph I.2.26: **S1 under alternative scenarios – deviation from baseline, pps of GDP**



*2021 Ageing Report scenario. See also Box I.3.2 in Chapter 3 for further explanations on the scenarios.
Source: European Commission.

2.5. OVERALL MEDIUM-TERM RISKS

2.5.1. Overall medium-term risk classification

The medium-term risk classification relies on simpler decision trees that give more weight to the debt trajectory and stochastic projections. For the deterministic projections, the projected debt level in 10 years' time still provides the main information; however, the risk category derived from the debt level can be notched up or down, depending on the debt path and the available 'fiscal consolidation space'. Furthermore, when the stochastic projections point to medium or high risk, they can notch up the preliminary low or medium risk signal provided by the baseline in a more consistent way than in previous reports (along with additional scenarios and stress tests). As in previous reports, however, neither stochastic projections nor additional scenarios and stress tests can notch *down* the risk signal resulting from the baseline. The changes introduced in this report are explained in Box I.2.2.

Based on this approach, 11 EU countries are deemed at high fiscal sustainability risk over the medium term. These are Belgium, Greece, Spain, France, Croatia, Italy, Malta, Portugal, Romania, Slovenia and Slovakia (Table I.2.7).

– Among them, both the DSA and S1 signal high risks for 8 countries. In the case of **Belgium**, **Spain**, **France** and **Italy**, every component of the analysis (i.e. S1, the baseline and other deterministic scenarios, and the stochastic projections) points to high risk, mainly because their debts are well above 90% of GDP and increasing under most scenarios – a trend also largely confirmed by the stochastic projections. For **Greece**, most scenarios flash red because of the very high (although declining) debt level and the rather ambitious fiscal assumptions ([56]). **Slovenia** is at high risk because its debt ratio is projected to increase in most scenarios, exceeding 90% by the end of the projection period. For **Slovakia**, the assessment also reflects the projected increase in debt (which would however remain below

([56]) However, the fiscal assumptions appear plausible considering that Greece recorded an average structural primary surplus of 2.1% of GDP over the last 15 years.

90% of GDP), along with fairly limited room for policy correction. Finally, the high-risk assessment for **Portugal** is jointly driven by S1, the stochastic projections and the two scenarios affecting interest rates, mostly on the back of its very high debt level and uncertainty.

– **Croatia** and **Malta** are deemed at high risk on the basis of the DSA, while S1 only signals medium risk. In both cases, the baseline sends a medium-risk signal, as debt, albeit increasing at the end of the projection period, is projected to remain below 90% of GDP (and below its 2021 level in the case of Croatia). Nevertheless, debt's sensitivity to adverse assumptions leads to identifying high risks.

– Finally, **Romania** is classified at high risk because of the value of the S1 indicator, while every component of the DSA suggests a medium risk. This is because debt, although on an increasing path, is projected to remain below 90% of GDP by 2032.

In 8 other countries, medium-term risks are deemed medium. These are Bulgaria, Czechia, Germany, Cyprus, Hungary, the Netherlands, Austria and Finland.

– For 4 countries, the medium-risk classification is due to both the DSA and S1. In **Czechia**, **Cyprus**, **Hungary** and **the Netherlands**, debt is projected to stand at an intermediate level of 60% to 90% of GDP under most scenarios. Moreover, in Czechia and the Netherlands, debt ratios are at projected to increase at least at the end of the projection period, exceeding the 2021 level by 2032 under most deterministic scenarios. For Czechia, the stochastic projections also flag a likely debt increase between 2021 and 2026. For Cyprus, the classification is also driven by the fairly limited fiscal consolidation space. In Hungary, the medium risk originates in the debt level, the high uncertainty and the vulnerability under the 'lower SPB' scenario.

– For **Bulgaria**, the overall medium-risk conclusion stems from the DSA. Bulgaria's debt is projected to increase and, while it would stay at a low level by 2032 under all deterministic scenarios, the stochastic projections suggest that the magnitude of the change in debt is subject to particularly large uncertainty.

– For the 3 other countries, the overall medium-risk conclusion is driven by the S1 indicator. **Germany, Austria** and **Finland** start with favourable initial budgetary positions but with debt ratios above 60%; these are projected to decline, although under pressure from increasing costs of ageing. Finland is a borderline case as its S1 is just above zero, with debt gradually approaching 60% already under the baseline. Germany is in a similar situation with a slightly larger S1, and Austria faces less favourable conditions overall. In Germany and Austria, debt would remain well above 60% of GDP by 2032 if the consolidation forecast for 2022 and 2023 did not materialise.

Finally, the remaining 8 Member States are found to be at low risk over the medium term. These are **Denmark**, **Estonia**, **Ireland**, **Latvia**, **Lithuania**, **Luxembourg**, **Poland** and **Sweden**. In these countries, S1, the baseline and the stochastic projections all point to low risk. This classification is not modified by the few sources of vulnerability. In particular, in Latvia, debt would remain above 60% of GDP by 2032 if the consolidation forecast for 2022-2023 did not materialise, and Estonia's debt is on an upward path – but starting from an extremely low level.

2.5.2. Comparison with the 2020 DSM results

Debt projections

Despite generally lower initial debt levels than in the 2020 DSM, the 2021 FSR does not point to an overall improvement over the medium term. For most countries, the debt levels expected for 2022 in the Commission 2021 autumn forecast are lower than in the 2020 DSM, reflecting mainly the stronger-than-expected recovery in 2021 (Table I.2.4). At the aggregate level, the 2022 debt was revised downwards by close to 5 pps. of GDP. Still, by 2031, the aggregate debt level is projected to be broadly unchanged compared to the 2020 DSM. This is mainly because the 2031 debt level is sizeably below the 2020 DSM projections in only few countries (in particular, Romania, Sweden, Spain and Slovakia), while in a few other countries, debt has been revised significantly upwards – e.g. in Malta, Czechia, Portugal, Slovenia and Bulgaria.

The less favourable debt paths despite stronger medium-term growth are mainly driven by the revision to fiscal assumptions between the two reports. The 2020 DSM was anchored on the assumption that, as from 2023, the SPB would gradually converge back to the level that was expected for 2021 in the 2019 DSM, prior to the COVID-19 crisis. This convergence rested on the assumption that the temporary support measures aiming to bridge the crisis would be phased out. By contrast, the 2021 FSR is based on the standard 'no-fiscal policy change' assumption, i.e. it assumes that the SPB remains constant at its last forecast value (for 2023), only modified by projected ageing costs. Moreover, the Commission 2021 autumn forecast up to 2023 entails lower SPBs than the 2020 DSM for most countries, on the back of permanent measures increasing current spending. The revised assumption explains the difference in average SPB levels in 2023-2031 (see Table I.2.5). On the other hand, the growth outlook over the medium term is stronger in the Commission 2021 autumn forecast thanks to the investments undertaken under the Next Generation EU package to support the green and digital transition.

Table I.2.4: **Baseline debt projections in the 2020 DSM and the 2021 FSR**

	Debt (Commission T+2 forecast) 2022			Debt (baseline projections) 2031		
	2020 DSM	2021 FSR		2020 DSM	2021 FSR	
BE	118.6	113.1	-5.5	121.2	130.9	9.7
BG	26.3	26.7	0.4	23.0	35.0	12.1
CZ	42.2	44.3	2.1	43.1	64.1	21.0
DK	40.9	38.8	-2.1	24.7	17.7	-7.0
DE	69.0	69.2	0.2	57.1	61.7	4.6
EE	26.4	20.4	-6.0	31.7	25.2	-6.5
IE	66.0	52.3	-13.7	48.3	45.0	-3.3
EL	193.1	196.9	3.8	155.5	159.8	4.3
ES	123.9	118.2	-5.7	140.6	125.7	-14.8
FR	119.4	113.7	-5.7	119.9	121.4	1.5
HR	81.6	79.2	-2.5	76.8	76.3	-0.5
IT	159.1	151.4	-7.8	155.8	159.1	3.3
CY	102.8	97.6	-5.2	82.6	79.3	-3.3
LV	45.5	50.7	5.2	45.3	48.7	3.4
LT	49.5	44.1	-5.3	42.9	39.2	-3.6
LU	28.9	25.6	-3.2	17.9	18.1	0.2
HU	77.2	77.2	0.0	64.0	68.0	4.1
MT	59.3	62.4	3.1	43.3	72.5	29.2
NL	65.9	56.8	-9.1	63.5	61.3	-2.2
AT	85.1	79.4	-5.8	76.3	75.7	-0.7
PL	56.4	51.0	-5.4	46.4	47.9	1.5
PT	127.2	123.9	-3.3	107.6	125.0	17.4
RO	63.6	51.8	-11.8	126.8	73.0	-53.8
SI	79.8	76.4	-3.4	79.1	92.1	13.0
SK	67.6	60.0	-7.5	84.2	69.7	-14.5
FI	72.5	71.2	-1.4	70.5	64.5	-6.0
SE	40.3	34.2	-6.0	30.6	13.2	-17.4
EU	94.9	90.0	-4.8	90.1	88.7	-1.4
EA	102.6	97.9	-4.7	98.2	98.2	0.1

Source: European Commission.

Table I.2.5: **Main baseline assumptions in the 2020 DSM and the 2021 FSR (2023-2031 averages)**

	Structural primary balance			Potential growth			'r-g' differential		
	2020 DSM	2021 FSR		2020 DSM	2021 FSR		2020 DSM	2021 FSR	
BE	-1.6	-3.6	-2.0	0.7	1.1	0.5	-1.6	-1.9	-0.3
BG	0.3	-1.9	-2.2	1.4	1.7	0.3	-1.4	-2.5	-1.1
CZ	-0.6	-3.1	-2.5	1.6	1.8	0.2	-2.0	-2.2	-0.2
DK	0.7	2.5	1.8	1.4	1.5	0.1	-2.6	-2.1	0.5
DE	0.3	-0.4	-0.6	0.8	1.1	0.3	-2.4	-2.6	-0.2
EE	-1.5	-1.8	-0.3	3.0	3.0	0.0	-5.1	-4.8	0.2
IE	0.7	-0.5	-1.2	2.6	4.0	1.4	-3.2	-4.0	-0.8
EL	3.0	0.5		-	1.3		-	-1.4	
ES	-2.9	-2.5	0.4	1.0	1.0	0.0	-1.4	-1.1	0.2
FR	-2.0	-2.9	-0.9	0.9	1.0	0.2	-2.1	-1.9	0.2
HR	0.4	-1.4	-1.7	0.4	1.6	1.2	-0.3	-2.0	-1.7
IT	0.0	-2.1	-2.1	0.6	1.1	0.5	-0.8	-1.0	-0.3
CY	1.3	-0.2	-1.5	1.6	2.1	0.6	-1.4	-2.3	-0.9
LV	-0.8	-1.6	-0.8	1.6	2.0	0.4	-2.3	-3.1	-0.8
LT	-0.3	-0.4	-0.1	2.1	2.4	0.3	-4.0	-3.8	0.2
LU	1.2	0.8	-0.4	1.7	2.2	0.5	-2.9	-3.9	-1.0
HU	0.2	-1.3	-1.5	2.2	3.1	0.9	-2.2	-3.1	-0.8
MT	0.8	-3.3	-4.1	2.6	2.7	0.1	-3.1	-3.1	-0.1
NL	-0.3	-1.2	-0.8	0.4	0.8	0.3	-1.9	-2.0	-0.1
AT	0.1	-0.8	-0.8	0.9	1.3	0.4	-1.8	-2.3	-0.5
PL	-0.5	-1.4	-0.9	2.9	3.0	0.1	-3.6	-3.5	0.1
PT	1.8	-0.8	-2.6	0.6	0.9	0.3	-0.7	-1.0	-0.3
RO	-6.9	-4.2	2.7	2.3	3.0	0.7	-0.5	-2.5	-2.1
SI	-1.7	-4.3	-2.6	2.4	2.9	0.5	-2.5	-3.3	-0.8
SK	-3.0	-2.5	0.5	1.3	2.8	1.4	-1.8	-3.2	-1.5
FI	-1.0	-0.7	0.3	1.0	1.2	0.2	-2.4	-2.9	-0.5
SE	-0.1	1.5	1.7	1.7	1.8	0.1	-3.5	-3.0	0.5
EU	-0.7	-1.4	-0.8	1.1	1.3	0.3	-2.0	-2.2	-0.2
EA	-0.6	-1.6	-0.9	0.9	1.1	0.3	-1.9	-2.1	-0.2

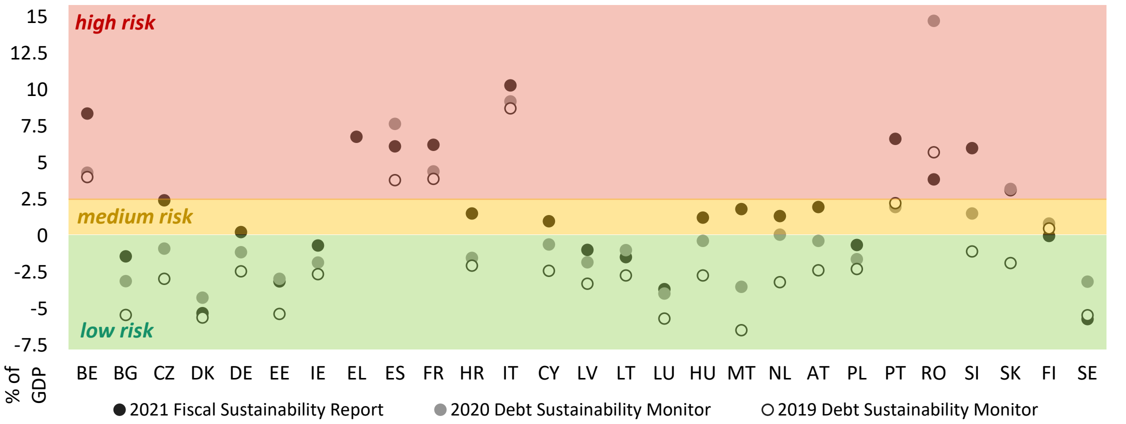
Source: European Commission.

Overall risk classification

The new medium-term classification shows a less favourable risk assessment for five countries compared to the 2020 DSM. Overall, three more countries than in the 2020 DSM are deemed at high risk: Croatia and Malta, up from the medium- and low-risk categories respectively, plus Greece, which is now integrated in the risk classification (Table I.2.6). Two more countries are at medium risk, as Bulgaria, Czechia and Germany joined this category (all up from low risk) while Croatia left it. In total, four less countries are therefore considered at low risk: Bulgaria, Czechia, Germany and Malta.

These changes reflect less favourable initial conditions compared to the pre-crisis forecast level, worsened outlooks and adjustments to the methodology. Croatia moved from medium to high risk mainly on account of its debt dynamics under the new 'adverse r-g' scenario. Bulgaria moved from low to medium risk due to the more decisive role of stochastic projections in the classification. Czechia made the same move because its debt is now projected to exceed 60% of GDP under all scenarios, and Germany because its weaker initial position implies a more gradual decline in debt. Finally, Malta changed from low to high risk, due to a higher initial and projected debt level, as well as a higher initial deficit.

Graph I.2.27: **Comparison of S1 across recent Commission reports**



Notes: (1) S1 was not calculated for Greece in the 2019 and 2020 DSMs. (2) The 2019 DSM was based on the Commission 2019 autumn forecast and the 2018 Ageing Report (using ageing costs projected for 2022 to 2034). (3) The 2020 DSM was based on the Commission 2020 autumn forecast and the 2018 Ageing Report (updated for Croatia, Italy, Romania and Slovakia to reflect pension reforms; ageing costs were taken into account only once the pre-crisis SPB was projected to be reached). (4) The 2021 FSR is based on the Commission 2021 autumn forecast and the 2021 Ageing Report (using ageing costs projected for 2024 to 2038).
Source: European Commission.

Table I.2.6: **Medium-term risk classifications in the 2020 DSM and the 2021 FSR**

2020 DSM medium-term risk	2021 FSR medium-term risk: low	2021 FSR medium-term risk: medium	2021 FSR medium-term risk: high
low	DK, EE, IE, LV, LT, LU, PL, SE	**BG, CZ, DE**	**MT**
medium		CY, HU, NL, AT, FI	**HR**
high			BE, EL*, ES, FR, IT, PT, RO, SI, SK

Note: (1) Greece was not covered in the 2020 DSM risk classification. (2) The risk classification of countries in bold has changed between the two reports.
Source: European Commission.

S1 indicator

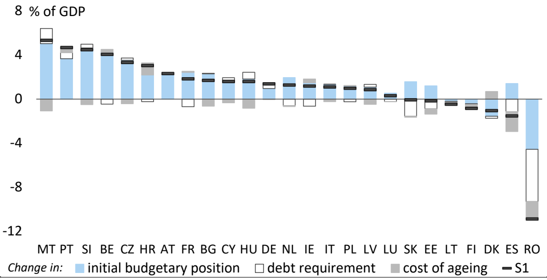
For most countries, the value of S1 is now higher than in the 2019 and 2020 DSMs, with some implications for the risk classification. Among the 9 countries currently deemed at high risk, 5 were already in that category in the 2019 DSM, prior to the COVID-19 crisis: Belgium, Spain, France, Italy and Romania ([57]) (see Graph I.2.27). Slovakia moved into the high-risk category with the 2020 DSM, and Portugal and Slovenia with this report. As for the 9 medium-risk countries, only one (Finland) was already in that category at the time of the 2019 DSM; the others moved from the low-risk category with the 2020 DSM (the Netherlands) or, in most cases, with this report (Czechia, Germany, Croatia, Cyprus, Hungary, Malta and Austria). Finally, 9 countries that were deemed at low risk prior to the pandemic still get the same assessment, despite higher S1 values in most cases. No country has seen its risk category improve.

The main reason for the increase in S1 compared to the 2020 DSM lies in the less favourable initial budgetary positions compared to pre-crisis forecast levels. The 2019 and 2020 DSMs were based on older Commission forecasts and ageing-related projections from the 2018 Ageing Report. Moreover, the 2020 DSM assumed that each country's 5-year fiscal adjustment would start in the year when its baseline SPB would reach the value forecast for 2021 prior to the COVID crisis. Graph I.2.28 shows the revision of S1 between the 2020 DSM and this report and breaks it down into the revision in the initial budgetary position, the debt requirement and ageing costs. It shows that the lower SPBs forecast for 2023 – compared to those used in the 2020 DSM, namely those forecast for 2021 in the 2019 DSM – are the chief driver

([57]) The S1 indicator for Greece was not calculated for the 2019 and 2020 DSMs.

behind the general increase in S1, causing it to rise in all but four Member States. For Malta and Slovenia, the lower SPB pushes up S1 by about 5 pps of GDP, and the impact exceeds 3 pps for Belgium, Czechia and Portugal. By contrast, revisions in the two other components – the 'debt requirement' and the cost of ageing – are in most cases limited or broadly offset each other. The two largest revisions are for Spain and Romania, where these two components significantly reduce the value of S1 compared to the 2020 DSM (although not enough to exit the high-risk territory).

Graph I.2.28: **Breakdown of the change in S1**



Note: S1 was not calculated for Greece in the 2020 DSM.
Source: European Commission.

Table I.2.7: **Heat map of medium-term fiscal sustainability risks in EU countries**

	Heat map for medium-term risks in EU countries																										
	S1 indicator in EU countries																										
	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
S1 indicator - Baseline scenario	8.4	-1.4	2.5	-5.3	0.3	-3.1	-0.6	6.8	6.2	6.3	1.6	10.3	1.0	-0.9	-1.4	-3.6	1.3	1.8	1.4	2.0	-0.6	6.7	3.9	6.0	3.2	0.0	-5.7
S1 indicator - overall risk assessment	HIGH	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW
	Debt sustainability analysis: Sovereign-debt sustainability risks in EU countries																										
	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
Baseline ('no-policy change' scenario)	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	133.6	36.4	67.1	15.6	61.6	25.7	45.7	154.7	126.1	122.3	76.7	161.6	77.8	48.8	39.4	18.2	68.1	73.2	62.8	76.3	48.3	126.2	76.9	95.2	72.2	63.9	11.2
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2021	2032	2021	2022	2023	2021	2021	2032	2032	2021	2021	2021	2032	2032	2032	2021	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	98%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	81%	97%	48%	94%	60%
Stochastic projections	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	HIGH	HIGH	LOW	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	MEDIUM	LOW	LOW	LOW	LOW
Probability of debt in 2026 greater than in 2021 (%)	66%	54%	79%	7%	27%	98%	22.2%	18%	57%	59%	21%	41%	16%	52%	38%	31%	31%	76%	44%	26%	14%	36%	71%	60%	41%	35.0%	0%
Difference of the 10th and 90th percentile in 2026 (p.p. of GDP)	37.4	50.7	28.8	19.9	26.9	9.0	31.4	64.7	40.3	21.7	28.9	42.7	43.7	34.6	30.4	28.2	43.9	27.6	28.3	32.3	17.5	58.7	42.3	27.8	31.7	24.5	9.1
Historical SPB scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	LOW	LOW
Debt level (2032)	109.7	23.7	52.1	16.4	49.5	17.0	52.8	143.0	116.7	114.3	75.7	137.2	67.8	48.1	45.3	11.1	60.7	51.5	54.7	68.9	51.2	121.0	66.4	77.4	69.5	54.5	11.6
Debt trajectory (debt peak year)	2026	2024	2032	2021	2021	2024	2021	2021	2027	2027	2021	2021	2021	2022	2023	2021	2021	2025	2021	2021	2021	2021	2032	2027	2032	2021	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	86%	79%	33%	65%	38%	66%	77%	22%	73%	85%	48%	48%	29%	69%	53%	73%	59%	52%	83%	73%	75%	52%	75%	72%	45%	68%	60%
Adverse 'r-g' differential scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	143.0	38.6	71.6	17.5	66.8	27.2	48.8	165.6	136.1	131.4	82.6	174.8	83.6	52.5	42.4	19.5	73.7	78.4	67.5	81.8	51.7	136.3	82.0	101.6	76.4	68.2	12.4
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2032	2032	2021	2032	2023	2021	2021	2032	2032	2021	2021	2032	2032	2032	2032	2023	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	86%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	100%	97%	48%	94%	60%
Financial stress scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	135.6	36.7	67.6	15.9	62.2	25.8	45.9	159.0	128.9	124.5	77.2	167.9	78.1	49.3	39.7	18.3	68.7	73.9	63.4	76.8	48.6	128.5	77.4	95.8	72.6	64.3	11.3
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2021	2032	2021	2022	2023	2021	2021	2032	2032	2021	2021	2032	2032	2032	2032	2022	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	98%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	100%	97%	48%	94%	60%
Lower SPB scenario	HIGH	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	MEDIUM	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM	LOW	LOW
Debt level (2032)	141.3	39.1	76.6	34.2	79.6	33.7	59.8	184.0	126.7	134.1	78.5	173.2	90.3	77.4	52.9	18.4	82.0	94.5	75.2	86.6	50.0	127.8	83.1	103.7	84.5	70.2	16.2
Debt trajectory (debt peak year)	2032	2032	2032	2023	2032	2032	2032	2021	2032	2032	2021	2032	2021	2032	2032	2021	2032	2032	2032	2032	2021	2021	2032	2032	2032	2023	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	100%	95%	91%	96%	96%	98%	80%	51%	92%	100%	50%	95%	75%	100%	64%	83%	74%	99%	100%	98%	70%	58%	100%	100%	65%	97%	70%
Debt sustainability analysis - overall risk assessment	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Overall MEDIUM-TERM risk category	HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW

Source: European Commission.

Box I.2.1: Revising the inflation rate assumption: rationale, description and impact

This box presents the new baseline inflation assumption used in this report. This assumption relies on inflation market expectations, reflected in inflation-linked swaps, to set the projection path for the inflation rate. The previous assumption relied on a conventional assumption of convergence of inflation to a (monetary policy) target over the medium run. The revision of the assumption enhances plausibility by allowing it to reflect the evolving inflation environment. Yet, in practice, at the current juncture, the change in assumption implies broadly unchanged inflation paths for all EU countries, compared to those implied by the previous projection assumption. The rest of the box describes the rationale for reconsidering the inflation rate assumption (Section 1), the design of the new assumption (Section 2) and the impact of this revision (Section 3).

Rationale for reconsidering the inflation rate assumption

The previous inflation projections relied on a conventional assumption of convergence of inflation to the ECB's inflation target of 2% over the medium run ([1])**.** Other institutions (e.g. the US Congressional Budget Office and UK's Office for Budget Responsibility) also rely on such fixed targets for their inflation projections in their fiscal sustainability framework. The ECB follows a similar approach, assuming that euro area inflation converges to 1.9% by T+7, with country inflation converging to that common target by T+10, after first keeping spreads vis-à-vis the euro area constant until T+5 ([2]). The IMF relies on forecast judgement to set inflation projection paths in its country DSAs.

In the Commission's DSA, two aspects suggest the need to revise such a conventional assumption. *Firstly*, inflation has remained subdued until recently, notably lower than the assumed 2% target. Assuming a return to this target over the medium run, as done under the previous conventional assumption, overlooks on-going and foreseeable inflation developments in DSA computations. In particular, not reflecting a persistent change in the inflation environment could potentially be a source of systematic debt projection errors. *Secondly*, following a recent similar change to the interest rate projection assumption ([3]), changing the inflation assumption allows improving consistency across these variables over the projection horizon. Specifically, the new interest rate assumption relies on market-based expectations ([4]), implying that the inflation component of the nominal interest rate reflects market-based expectations. Fostering consistency between the interest and the inflation projections calls for relying on up-to-date (e.g. market-based) expectations for the inflation projection.

Description of the new inflation rate assumption

Inflation-linked swaps provide a way of gauging market-based inflation expectations. Such financial contracts are commonly used to hedge inflation risks. Inflation-linked swaps are typically zero-coupon contracts. At maturity, the contract implies payment of a compensation for average realised inflation over the lifespan of the contract. Ex ante, the value of the contract thus reflects the expected average inflation over its lifespan, plus a premium for bearing the uncertainty associated with the path of future inflation – i.e. the inflation risk premium. Trading ensures that the value of these contracts tracks the evolution of inflation expectations, with market quotes providing a direct measure of inflation expectations (plus the inflation risk premium). A liquid euro area inflation-linked swap market was set up in 2002 and grew rapidly.

Inflation expectation can be computed for specific future periods. For instance, the expected average inflation between T+10 and T+20 can be computed by combining quotes on 10-year and 20-year swap contracts. Such computations yield the so-called 10-year forward (inflation-linked) swap rate 10 years ahead ([5]). Formally, the formula below describes such computations. It relies on a

(1) In three countries, inflation is assumed to converge to a higher level, reflecting different national central banks' targets. This concerns Poland and Romania (2.5%) as well as Hungary (3%).
(2) See Bouabdallah et al. (2017).
(3) See Box 3.2 in the 2019 Debt Sustainability Monitor.
(4) The ECB also relies on such market forward interest rates to set its interest rate projection path in its DSA framework, see Bouabdallah et al. (2017).
(5) An alternative horizon, the 5-year forward (inflation-linked) swap rate 5 years ahead, has become a widely used measure to assess euro area long-term inflation expectations - see ECB (2018).

(Continued on the next page)

Box (continued)

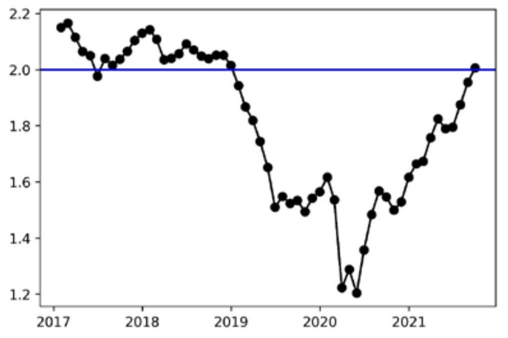
spot zero-coupon 10-year maturity swap, s_t^{20y}, which reflects average expected inflation over the next 20 years, and on a spot 10-year maturity swap s_t^{10y}. Together, these swaps allow computing the 10-year forward swap rate 10 years ahead, f_t^{10y10y}, which reflects the expected average inflation between 10 and 20 years ahead (or over 10 years, starting 10 years ahead).

$$\left(1 + f_t^{10y10y}\right)^{10} = \frac{\left(1 + s_t^{20y}\right)^{20}}{\left(1 + s_t^{10y}\right)^{10}}$$

Some caveats should however be borne in mind when interpreting financial indicators of inflation expectations. They are imperfect measures of inflation expectations, biased by an inflation (and liquidity) risk premium. Statistical techniques (e.g. affine models) may provide more accurate market-based inflation expectation measures by accounting for the presence of the risk premium. However, the use of plain computations as described in the equation above remains commonplace and the gain in accuracy provided by more advanced statistical techniques need to be weighed against the uncertainty still prevailing at the modelling stage as well as against the reduced transparency that the use of sophisticated modelling techniques generates. Finally, the method proposed needs to anchor the inflation assumption of all countries to the euro area swap-based inflation expectation as country level swap-based inflation expectation data is available for only a very limited set of EU countries ([6]).

Graph 1 shows the evolution of market-based expectations for euro area inflation, computed for the 10-year window 10 years ahead. That is, the graph shows the evolution of the indicator f_t^{10y10y}, described in the formula above. It points at some significant de-anchoring of inflation expectations from the 2% ECB monetary policy target in 2019-20. Such fluctuations in inflation expectations over time underpin the rationale for moving away from a static target. Yet, the graph also shows that more recently inflation expectations have converged back to the 2% mark. Going forward, however, recent inflation pressures may push market-based inflation measures beyond that level.

Graph 1: **Evolution of euro area market-based inflation expectation**



(1) The graph shows the evolution of market-based expectations for euro area inflation, for the 10-year window 10 years ahead.
(2) Monthly data, latest observation: September 2021.
Source: Bloomberg.

As regards the evolution of the inflation risk premium, recent evidence points at a shrinkage of this component ([7]). Since the global financial crisis (GFC), the inflation risk premium appears less significant. This supports the use of simple measures of inflation expectations directly based on inflation-linked swaps (i.e. measures that do not attempt to identify and adjust for the existence of a risk premium). Yet, various studies also point to fluctuations in the risk premium, including occasional negative values for this component, in the US and the euro area since the GFC ([8]). Such movements in the inflation risk premium are argued to be linked to shifts in the balance of risks of future high(er) inflation and risks of future deflation. When the latter prevails, the inflation risk premium turns negative. A negative inflation risk premium implies that market participants pay a premium when buying swaps, as those contracts provide them with a hedge against deflation risks. In contrast, in 'normal' times, swap-holders receive a positive premium (i.e. pay less for the swap) as compensation for the risk they bear that inflation may turn out to be higher than currently expected. When deflationary and inflationary risk are broadly balanced, the inflation risk premium is small, seemingly the situation in the euro area, up to recently. Yet, if this balance of risk would be

([6]) More specifically, inflation-linked swaps at the country level at the maturity needed (10-year and 20-year) to compute the target are not available and/or have low liquidity.

([7]) See ECB (2021).
([8]) See e.g. Camba-Mendez, G. and T. Werner (2017).

(Continued on the next page)

Box (continued)

shifting towards prevailing inflationary risks, the risk premium would tend to increase. This would yield some overestimation of inflation expectations when relying on direct measures based on inflation-linked swaps as those described in the above formula. Close monitoring and potential further methodologically work may be warranted if such risks of over- or under-estimation of inflation expectations become apparent.

To ensure that the inflation assumption reflects up-to-date long-term inflation expectations, a new approach is developed. To project inflation in the DSA framework, the following steps are used under the new inflation assumption:

1. We set country inflation **up to T+10** by assuming that all countries converge to the (swap-based) euro area inflation expectation over the 10-year window starting 10 years ahead (i.e. the same forward window used to set market-based interest rate T+10 projection targets). For Poland, Romania and Hungary, we assume that half of the spread vis-à-vis euro area inflation observed in T+2 remains by T+10, to assume gradual compression of that spread over that horizon ([9]).

2. We set country inflation **between T+10 and T+30** by assuming gradual convergence to 2% for all countries by T+30 (except for Poland (2.5%), Romania (2.5%) and Hungary (3%) reflecting national central banks' targets), reverting to the simpler conventional targets, acknowledging large uncertainties at longer horizon.

Implications of changing the inflation projection assumption

Table 1 compares the inflation projection paths under the new and previous assumptions. Importantly, at this juncture, the two sets of assumptions point to broadly similar results, reflecting the fact that September 2021 market-data ([10]) for the euro area 10-year in 10-year inflation expectation points to a 2% inflation expectation as was also shown in Graph 1, which is identical to the T+10 target that was used under the previous assumption ([11]). This implies that this change in assumption has virtually no impact on debt projections. Romania is the only country for which the new inflation path differs slightly, with a noticeably higher T+10 inflation target. This implies a slightly more favourable debt projection path for that country, due to a more favourable snowball effect than under the previous assumption.

Overall, the change in assumption implies broadly unchanged inflation paths at the current juncture. Yet, it ensures more plausible inflation projections under future potential changes in the inflation environment.

Table 1: **New versus previous inflation projection assumptions**

	New assumption					Previous assumption					Impact: New minus Previous				
	T+2	T+5	T+10	T+20	T+30	T+2	T+5	T+10	T+20	T+30	T+2	T+5	T+10	T+20	T+30
	2023	**2026**	**2032**	**2042**	**2052**	**2023**	**2026**	**2032**	**2042**	**2052**	**2023**	**2026**	**2032**	**2042**	**2052**
BE	1.6	1.8	2.0	2.0	2.0	1.6	1.8	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
BG	3.5	3.0	2.0	2.0	2.0	3.5	3.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
CZ	2.5	2.3	2.0	2.0	2.0	2.5	2.3	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
DK	1.5	1.6	2.0	2.0	2.0	1.5	1.6	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
DE	1.8	1.9	2.0	2.0	2.0	1.8	1.9	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
EE	2.4	2.3	2.0	2.0	2.0	2.4	2.3	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
IE	1.4	1.6	2.0	2.0	2.0	1.4	1.6	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
EL	0.4	1.0	2.0	2.0	2.0	0.4	1.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
ES	0.9	1.3	2.0	2.0	2.0	0.9	1.3	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
FR	1.4	1.6	2.0	2.0	2.0	1.4	1.6	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
HR	1.9	1.9	2.0	2.0	2.0	1.9	1.9	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
IT	1.4	1.6	2.0	2.0	2.0	1.4	1.6	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
CY	1.0	1.4	2.0	2.0	2.0	1.0	1.4	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
LV	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
LT	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
LU	2.2	2.1	2.0	2.0	2.0	2.2	2.1	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
HU	3.7	3.5	3.0	3.0	3.0	3.7	3.5	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0
MT	1.5	1.7	2.0	2.0	2.0	1.5	1.7	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
NL	1.5	1.7	2.0	2.0	2.0	1.5	1.7	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
AT	2.1	2.1	2.0	2.0	2.0	2.1	2.1	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
PL	2.7	2.7	2.6	2.6	2.5	2.7	2.7	2.5	2.5	2.5	0.0	0.0	0.1	0.1	0.0
PT	1.4	1.6	2.0	2.0	2.0	1.4	1.6	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
RO	4.1	3.8	3.3	2.9	2.5	4.1	3.5	2.5	2.5	2.5	0.0	0.3	0.8	0.4	0.0
SI	1.7	1.8	2.0	2.0	2.0	1.7	1.8	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
SK	2.2	2.1	2.0	2.0	2.0	2.2	2.1	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
FI	2.3	2.2	2.0	2.0	2.0	2.3	2.2	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
SE	1.6	1.8	2.0	2.0	2.0	1.6	1.8	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
EA-19	1.5	1.7	2.0	2.0	2.0	1.5	1.7	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0

Source: Commission services.

([9]) This is also in line with the fact that a long-term spread vis-à-vis euro area inflation is assumed to prevail, given that the Central Bank's target of these countries differ from 2% (see step 2).

([10]) Market data as of September 2021 are used in this report for the inflation projection target (and the interest rate projection targets).

([11]) As explained above, the T+10 target for Romania, Hungary and Poland is the market-based target applied to the other countries (i.e. the euro area inflation expectation based on the 10Y10Y swap) retaining on top of this half of the spread vis-à-vis euro area inflation that was observed in T+2.

Box I.2.2: Streamlined decision trees for the DSA risk classification

This box explains how three methodological changes to the DSA methodology have streamlined the analysis and made it more relevant for the post-COVID environment. This box focuses on presenting these revisions, while Annex A1 gives a thorough overview of the approach used in this report. The changes are as follows. First, the decision tree for the risk classification based on deterministic scenarios has been simplified and refocused: while remaining anchored on the projected debt *level*, it gives more prominence to the debt *trajectory* and to the plausibility of fiscal assumptions. Second, this plausibility and the feasibility of potential corrective measures (as measured by the available 'fiscal consolidation space') is now assessed against country-specific rather than EU-wide observations, making the analysis more relevant for individual countries. Third, the decision tree guiding the overall DSA risk classification has been streamlined and gives more weight to stochastic projections in stress-testing the baseline.

The DSA decision tree: general presentation

The DSA risk classification feeds into the medium-term risk assessment and is established in two steps. As explained in Annex A1, the DSA is the basis for the assessment of medium-term sustainability risks, along with the S1 indicator. The DSA risk classification is done in two steps. The first step assigns a risk category to the country under consideration for each of the deterministic projections and for the stochastic projections. For the deterministic projections, the risk category depends on three criteria. These are (1) the projected debt *level* in 10 years' time, (2) the debt *trajectory* (as summarised by the year in which debt is projected to peak), and (3) the 'fiscal consolidation space' (as measured by the level of the structural primary balance relative to the track record in the country, as discussed below) (1). The second step of the DSA classification then combines the risk categories derived from the various deterministic scenarios and from the stochastic projections, to conclude on the overall DSA risk category.

(1) For the stochastic simulations, which provide a range of debt paths rather than a single path, specific criteria are used (see below).

A simplified decision tree giving more weight to the debt trajectory and its plausibility

This report makes the first step of the analysis easier to read and more consistent. Unlike in previous reports, a unique decision tree applies to all deterministic scenarios, and this decision tree has been streamlined and refocused (see Graph 1). The projected debt level still provides the main signal; however, this signal can be notched up or down by signals from the debt trajectory and the available 'fiscal consolidation space' in a more influential and consistent manner than in past reports.

By stressing the importance of the debt path and of its feasibility, this approach is consistent with the definition of public debt sustainability. While a 'high risk' signal remains linked to a high debt level, a risky trajectory and the lack of realistic policy space to correct it are decisive for the final classification. This approach is anchored to the definition of public debt sustainability used by international institutions such as the IMF and the ECB. According to this definition, debt can be considered unsustainable only in cases when there is *no politically and economically feasible fiscal path that can at least stabilise debt over the medium term* (2).

As a result, the risk classification may be more favourable than suggested by the debt level alone. A country with a debt level projected to remain above 90% of GDP in 10 years' time can still be considered only at medium risk provided that the debt trajectory is plausibly declining (this corresponds to case 3 in Graph 1). Similarly, a country with a debt level projected to remain above 60% of GDP at the end of the projection horizon may be deemed at low risk if the debt trajectory is plausibly declining (case 8).

(2) The full definition clarifies that this is to be considered under the baseline and realistic shock scenarios, and that it should be consistent with both keeping rollover risk at an acceptably low level and preserving potential growth.

(Continued on the next page)

Box (continued)

Graph 1: **The new decision tree for all deterministic projections**

Case	Debt level	Debt path	Consolidation space	Overall
1	HIGH	HIGH/MEDIUM	ANY	HIGH
2	HIGH	LOW	HIGH/MEDIUM	HIGH
3	HIGH	LOW	LOW	MEDIUM
4	MEDIUM	HIGH	HIGH/MEDIUM	HIGH
5	MEDIUM	HIGH	LOW	MEDIUM
6	MEDIUM	MEDIUM	ANY	MEDIUM
7	MEDIUM	LOW	HIGH/MEDIUM	MEDIUM
8	MEDIUM	LOW	LOW	LOW
9	LOW	HIGH	HIGH/MEDIUM	MEDIUM
10	LOW	HIGH	LOW	LOW
11	LOW	MEDIUM/LOW	ANY	LOW

Notes: The table is to be read as a decision tree starting from the debt level then moving on to the debt path and the fiscal consolidation space. The risk category derived from the debt level in T+10 is notched up if the debt path points to high risk and the consolidation space points to medium or high risk (cases 4 and 9). Indeed, in these cases, countries have an increasing debt and limited consolidation space, meaning that there is a chance that there is no feasible adjustment path to curb the debt path. Conversely, the risk is notched down if both the debt path and the consolidation space indicator point to low risk (cases 3 and 8). In these cases, the projected debt level is high or medium, but the debt path is decreasing and the country has enough space to take measures in case of adverse shocks.
Source: European Commission.

The decision tree leads to signalling a high risk in three cases:

– Debt is projected to exceed 90% of GDP in 10 years' time and to stabilise only late (or not at all) (case 1 in Graph 1);

– Debt, although declining, is projected to remain above 90% of GDP, and the projected decline rests on a demanding fiscal position by historical standards (case 2); or

– Debt is projected to increase steadily (or peak late), reaching a level of 60% to 90% of GDP, despite a fairly demanding fiscal position by historical standards that leaves only moderate to limited room for additional policy correction (case 4).

A country-specific indicator to gauge the plausibility of fiscal assumptions

The 'fiscal consolidation space' tells how often more stringent fiscal positions than assumed in the projections were observed in the past. Technically, it starts from the structural primary balance (SPB) assumed on average over the projection period and measures the percentile rank of that SPB within the distribution of all SPBs observed in past decades. This gives an indication of whether the fiscal assumption is plausible by historical standards and whether the country credibly has available fiscal room for manoeuvre to take corrective measures if necessary.

The fiscal consolidation space is now assessed against each country's own track record. In previous reports, this indicator was based on the distribution of SPB observed in all EU Member States. In this report, it relies on country-specific observations, improving its relevance. This means that it is considered more plausible to assume a structural primary surplus in a country that has often recorded surpluses in the past than for a country that has recorded deficits most of the time ([3]). For example, a percentile rank of 10% associated with an average SPB of 1% of GDP for a given country would indicate that this is an ambitious fiscal assumption, given the low frequency with which the country recorded SPBs of at least 1% of GDP in the past.

As a side revision, the thresholds associated with the percentile ranks have been adjusted. In previous reports, a percentile rank of less than 15% was interpreted as indicating a demanding fiscal assumption, while the assumption was deemed plausible when it was associated with a percentile rank of more than 30%. As public finances strongly deteriorated during the COVID-19 crisis (and although they are assumed to improve in the baseline), the projected SPBs are particularly low for most countries, which would point to low risk according to those thresholds. To reflect risks more accurately, the thresholds have therefore been increased to 25% and 50% respectively.

A more consistent role for stochastic projections and stress-test scenarios

The second step of the DSA consists in stress-testing the results from the baseline, possibly notching up the risk category. In line with state-of-the-art practices, additional deterministic scenarios and stochastic simulations complement

([3]) A country with a history of weak fiscal positions may well record stronger positions in the future, however this assumption would need to be backed by credible policy measures to be considered plausible.

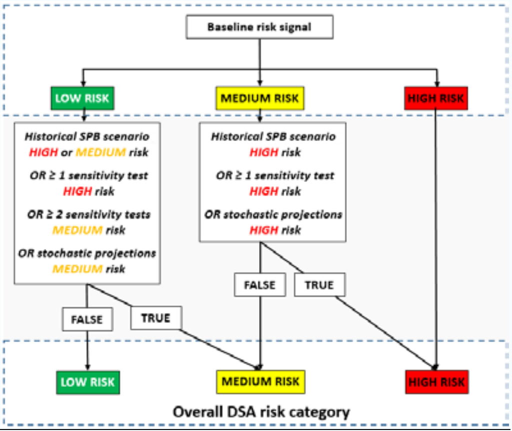
(Continued on the next page)

Box (continued)

the baseline. The results from each deterministic scenario are summarised into a risk signal, as described above. For the stochastic simulations, whose outcome is not a single debt path but a distribution of debt paths, specific criteria are used to establish the risk signal, namely the probability that debt will not stabilise over the next 5 years and the magnitude of uncertainty. Under the second step of the DSA, all the risk signals are combined to conclude on the overall DSA risk category. This combination either confirms the baseline risk signal or worsens it by one notch, as described in Graph 2. If the baseline points to high risk, this conclusion cannot be downgraded: the aim of stress-testing is to take into account more adverse conditions than under the baseline.

The new decision tree for this second step makes the approach more effective and homogenous, as stochastic projections are sufficient to notch up the risk category. The revised decision tree adjusts the preliminary risk category derived from the baseline in a more consistent manner than in previous reports (see Graph 2). If the baseline points to low or medium risk, this signal may now be notched up by the complementary deterministic scenarios *or* the stochastic simulations alone. This corrects two weaknesses of the previous approach: the decision tree was relatively complex and, in practice, countries were reclassified from low to medium risk in only very few cases. This was because, when the baseline pointed to low risk, stochastic projections could modify the classification to medium risk only if a deterministic scenario also supported this conclusion.

Graph 2: **The new decision tree for the overall DSA risk classification**



Source: European Commission.

Giving a higher weight to the stochastic approach is important, especially in the current environment. It reflects the uncertainty surrounding the baseline in the wake of the COVID-19 crisis. It also mirrors recent academic thinking (for instance, Blanchard et al. (2021) and Martin et al. (2021)) and it is in line with the latest advances in DSA frameworks of other institutions such as the IMF.

Box I.2.3: Possible paths to review the SFA projection assumptions

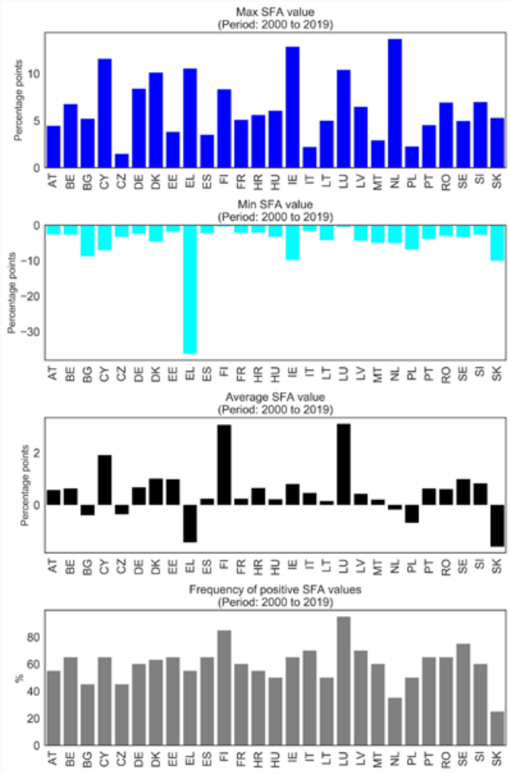
This box reviews the potential need to amend the stock-flow adjustment (SFA) projection assumptions for some countries. SFA measures the difference between the change in government debt and the government budget balance. Historical SFA patterns reveal that assuming zero SFA over the projection horizon ([1]), as is commonly done, may need reviewing for Finland and Luxembourg. The key factors underpinning systematically positive SFAs for these two countries are discussed and the implications of assuming non-zero SFAs for their debt projections are reviewed.

SFA stylised facts

The Commission's DSA assumes that SFAs are equal to zero over the projection horizon (i.e. beyond T+2). This common assumption, also in line with other institutions' practices (e.g. ECB, 2019) reflects the fact that this variable is highly volatile and seen as not showing any clear tendency to be either systematically positive or negative. In turn, this reflects the fact that SFA combines a wide range of equally (potentially) volatile sub-items, each prone to be affected by various events, and therefore difficult to project over the medium term ([2]).

Net acquisition of financial assets tends to be the main driver of SFA developments ([3]). For the EU as a whole, this SFA sub-item posted a sharp increase in 2020, reflecting a sharp increase in the accumulation of cash and deposits. This is because many countries accumulated cash, mainly through the issuance of bonds, to boost their liquidity positions during the crisis, a strategy also supported by persistently low (even sometimes negative) interest rates. Borrowing from the EU (e.g. SURE) also contributed to an increase in the 'currency and deposits' SFA item. Loans also showed a sharp increase, explained by the provision of loans by the public sector to corporations in the context of the pandemic ([4]).

Graph 1: **Historical stylised facts on stock-flow adjustment across the EU**



Source: AMECO (Autumn 2021).

Graph 1 summarises overall historical patterns for SFAs across the EU countries. It shows that all countries occasionally post large positive or negative SFA values, confirming the high volatility of this variable. Yet, in the case of Finland and Luxembourg, the average SFA level is significantly above zero, standing at close to 3% of GDP in both countries on average before the Covid-19 crisis – i.e. over 2000-2019 (Graph 1, third panel). These two countries also stand out as posting more

([1]) Aside from potential (limited) impacts of NGEU implementation on SFA projected levels, see Part II, Section 1.

([2]) Eurostat collects statistics on SFA and its sub-components, distinguishing 17 sub-items and grouping them into three main categories: (i) net acquisition of financial assets, (ii) debt adjustment effects and (iii) statistical discrepancies. The data are available for general government and its sub-sectors including social security funds.

([3]) Eurostat reports information on net acquisition of financial assets of the general government on a consolidated basis.

([4]) For details, see Eurostat's "Stock flow adjustment note", October 2021.

(Continued on the next page)

Box (continued)

systematically positive SFA values than other countries (Graph 1, bottom panel) ([5]).

A change in the SFA projection assumption for Finland and Luxembourg may thus be warranted. In contrast, for the other countries significant SFA values and/or outliers are observed but, on average, SFAs show less clear tendencies to be systematically positive or negative.

Pension funds: a key driver of positive SFAs

The constitution of pension fund reserves is an important driver of systematically positive SFAs in Luxembourg and Finland. In practice, fiscal surpluses used to accumulate these pension funds are reflected in the budget balance of the general government, though they do not contribute to reducing public debt but instead feed into the funded pension schemes. This causes a systematic increase in the SFA level (notably via the 'net acquisition of financial assets' SFA sub-item) ([6]).

Both Finland and Luxembourg have constituted such funded pension schemes. The accumulated assets of the pension funds of Finland and Luxembourg amounted to 90% and 35% of GDP, respectively, by the end of 2019. Going forward, the amount of accumulated assets may remain stable or even increase further over the medium term, but over the long term, the size of the funds would decline in both countries, reflecting pension spending and contribution trends, notably affected by population ageing as evidenced ([7]).

([5]) In the other countries, temporary large SFA values include a large negative SFA in 2012 in Greece, as a result of the agreed debt write-off, a large positive SFA in Ireland in 2011 linked to the government response to the global financial crisis, while developments during that crisis also caused large positive SFAs in 2013 in Cyprus and in 2008 in the Netherlands.

([6]) In other words, the surplus of pension schemes is not used to pay off general government debt, but to acquire financial assets (other than government debt instruments, which would be netted out from government debt). This is reflected in positive SFA, which results in offsetting the effect of the surplus on the change in the debt ratio.

([7]) See Ageing Report 2021.

SFA projections based on pension fund information

Projecting SFAs by directly accounting for the accumulation of pension funds is challenging. Conceptually, SFA projections could rely on projections for the surplus that is used to accumulate the pension fund. Similarly, projections could account for the projected change in the size of the pension fund. Yet, such approaches present some practical challenges. They require assumptions on the future return on property income received on accumulated pension assets. Relying on the projected (net) variation of the pension fund to adjust SFA projection faces the challenge of missing information on the source of such variations and on the use of the funds withdrawn from the pension funds. In particular, while a projected drawing up of the pension fund may justify adjusting upwards the SFA projection, a projected drawing down of the fund may justify projecting systematically negative SFAs levels, if the drawn out funds are used – as intended – to finance pension spending ([8]). In practice, however, the impact of the drawing down of the pension funds on debt is surrounded by uncertainty, as alternative uses for the accumulated funds may eventually be envisaged over the long term. For instance, funds could be reinvested to maintain or even further increase reserves, for similar (i.e. pension) or other purposes, such as climate change. Given such uncertainty, it appears warranted to refrain from setting strong assumptions for SFA dynamics over the (very) long term, e.g. beyond 10 years.

Eurostat's granular data on SFAs helps track the impact of pension fund developments related to pension funds but establishing a direct link remains challenging. Specific sub-items such as the 'equity and investment fund shares/units' item captures portfolio investments made by asset-rich social security funds countries, such as Finland and Luxembourg. However, investigating this impact is complicated by the fact that this and other relevant sub-items of Eurostat's SFA data are reported in net (rather than gross) terms. Increases in the 'currency and deposits' item may also capture

([8]) The disposal / sell off of the accumulated financial assets – used in principle to finance pension spending – would give rise to negative SFA, offsetting impact on debt that would be caused by the increase in pension spending (all else being equal).

(Continued on the next page)

Box (continued)

some of the impact of the surplus (eventually) meant to contribute to pension fund accumulation, as those surpluses occasionally (temporarily) accumulate in the form of cash; this was for instance the case for Finland in 2020.

SFA projections based on historical patterns

By way of illustration, we rely on the last year of the SFA forecast (i.e. 2023) to adjust SFA projections for Luxembourg and Finland. This approach accounts for the fact that key drivers of SFA developments, such as the degree of accumulation of the pension funds, vary over time, an aspect reflected in SFA forecasts ([9]). In practice, the SFA forecast for 2023 is 1.6% and 1.3% of GDP for Finland and Luxembourg, respectively. In turn, we assume that these values linearly converge to zero within 10 years, i.e. from 2023 to 2032. This assumption of a gradual return to the common assumption reflects the uncertainty surrounding the evolution of key drivers of SFA over the long term, as discussed above.

Table 1 **presents the adjusted SFA projection for Finland and Luxembourg, based on the 'last forecast year' approach.** The adjusted SFA projection would imply, by 2032, a cumulative impact on the projected debt-to-GDP level of 6.4 pps. in Finland and 5.2 pps. in Luxembourg. The impact on the projected debt profile is shown in Graph 2.

The results presented in this box confirm the need, in view of past SFAs, and the merit, in view of the impact on debt projections, of adjusting SFA projections for Finland and Luxembourg. Relying on recent SFA forecasts (or recent historical averages) is useful to highlight the issue at stake. Going forward, however, baseline SFA projections could be adjusted for these countries in relation to the projected evolution of their pension funds accumulation, if the practical challenges described above can be addressed.

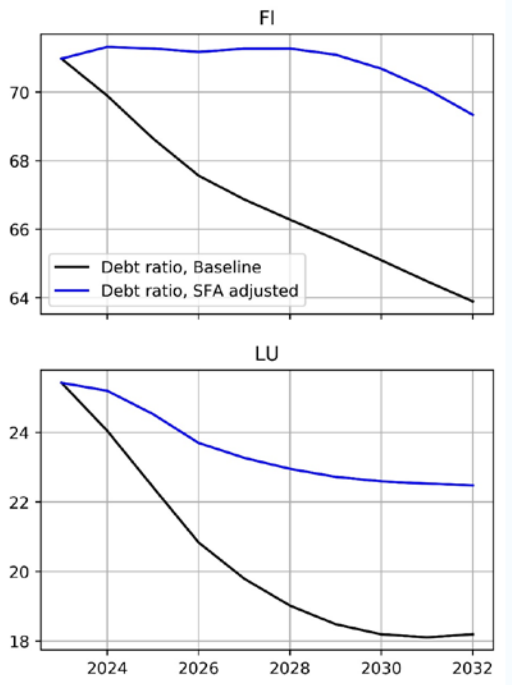
([9]) Evidence suggests that relying on moving averages of recent observations (over e.g. 3 or 5 years) would yield a similar starting point for the adjusted SFA projection as using the last forecast year. This is because both forecasts and moving averages tend to reflect mostly structural/stable factors.

Table 1: **SFA projection based on the last forecast year (% of GDP)**

	Finland	Luxembourg
2023	**1.6**	**1.3**
2024	1.4	1.1
2025	1.2	1.0
2026	1.1	0.9
2027	0.9	0.7
2028	0.7	0.6
2029	0.5	0.4
2030	0.4	0.3
2031	0.2	0.1
2032	0.0	0.0
Cumulative	**6.4**	**5.2**

(1) The projected SFA converges linearly to zero by 2032, starting from the (autumn 2021) forecast value for 2023.
(2) The cumulative figure is the sum of the values over the 2024-2032 projection path, yielding the total debt-to-GDP impact that such an adjusted SFA assumption would imply on the baseline debt-to-GDP projection for Finland and Luxembourg.
Source: Commission services.

Graph 2: **Debt-to-GDP projection, baseline and with SFA adjustment (% of GDP)**



(1) Debt ratio with SFA adjusted refers to debt ratio projections relying on the adjusted SFA paths shown in Table 1.
Source: Commission services.

3. LONG-TERM FISCAL SUSTAINABILITY ANALYSIS

The long-term risk classification is based on the S2 fiscal gap indicator and the debt sustainability analysis*. The S2 indicator measures the upfront fiscal effort needed to stabilise public debt over the long term. It includes the projections of the 2021 Ageing Report for pension, healthcare, long-term care and education expenditure. The results of the DSA discussed in Chapter 2 provide a complementary signal to S2, together determining the overall long-term fiscal risk classification.*

Due to a fast demographic ageing over the next decades, ageing costs are projected to rise in most Member States at unchanged policies. *Due to a sharp expected decrease in the working-age population and growing shares of older people, pension expenditure would rise considerably in many Member States, especially in the next decades. Public spending on healthcare and long-term care is expected to increase in all countries, while education expenditure would fall for most. For a majority of countries, total age-related spending is projected to increase by 2070. Long-term ageing cost projections are surrounded by considerable uncertainty and risks, including policy risks such as possible reform reversals or the need for measures to counteract a projected decline in pension adequacy.*

The S2 indicator identifies seven Member States as having high fiscal risk in the long term, with medium risks for ten other Member States *(see Table* I.3.1*). The initial budgetary position as projected for 2023 is the main driver of S2, with ageing costs contributing less on average. However, for high-risk countries, ageing costs are the main determinant of the S2. Moreover, the S2 indicator implies particularly demanding fiscal performance in many Member States compared with historical evidence. Compared to the 2020 Debt Sustainability Monitor, the S2 shows a general increase, thus pointing to higher long-term fiscal sustainability risks. This increase in the S2 is mainly due to a worse initial budgetary position compared to the pre-crisis forecast level.*

The DSA results point to high risks for ten Member States and medium risks in six cases *(see Table* I.3.1*). As discussed in Chapter 2, high-risk classifications are the result of high and/or increasing debt ratios, considerable uncertainty and rather limited room for corrective fiscal measures in some cases.*

Combining the S2 and DSA results, nine Member States have high fiscal sustainability risks in the long term: Belgium, Czechia, Spain, Italy, Luxembourg, Hungary, Malta, Slovenia and Slovakia *(see Table* I.3.1*). Thirteen additional Member States are considered at medium risk, namely Bulgaria, Germany, Ireland, Greece, France, Croatia, Cyprus, the Netherlands, Austria, Poland, Portugal, Romania and Finland. While only in 12 instances the S2 risk category is identical to the DSA risk classification, the S2 signal determines the overall long-term risk classification for 20 out of 27 Member States. For Greece, Spain, France, Croatia, Italy, Cyprus and Portugal, the DSA risk category leads to a worse overall risk classification than the S2 results.*

Compared to the 2020 Debt Sustainability Monitor, six countries face higher long-term risks, while for two countries risks are lower. *For Czechia, Spain, Italy, Hungary and Malta, the risk category moves from medium to high, while for Poland it goes from low to medium risk. The risk deterioration is due to the S2 indicator, with a worse initial budgetary position compared to the pre-crisis forecast level, and, in the case of Poland, higher ageing costs pushing up the required fiscal effort. Overall long-term risks fall from medium to low for Sweden and from high to medium for Romania. Again, S2 is driving the revisions, namely a better initial budgetary position for Sweden and lower ageing costs for Romania.*

Table I.3.1: **Overview of S2, DSA and overall long-term risk classifications**

	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
S2	high	medium	high	low	medium	low	medium	low	medium	low	low	medium	low	low	low	high	high	high	medium	medium	medium	low	medium	high	high	medium	low
DSA	high	medium	medium	low	low	low	low	high	high	high	high	high	medium	low	low	low	medium	high	medium	low	low	high	medium	high	high	low	low
long-term risk	high	medium	high	low	medium	low	medium	medium	high	medium	medium	high	medium	low	low	high	high	high	medium	medium	medium	medium	medium	high	high	medium	low

high risk | medium risk | low risk

Source: European Commission.

3.1. AGEING COST PROJECTIONS

Population projections show a fast demographic ageing in the next decades, with the working-age population expected to decrease sharply. According to Eurostat's latest demographic projections, the median age in the EU would rise by around 5 years for both men and women between 2019 and 2070 (Eurostat, 2020; European Commission, 2020b). Demographic ageing is expected to take place in all EU Member States, though to varying degrees and speed. This reflects the general assumptions of a further rise in life expectancy, below-replacement fertility rates and net migration in line with recent trends. As a result, the population composition would change radically, due to more older people and fewer people at working-age. This demographic shift has important budgetary consequences. More people will receive pension, health and long-term care benefits, while at the same time the number of contributors to Member States' social security systems will fall, even when assuming a higher employment rate.

According to the *2021 Ageing Report*, total ageing-related expenditure would rise in most Member States by 2070. The *Ageing Report* provides long-term projections for pension, health-care, long-term care and education expenditure (European Commission, 2021b). Table I.3.2 shows the change under the baseline projections for these four items in 2019-2070. Over this period, age-related expenditure is expected to rise by 1.9 pps of GDP on average in the EU. Spending would go up in 19 Member States and by at least 5 pps of GDP in Slovakia, Luxembourg, Slovenia, Malta, Ireland, Czechia, Hungary, Belgium, the Netherlands and Romania. In 8 Member States, the projections show an overall downward impact, due to a projected decline in pension expenditure by 2070 and, to a lesser extent, lower spending on education. However, even for these countries ageing costs are expected to increase in the next decades.

Pension expenditure would rise considerably in many Member States, especially in the next decades. In 2070, public pension spending would be very similar to the current average level in the EU as a whole. However, expenditure is projected to increase in 16 Member States. The largest increases would be in Luxembourg, Slovenia, Slovakia, Hungary, Malta, Romania, Ireland and Belgium, with an increase of at least 3 pps in the pension expenditure-to-GDP ratio (see Table I.3.2). Conversely, 11 Member States would see public pension expenditure decline by 2070, notwithstanding an initial increase in pension spending for several of them. The pension projections are based on current legislation: they already account for planned increases in legal retirement ages and apply the legal indexation rules. There are significant policy risks surrounding the baseline projections. If already legislated but not yet enacted increases in the legal retirement age are revoked, pension expenditure would rise more, as estimations included in the *2021 Ageing Report* show. The same holds for possible measures to counteract the general decline in pension adequacy in the baseline projections.

Table I.3.2: **Ageing costs – baseline, pps of GDP change 2019-2070**

	pensions	healthcare	long-term care	education	total
SK	5.9	2.5	2.1	0.4	**10.8**
LU	8.7	1.1	1.4	-0.8	**10.4**
SI	6.0	1.5	1.3	0.1	**8.9**
MT	3.8	2.6	1.9	-0.3	**8.0**
IE	3.0	1.4	1.9	-0.1	**6.2**
CZ	2.9	0.9	1.7	0.6	**6.1**
HU	4.1	0.9	0.7	-0.1	**5.5**
BE	3.0	0.6	2.1	-0.4	**5.4**
NL	2.3	0.8	2.7	-0.5	**5.4**
RO	3.8	0.9	0.4	-0.1	**5.1**
PL	-0.2	2.6	1.6	-0.1	**4.0**
AT	1.0	1.2	1.8	-0.1	**3.8**
FI	1.3	0.8	2.1	-0.9	**3.4**
DE	2.1	0.4	0.2	0.5	**3.3**
SE	-0.1	0.8	2.2	-0.5	**2.3**
BG	1.4	0.2	0.1	0.4	**2.1**
CY	2.1	0.3	0.3	-0.7	**2.0**
LT	0.4	0.6	0.8	-0.1	**1.6**
DK	-2.0	0.9	3.4	-0.8	**1.5**
IT	-1.8	1.2	1.0	-0.4	**-0.1**
HR	-0.7	0.7	0.2	-0.5	**-0.3**
ES	-2.1	1.3	0.8	-0.4	**-0.4**
LV	-1.2	0.4	0.2	0.0	**-0.6**
FR	-2.2	1.1	0.8	-0.6	**-0.8**
PT	-3.2	1.6	0.4	-0.1	**-1.3**
EE	-2.3	0.8	0.3	-0.4	**-1.6**
EL	-3.8	0.8	0.0	-0.6	**-3.7**
EU	0.1	0.9	1.1	-0.2	**1.9**

Source: 2021 Ageing Report.

Healthcare spending is expected to increase in all countries, though to varying degrees. The *2021 Ageing Report* baseline projections assume that half of the future gains in life expectancy will be spent in good health and that the income elasticity of healthcare spending exceeds unity over part of the projection period, though eventually converging linearly to 1 in 2070 (reflecting the observed pattern that, as countries grow richer, they tend to spend relatively more on healthcare). An average increase in healthcare spending of close to 1 pp of GDP is projected by 2070. The largest budgetary impact is found for Malta, Poland, Slovakia, Portugal and Slovenia, with expected increases of at least 1.5 pps of GDP (see Table I.3.2).

Likewise, a general increase in long-term care spending is projected to contribute to ageing costs. The *2021 Ageing Report* baseline projections assume that half of the projected gains in life expectancy will be spent without disability and that the income elasticity of long-term care exceeds unity over part of the projection period, though eventually converging to 1 in 2070. An average increase in long-term care expenditure of more than 1 pp of GDP is estimated by 2070, with the biggest growth in Denmark, the Netherlands, Sweden, Belgium, Slovakia and Finland, with projected increases of at least 2 pps of GDP (see Table I.3.2). Non demographic factors could cause a considerably higher increase than estimated under the baseline healthcare and long-term care projections, as discussed lower (see Table I.3.3).

Education expenditure is expected to fall in most countries, though to a limited extent. The *2021 Ageing Report* baseline education scenario focuses on the impact of demographic factors, the key assumption being a constant students-to-staff ratio. At EU aggregate level, public education spending is projected to fall by 0.2 pps of GDP in 2019-2070 (see Table I.3.2). An increase of up to 0.6 pps of GDP is expected in 5 Member States. For a large majority of countries, education spending would thus marginally decline because of demographic ageing, though by 0.6 pps of GDP at the most.

The *2021 Ageing Report* includes a set of sensitivity tests that illustrate the extent to which the expenditure projections react to changes in key assumptions. These include demographic, labour force and productivity trends, as well as non-demographic cost drivers of healthcare and long-term care. Table I.3.3 shows the results for some of the scenarios with the highest upward impact on ageing costs.

– ***Non-demographic risk factors scenario***: this scenario captures how non-demographic factors affect healthcare and long-term care expenditure. It assumes a partial continuation of upward healthcare expenditure trends, notably due to technological progress, and an upward convergence of coverage and costs of long-term care towards the EU average. It does not affect the pension and education projections. This scenario shows how non-demographic factors could push up ageing costs considerably. The average additional increase in the EU is estimated at 3 pps of GDP, with an impact of more than 5 pps in the cases of Portugal, Estonia, Poland, Lithuania and Latvia.

– ***Lower fertility scenario***: relatively small changes in the demographic assumptions can induce large differences in expenditure projections over time. If fertility rates – the number of live births per woman – would be 20% lower throughout the projection period, total ageing costs would be 1.4 pps of GDP higher on average than under the baseline fertility assumption. The estimated impact of lower-than-assumed fertility rates exceeds 2 pps of GDP for Slovakia, Luxembourg, Slovenia, Belgium, France and Romania.

– ***Lower productivity scenario***: the baseline productivity assumptions include a gradual convergence of total factor productivity growth (TFP) to 1% for all Member States. However, this might be hard to achieve considering the trend in TFP in recent decades. Therefore, the 'lower productivity' scenario assumes convergence to a lower TFP growth rate of 0.8% instead of 1%. Under this scenario, total ageing costs would be 0.4 pps of GDP higher on average in the EU. Belgium, Bulgaria, France and Spain would be the most affected, with additional ageing costs of about 1 pp of GDP.

– ***Structural macroeconomic shock scenario***: to cater for the uncertainty surrounding the macroeconomic outlook due to the COVID-19 pandemic, an alternative scenario was included in the *2021 Ageing Report*. This 'structural shock' scenario assumes a stronger cyclical downturn in the wake of the pandemic and a permanently lower growth potential. If such a scenario were to occur, it would cause ageing costs to rise by an additional 1 pp of GDP on average. The extra cost would exceed 1.5 pps of GDP in the cases of Belgium, Malta, France, Italy and Romania.

Table I.3.3: **Ageing costs – baseline and sensitivity scenarios, pps of GDP change 2019-2070**

		difference vs baseline scenario (pps of GDP)			
	baseline scenario	non-demo-graphic risk*	lower fertility	lower productivity	structural shock
SK	10.8	4.7	2.6	0.2	1.1
LU	10.4	2.6	2.4	0.7	1.4
SI	8.9	4.6	2.1	0.1	1.1
MT	8	4.0	1.1	0.6	1.6
IE	6.2	2.4	1.3	0.0	0.4
CZ	6.1	1.9	1.7	0.2	0.8
HU	5.5	4.3	1.5	0.5	1.4
BE	5.4	2.0	2.1	1.0	2.1
NL	5.4	2.0	1.7	-0.1	0.2
RO	5.1	4.9	2.0	0.8	1.5
PL	4	5.8	1.3	0.3	0.9
AT	3.8	2.0	0.9	0.4	0.7
FI	3.4	2.9	1.9	0.5	1.0
DE	3.3	2.4	1.0	0.1	0.5
SE	2.3	4.8	1.4	0.0	0.4
BG	2.1	2.0	1.2	1.0	0.5
CY	2	2.9	0.6	0.3	0.3
LT	1.6	5.7	0.0	0.0	0.4
DK	1.5	2.0	1.4	-0.1	0.3
IT	-0.1	1.7	1.1	0.6	1.5
HR	-0.3	3.1	1.2	0.2	0.9
ES	-0.4	2.8	1.1	0.9	1.4
LV	-0.6	5.0	0.2	0.1	0.5
FR	-0.8	3.4	2.1	0.9	1.6
PT	-1.3	8.3	1.4	0.7	1.4
EE	-1.6	6.1	-0.1	0.1	0.5
EL	-3.7	3.3	1.1	0.7	0.8
EU	1.9	**3.0**	**1.4**	**0.4**	**1.0**

*referred to as 'AWG risk' scenario in the Ageing Report.
Source: 2021 Ageing Report.

3.2. THE S2 INDICATOR

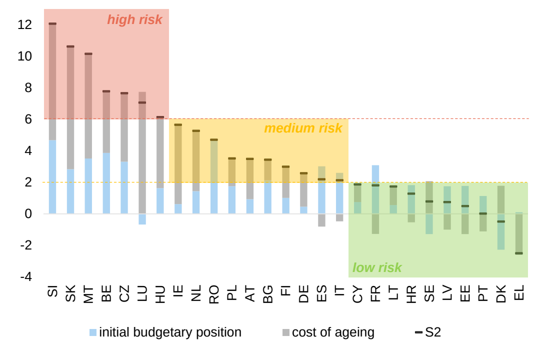
The S2 indicator measures the fiscal adjustment required to stabilise government debt in the long term. Together with the results of the DSA discussed in Chapter 2, this fiscal gap indicator determines the overall long-term risk classification (see section 3.3 and Box I.3.1 at the end of this chapter).

S2 – baseline

The S2 indicator identifies seven Member States as having high fiscal risk in the long term. Graph I.3.1 shows the results for S2, expressed as the permanent adjustment in the structural primary balance (SPB) in 2024 that would be required to stabilise public debt over the long term. Seven Member States are at high risk, i.e. an overall adjustment of at least 6 pps of GDP would be needed to prevent debt from entering on an ever-increasing path. For Slovenia, Slovakia and Malta, the fiscal effort is estimates at more than 10 pps. For Belgium, Czechia, Luxembourg and Hungary the S2 implies an adjustment of 6-8 pps.

For another 10 Member States, long-term fiscal risks are considered medium based on S2. With a required fiscal adjustment of 2-6 pps of GDP, the S2 indicator points to medium risks in Ireland, the Netherlands, Romania, Poland, Austria, Bulgaria, Finland, Germany, Spain and Italy. For the remaining 10 countries, long-term fiscal risks are low based on S2.

Graph I.3.1: **S2 – baseline, pps of GDP**



Source: European Commission.

For a majority of countries, both the initial budgetary position and projected ageing costs are unfavourable. The 'initial budgetary position' measures the gap between the initial SPB and the debt-stabilising structural primary balance. It thus ignores future ageing costs, which are measured separately. ([58]) The sum of both components determines the overall S2 value. In all Member States at least one component is positive. In Denmark, Luxembourg and Sweden the structural primary balance could deteriorate without leading to a continuous increase in the debt ratio – not accounting for any ageing costs (see Table I.3.4). In Estonia, Greece, Spain, France, Croatia, Italy, Latvia and Portugal projected ageing costs are negative as discussed supra. Falling ageing costs imply that a lower fiscal adjustment is needed to stabilise debt.

The initial fiscal position is the main determinant of the S2 value, with ageing costs contributing less on average. In the EU as a whole, S2 indicates that an average fiscal adjustment of 3 pps of GDP would be required to stabilise debt in the long term. The initial budgetary situation necessitates a 1.7 pps of GDP adjustment, while ageing costs add another 1.3 pps to the sustainability gap. The fiscal starting point is the least favourable in Romania, Slovenia, Belgium, Malta, Czechia, France and Spain. Solely based on the SPB forecast in the 2023, a budgetary correction of at least 3 pps of GDP would be needed in these countries to prevent un upward public debt spiral.

However, high long-term sustainability risks mainly stem from a sharp projected increase in ageing costs. For Slovakia, Luxembourg, Slovenia and Malta, the ageing component exceeds 6 pps of GDP, meaning that ageing costs alone suffice to put these countries in the high risk category. As discussed in the previous section, healthcare and long-term care costs are expected to increase for all countries but in countries with large total ageing costs, these mainly result from the projected increase in pension expenditure (see Table I.3.4).

([58]) The ageing cost contribution differs from the overall change in age-related expenditure between 2019 and 2070 as discussed in Section 3.1 because the S2 indicator is based on the discounted annual changes for the different expenditure items. In addition, changes are included as of 2024 onward, with earlier changes captured by the Commission 2021 autumn forecast.

Table I.3.4: **S2 – breakdown, pps of GDP**

S2		*initial budgetary position*	*cost of ageing*				
			total	pensions*	healthcare	long-term care	education
BE	7.8	3.9	3.9	1.7	0.5	1.9	-0.3
BG	3.4	2.1	1.3	0.7	0.2	0.1	0.3
CZ	7.7	3.3	4.4	1.7	0.8	1.4	0.4
DK	-0.5	-2.3	1.8	-1.5	0.7	3.0	-0.4
DE	2.6	0.5	2.1	1.0	0.4	0.2	0.5
EE	0.5	1.8	-1.3	-2.0	0.7	0.3	-0.3
IE	5.7	0.6	5.0	2.3	1.2	1.6	-0.1
EL	-2.5	0.1	-2.6	-2.7	0.7	0.0	-0.6
ES	2.2	3.0	-0.8	-2.2	1.2	0.7	-0.4
FR	1.8	3.1	-1.3	-2.1	0.6	0.7	-0.5
HR	1.3	1.8	-0.5	-1.1	0.6	0.2	-0.1
IT	2.1	2.6	-0.5	-1.9	0.8	0.9	-0.3
CY	1.9	0.7	1.1	1.0	0.3	0.2	-0.4
LV	0.7	1.7	-1.0	-1.3	0.2	0.1	-0.1
LT	1.7	0.6	1.2	0.0	0.5	0.7	0.0
LU	7.1	-0.7	7.7	6.1	0.9	1.3	-0.5
HU	6.1	1.6	4.5	3.3	0.7	0.6	0.0
MT	10.2	3.5	6.7	3.1	2.3	1.5	-0.1
NL	5.3	1.4	3.8	1.1	0.7	2.3	-0.2
AT	3.5	0.9	2.6	-0.1	1.0	1.6	0.0
PL	3.5	1.7	1.8	-0.9	1.3	1.3	0.0
PT	0.0	1.1	-1.1	-3.0	1.4	0.4	0.1
RO	4.7	4.7	0.0	-1.0	0.8	0.3	-0.1
SI	12.1	4.7	7.4	5.3	1.0	1.0	0.1
SK	10.6	2.8	7.8	4.1	1.6	1.7	0.4
FI	3.0	1.0	2.0	0.4	0.7	1.7	-0.8
SE	0.8	-1.3	2.1	-0.1	0.7	1.9	-0.4
EU	3.0	1.7	1.3	-0.3	0.7	0.9	-0.1
EA	2.9	1.8	1.1	-0.3	0.7	0.8	-0.1

* net of taxes on pensions and compulsory social security contributions paid by pensioners
Source: European Commission.

S2 – implied structural primary balance

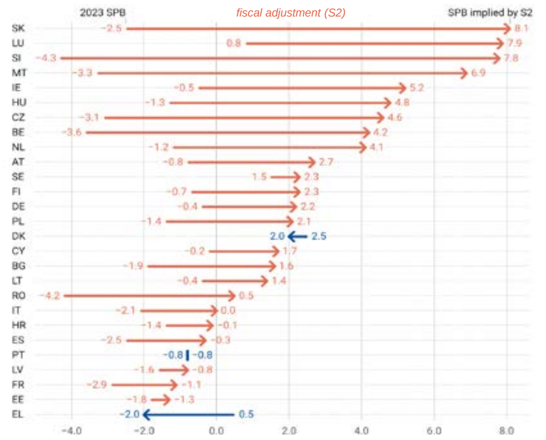
The SPB level implied by S2 informs about the fiscal policy needed to reach a steady state. The required SPB is the sum of the structural primary balance in 2023 – the end of the forecast period – and the fiscal adjustment required to stabilise the debt ratio in the long term as measured by S2. As show in Graph I.3.2, government debt levelling off corresponds to an SPB of around 8% of GDP for Slovakia, Luxembourg and Slovenia, and to an SPB of 7% for Malta. In the cases of Ireland, Hungary, Czechia, Belgium and the Netherlands, a shift to an SPB of about 4-5% of GDP would be required.

Past fiscal performance gives an idea about the plausibility of effectively achieving the required SPBs. The required SPB can be benchmarked to the distribution of available SPBs for each country since 1980. ([59]) This allows assessing how realistic the required fiscal position is, relative to actual past performance. In particular, it identifies the cases where the S2 implies an SPB that would be challenging to sustain in the long term, assuming

([59]) For some countries, data are not available for the entire period since 1980.

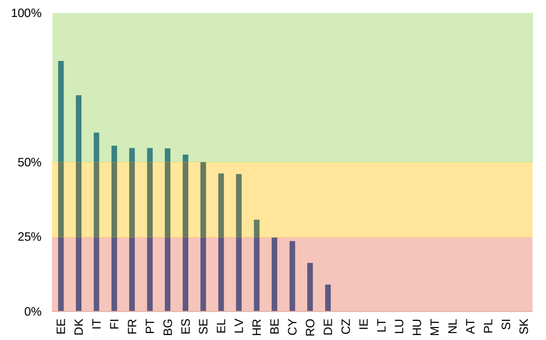
this required SPB can be achieved in the first place. Graph I.3.3 orders the required SPB according to their percentile ranks. It shows how the required SPB has never been achieved in recent decades in Slovakia, Slovenia, Poland, Austria, the Netherlands, Malta, Hungary, Luxembourg, Lithuania, Ireland and Czechia. In Germany and Romania, the SPB implied by S2 was reached a couple of times over the past three decades; in Cyprus and Belgium about a quarter of the time.

Graph I.3.2: **S2 – required structural primary balance (SPB), % of GDP**



Source: European Commission.

Graph I.3.3: **S2 – plausibility of the required SPB (% of cases achieved in the past)**

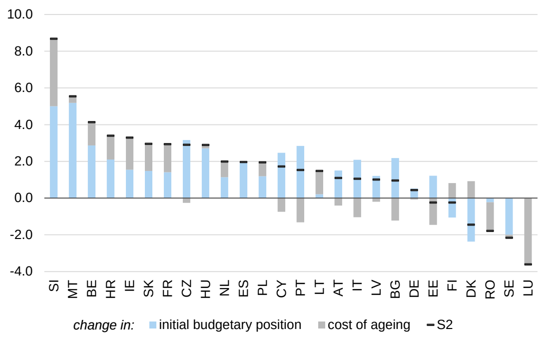


Based on available SPBs since 1980.
Source: European Commission.

S2 – comparison with previous results

The S2 indicator has increased for most countries, thus pointing to higher long-term fiscal sustainability risks. Graph I.3.5 compares the updated S2 with those in the *2019* and *2020 Debt Sustainability Monitors* (DSM). The updated S2 values are generally higher than in the pre-crisis 2019 DSM and the 2020 DSM, by 1.6 pps of GDP on average in both cases. Compared to the 2020 DSM, the largest differences are for Slovenia, Malta, Belgium, Croatia, Ireland, Slovakia, France, Czechia, Hungary, the Netherlands and Spain. The S2 risk classification goes from medium – in the 2020 DSM – to high for Belgium, Czechia, Hungary, Malta and Slovenia, and from low to medium for Spain, Italy and Poland. Only Estonia, Finland, Denmark, Romania, Sweden and Luxembourg now have a lower S2 value than in the 2020 DSM. In terms of risk classification, Romania went from high to medium risk, while Sweden went from medium to low.

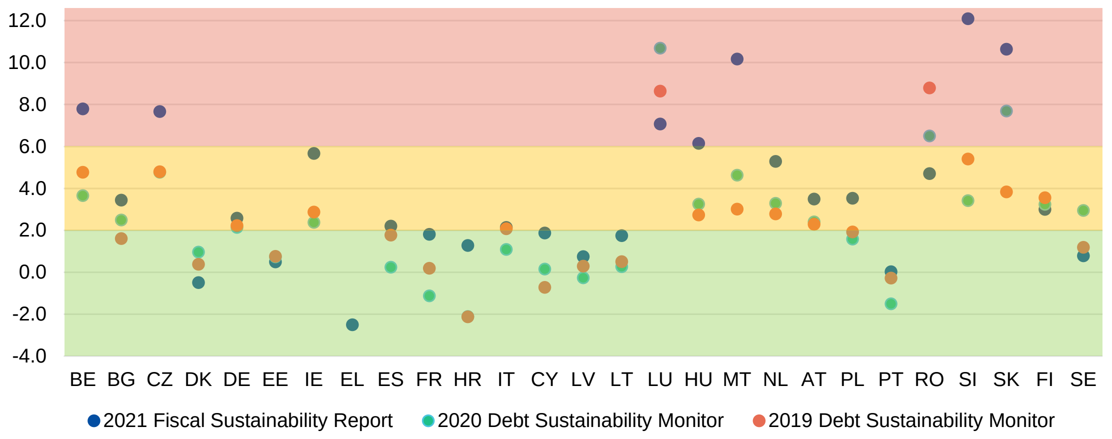
Graph I.3.4: **S2 – comparison to 2020 DSM, pps of GDP**



No S2 was calculated for EL in the 2020 DSM
Source: European Commission.

The increase in the S2 is mainly due to a worse initial budgetary position, i.e. a lower structural primary balance in 2023 compared to the pre-crisis forecast level. The 2019 and 2020 DSMs were based on previous Commission forecasts and the *2018 Ageing Report* ageing projections. Graph I.3.4 provides a comparison with the S2 calculated in the 2020 DSM, including a breakdown of the difference between the initial budgetary position and ageing costs. It shows how the lower end-of-forecast SPB for 2023 – compared to 2022 in the 2020 DSM – is the chief driver behind the general increase in the S2, causing the S2 to increase in all but five Member States. For Malta and Slovenia, the lower SPB pushes up the S2 by about 5 pps of GDP. The impact is around 3 pps for Belgium, Czechia, Hungary and Portugal. In contrast, for twelve Member States, the *2021 Ageing Report* projections have a lower S2 contribution than was the case for the *2018 Ageing Report* projections used in the 2020 DSM. The updated cost of ageing increases the sustainability gap by around 4 pps of GDP for Slovenia and reduces it to the same extent

Graph I.3.5: **S2 – comparison across recent Commission forecasts**



- No S2 was calculated for EL in the 2019 and 2020 DSMs;
- 2019 DSM: Commission 2019 autumn forecast & 2018 Ageing Report (ageing costs 2022-2070);
- 2020 DSM: Commission 2020 autumn forecast & 2018 Ageing Report (updated for HR, IT, RO & SK to reflect pension reforms; ageing costs included once the pre-crisis SPB was projected to be reached);
- 2021 FSR: Commission 2021 autumn forecast & 2021 Ageing Report (ageing costs 2024-2070).

Source: European Commission.

for Luxembourg. For the other countries revisions are within a ±2 pps of GDP bandwidth. (60)

S2 – sensitivity analysis

The S2 indicator being sensitive to changes in key assumptions, four sensitivity scenarios were run. Long-term fiscal projections are surrounded by uncertainty. This uncertainty can be assessed by comparing the baseline results with alternative scenarios. Four such scenarios are considered. Box I.3.2 provides the technical assumptions for each of these scenarios, as well as the detailed results. Graph I.3.6 presents the results in terms of deviation from the baseline.

- The **non-demographic risk scenario** adjusts the healthcare and long-term care expenditure projections for possible developments in non-demographic factors such as technological progress and convergence process. Under this scenario, the S2 would be considerably higher in all Member States (see Graph I.3.6-A). For Portugal, Estonia, Lithuania, Poland, Sweden and Latvia, the S2 would be at least 4 pps of GDP higher than the baseline result. Compared to the baseline, seven extra countries are considered at high risk: Estonia, Ireland, Lithuania, the Netherlands, Poland, Portugal and Romania. Moreover, France, Croatia, Cyprus and Latvia are deemed at medium risk, compared to low risk in the baseline.

- The **lower productivity scenario** determines the S2 value in case ageing cost projections are based on lower-than-assumed productivity growth. For a majority of countries, the S2 value would be limitedly affected by such scenario (see Graph I.3.6-B), with the impact notably reflecting pension benefit indexation rules. For Bulgaria, Belgium, Romania, Italy, France, Spain, Portugal and Greece, the S2 indicator is between 0.5 pps and 1 pp of GDP higher than in the baseline. In terms of long-term fiscal risk categorisation, Cyprus and France would be at medium risk, compared to low risk in the baseline.

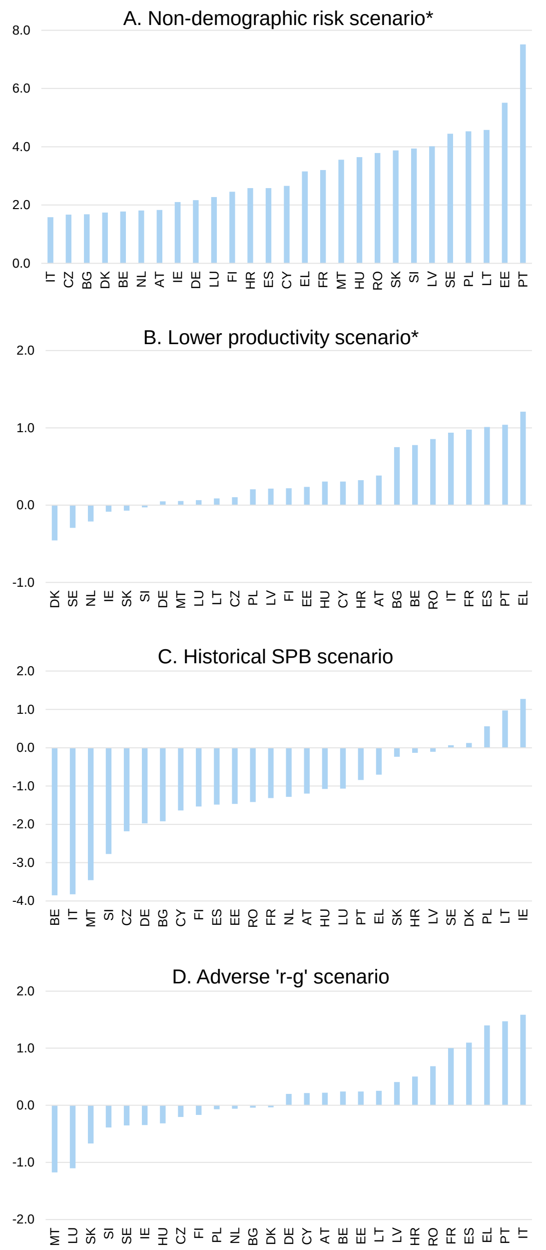
- The **historical SPB scenario** assumes that the SPB converges to its historical average level, thus improving the initial budgetary position when the SPB forecast for 2023 is below the historical average, as is the case for most countries. Reconnecting with past fiscal performance significantly reduces the fiscal effort required to stabilise debt over time (see Graph I.3.6-C). For Belgium, Italy, Malta,

(60) It should be noted that, to account for the exceptional crisis circumstances and the large temporary emergency measures taken by the Member States, the 2020 DSM included ageing costs only from the moment that SPBs were projected to have returned to their pre-crisis levels.

Slovenia, and Czechia, the S2 is 2 to 4 pps of GDP lower than in the baseline. The risk classification would improve from high to medium for Belgium, Czechia and Hungary, and from medium to low for Bulgaria, Germany, Spain, Italy and Finland. For Ireland, the risk classification goes from medium to high and for Lithuania from low to medium. This reflects how the 2023 SPB is higher than the historical average SPB.

- The **adverse 'r-g' scenario** assumes a 1 pp higher difference between interest rates and GDP growth. This implies a less favourable snowball effect and, especially for countries with high debt stocks, a higher required fiscal adjustment to stabilise the debt ratio. Italy, Portugal, Greece, Spain and France would be the most affected if the interest-growth rate differential were indeed to widen (see Graph I.3.6-D). Their S2 value would go up by 1-1.5 pps of GDP since a larger improvement in the SPB would be needed to counteract the impact on the debt ratio of a higher r-g. Under this scenario, Cyprus and France move from low to medium risk, while Luxembourg and Hungary move from high to medium risk, though just narrowly.

Graph I.3.6: **S2 – deviation from baseline, pps of GDP**



*2021 Ageing Report scenario
See also Box I.3.2
Source: European Commission.

3.3. OVERALL LONG-TERM RISKS

Overall long-term fiscal sustainability risks are assessed based on both the S2 and the DSA results. As discussed in Box I.3.1, the S2 indicator provides the starting point for the overall assessment of long-term fiscal risks. In addition, the DSA results might lead to a one-step deterioration of the risk classification. Table I.3.5 shows the risk classifications based on both indicators separately and provides the overall long-term risk classification.

- Nine Member States have **high fiscal sustainability risks in the long term: Belgium, Czechia, Spain, Italy, Luxembourg, Hungary, Malta, Slovenia and Slovakia**. The overall conclusion is generally based on the S2 indicator. Only for Spain and Italy the DSA signals high risk, compared to medium risk according to S2.

- Thirteen Member States have **medium fiscal sustainability risks in the long term: Bulgaria, Germany, Ireland, Greece, France, Croatia, Cyprus, the Netherlands, Austria, Poland, Portugal, Romania and Finland.** In the cases of Greece, France, Croatia, Cyprus and Portugal, this overall medium risk is driven by the DSA, with the S2 signalling low risks for these countries.

- Five Member States have **low fiscal sustainability risks in the long term: Denmark, Estonia, Latvia, Lithuania and Sweden.** For these countries, the S2 and the DSA both point to low risks.

- **In most cases, the DSA results do not change the conclusion based on the S2 indicator alone.** While only in 12 instances the S2 risk category is identical to the DSA risk classification, the S2 signal determines the overall long-term risk classification for 20 out of 27 Member States. For Greece, Spain, France, Croatia, Italy, Cyprus and Portugal, it is the higher DSA risk category that determines the overall risk classification.

Table I.3.5: S2, DSA and overall long-term risk classification

	S2	DSA	LT risk	
BE	high	high	high	BE
BG	medium	medium	medium	BG
CZ	high	medium	high	CZ
DK	low	low	low	DK
DE	medium	low	medium	DE
EE	low	low	low	EE
IE	medium	low	medium	IE
EL	low	high	medium	EL
ES	medium	high	high	ES
FR	low	high	medium	FR
HR	low	high	medium	HR
IT	medium	high	high	IT
CY	low	medium	medium	CY
LV	low	low	low	LV
LT	low	low	low	LT
LU	high	low	high	LU
HU	high	medium	high	HU
MT	high	high	high	MT
NL	medium	medium	medium	NL
AT	medium	low	medium	AT
PL	medium	low	medium	PL
PT	low	high	medium	PT
RO	medium	medium	medium	RO
SI	high	high	high	SI
SK	high	high	high	SK
FI	medium	low	medium	FI
SE	low	low	low	SE

Source: European Commission.

Compared to the *2020 Debt Sustainability Monitor*, six countries are deemed to face higher long-term risks, with lower risks for two other countries. Table I.3.6 compares the long-term risk classification with the one from the 2020 DSM.

- For Czechia, Spain, Italy, Hungary and Malta, long-term risks are now high, compared to medium in the 2020 DSM. This deterioration is driven by a worsening in the S2 indicator, due to the initial budgetary position. In the case of Malta, both the S2 and the DSA conclude high risks, compared to medium and low risks in the 2020 DSM. For Poland, the risk is now medium, compared to low in the 2020 DSM, with the difference due to a worse S2 signal because of both a worse initial budgetary position and higher ageing costs.

- Sweden is now at low risk, compared to medium in the 2020 DSM, with the S2 indicator improving because of a better initial budgetary position. For Romania, the risk classification improved from high to medium since both the S2 – because of lower ageing costs – and the DSA now conclude a medium risk, compared to high risk in the 2020 DSM.

Table I.3.6: **Comparison of long-term risk classifications**

		2021 FSR long-term risk		
		low	medium	high
2020 DSM long-term risk	low	DK, EE, LV, LT	**PL**	
	medium	**SE**	BG, DE, IE, FR, HR, CY, NL, AT, PT, FI	**CZ, ES, IT, HU, MT**
	high		**RO**	BE, LU, SI, SK

- EL was not covered in the 2020 DSM risk classification.
- The risk classification of countries in bold changed compared to the 2020 DSM.

Source: European Commission.

Box I.3.1: Methodology behind the long-term fiscal sustainability analysis

Long-term fiscal sustainability relates to the achievement of governments' intertemporal budget constraint. This constraint, also known as the solvency condition, refers to a country's capacity to meet its net debt obligations through future primary surpluses. Other things being equal, the higher the projected cost of ageing, the more difficult it is to fulfil the intertemporal budget constraint, as higher revenue – in present terms – is required to cover these costs, in addition to the other non-interest expenditure and debt service.

The fiscal sustainability challenges that arise from demographic ageing in the EU have been monitored for several decades. Since the early 2000s, the Commission and the Economic Policy Committee prepare on a regular basis long-term budgetary projections. The *2021 Ageing Report*, published in May 2021, provides the latest update of these projections, covering the period up to 2070 (European Commission, 2021b). To account for these ageing costs, a long-term fiscal gap indicator was introduced in the *2006 Fiscal Sustainability Report*, the 'S2 fiscal sustainability indicator'. The overall long-term risk classification is assessed on the basis of both the S2 indicator and the results of the debt sustainability analysis.

The S2 indicator

The S2 indicator is the central element of the long-term sustainability analysis. It is based on the infinite version of the government budget constraint. More specifically,

- this fiscal sustainability gap indicator shows the immediate and permanent adjustment to the current structural primary balance – subsequently kept constant at the adjusted value forever – that is required to stabilise the debt-to-GDP ratio over the infinite horizon;([1])

- this upfront adjustment is assumed to take place in 2024, i.e. the first projection year after the Commission 2021 autumn forecast;

- the 2023 structural primary balance – the primary balance adjusted for the cycle and one-off fiscal measures – as provided by the Commission 2021 autumn forecast serves as starting point, providing a proxy for the 'no-fiscal policy change' assumption;

- ageing costs as projected in the *2021 Ageing Report* are accounted for as from 2024 onwards, as the change in (net) expenditure affects the structural primary balance.([2]) This approach implies a return to past practice, from which the *2020 Debt Sustainability Monitor* deviated: because of the temporary situation of an exceptionally negative structural primary balance, a gradual return to the pre-pandemic forecast was assumed, with ageing costs included only from that point onward;

- beyong the T+10 horizon, interest rate assumptions and GDP projections are from the *2021 Ageing Report*. Over the long term, a progressive normalisation of financing conditions is assumed, with the 'r-g' differential stabilising at around 0.5 pps for the EU;

- the following thresholds are used to assess the scale of the sustainability challenge: if the S2 value (in pps of GDP) is lower than 2, the country is assigned 'low risk'; if S2 is between 2 and 6, the country is assigned 'medium risk'; and if S2 is above 6, the country is assigned 'high risk'. These threshold values are identical to those applied in earlier reports.

Despite the current low 'r-g' environment, the intertemporal budget constraint remains relevant, considering that (i) 'r-g' is assumed to normalise over the long term; (ii) ageing costs are projected to increase in many countries, putting permanent pressure on the primary balance; and (iii) many authors argue that even in the current environment, debt sustainability challenges linked to high/increasing debt persist, as discussed in Chapter 3 of Part II of this report.

([1]) See Annex 6 for the precise calculation of the S2 indicator.

([2]) The S2 indicator includes pension expenditure net of taxes on pensions and compulsory social security contributions paid by pensioners.

(Continued on the next page)

Box (continued)

Table 1: **Determination of overall long-term risk classification**

		DSA		
		high risk	medium risk	low risk
S2	high risk			
	medium risk			
	low risk			

Source: European Commission.

The overall long-term risk assessment

S2 measures the size of long-term fiscal imbalances without relying on a specific debt target. The intertemporal budget constraint implies that public debt stabilises in the long term, in the sense that future structural primary balances cover future debt servicing and ageing costs. It says nothing about the level at which this stabilisation takes place, thus ignoring risks linked to high debt levels. The adjustment implied by the S2 indicator might in fact lead to debt stabilising at (very) high levels. Based solely on S2, some countries might therefore be deemed on a sustainable path despite the fact that their debt ratios would stabilise at elevated levels in the long term.(3)

For this reason, to determine the overall long-term risk classification, the S2 indicator is complemented by the DSA results. Since the *2018 Fiscal Sustainability Report*, S2 has been supplemented with the results of the debt sustainability analysis (DSA, see Chapter 2). As a result, the long-term risk assessment is also influenced by vulnerabilities stemming from high debt levels.(4) Table 1 displays how both indicators combine into the eventual long-term risk classification. Since the S2 captures the fiscal gap due to projected ageing costs – including the infinite component beyond 2070 – a prudent approach is used. The DSA signal can worsen the outcome based on S2 by one step but can never improve the S2 results.

(3) For a detailed discussion of the strengths and shortcomings of the S2 indicator, see *2017 Debt Sustainability Monitor* (Box 3.2).

(4) In addition, the *2018 Fiscal Sustainability Report* introduced a more thorough sensitivity analysis around the central S2 scenario.

Box I.3.2: S2 – sensitivity scenarios: description and results

Non-demographic risk scenario

This scenario is based on a sensitivity scenario from the *2021 Ageing Report*, where it is called 'AWG risk' scenario. It captures the impact of non-demographic factors on healthcare and long-term care expenditure – pension and education projections are not affected by it. The scenario assumes a partial continuation of upward healthcare expenditure trends, notably due to technological progress, and an upward convergence of coverage and costs of long-term care towards the EU average.

Lower productivity scenario

This scenario is based on a sensitivity scenario from the *2021 Ageing Report*, where it is called 'TFP risk' scenario. While the *Ageing Report* baseline projections assume a gradual convergence of total factor productivity growth (TFP) to 1% for all Member States, this scenario assumes convergence to a lower TFP growth rate of 0.8%.

Historical SPB scenario

The historical structural primary balance (SPB) scenario uses the European Commission forecasts until 2023, followed by gradual convergence to the historical SPB average in 2027. The historical average is based on available data for 2006-2020.

Adverse 'r-g' scenario

This scenario applies a 1 pp higher difference between interest rates (r) and nominal GDP growth (g). The 'r-g' differential determines the snowball effect. It is discussed in-depth in Chapter 3 of Part II in this report. The scenario applies the higher 'r-g' for all Member States as of 2022.

Table 1: **Sensitivity scenarios – results, pps of GDP**

		S2			
	baseline	*Non-demographic risk scenario**	*Lower productivity scenario**	*Historical SPB scenario*	*Adverse 'r-g' scenario*
BE	7.8	9.6	8.6	3.9	8.0
BG	3.4	5.1	4.2	1.5	3.4
CZ	7.7	9.3	7.8	5.5	7.5
DK	-0.5	1.2	-0.9	-0.4	-0.5
DE	2.6	4.7	2.6	0.6	2.8
EE	0.5	6.0	0.7	-1.0	0.7
IE	5.7	7.8	5.6	6.9	5.3
EL	-2.5	0.7	-1.3	-3.2	-1.1
ES	2.2	4.8	3.2	0.7	3.3
FR	1.8	5.0	2.8	0.5	2.8
HR	1.3	3.9	1.6	1.1	1.8
IT	2.1	3.7	3.1	-1.7	3.7
CY	1.9	4.5	2.2	0.2	2.1
LV	0.7	4.8	1.0	0.6	1.2
LT	1.7	6.3	1.8	2.7	2.0
LU	7.1	9.3	7.1	6.0	6.0
HU	6.1	9.8	6.5	5.1	5.8
MT	10.2	13.7	10.2	6.7	9.0
NL	5.3	7.1	5.1	4.0	5.2
AT	3.5	5.3	3.9	2.3	3.7
PL	3.5	8.1	3.7	4.1	3.5
PT	0.0	7.5	1.1	-0.8	1.5
RO	4.7	8.5	5.6	3.3	5.4
SI	12.1	16.0	12.1	9.3	11.7
SK	10.6	14.5	10.6	10.4	10.0
FI	3.0	5.5	3.2	1.5	2.8
SE	0.8	5.2	0.5	0.8	0.4

red: higher than baseline; green: lower than baseline.
*Ageing Report scenario
Source: European Commission.

Box I.3.3: Possible future methodological revisions

Further methodological changes may be considered going forward. This report includes a number of methodological changes to the Commission's fiscal sustainability framework. However, several considerations imply that future updates may involve additional methodologic revisions. First, the framework might need adjustment in the post-COVID context. Second, the way indicators interact could be improved, in particular the role of the S1 signal. This box discusses the rationale behind some potential future revisions to the framework.

The S2 indicator remains a partial measure of long-term fiscal sustainability challenges, qualified in this report by the DSA results. As discussed in Box I.3.1, the S2 indicator provides the central signal for the assessment of long-term fiscal risks. It measures the permanent fiscal adjustment that is required to prevent debt from embarking on an ever-increasing path, thereby accounting for projected ageing costs. However, there is no restriction on the level at which this stabilisation occurs. Therefore, the S2 signal has been complemented by the DSA results in order to account for risks stemming from the starting point, i.e. high debt levels.

It may be considered to complement the S2 indicator instead by a revised S1 indicator. The Commission DSA's horizon is limited to 10 year beyond the end of the Commission forecast – 2032 in this report. This medium-term horizon contrasts with S2's long-term (infinite) horizon. For this reason, it could be considered to complement S2 instead by a revised S1 indicator. In its current design, the S1 indicator measures the fiscal effort needed to converge to a debt target of 60% of GDP in 15 years – 2038 in this report. To shift the focus to long-term sustainability, the target date could be delayed. In this case, other revisions could be considered to bring the revised S1 indicator closer to the way S2 operates: estimating an upfront adjustment instead of a cumulated effort over 5 year and using the same low/medium and medium/high risk thresholds as the S2 indicator: 2 and 6 compared to 0 and 2.5 currently.

Under this approach, the long-term risk assessment would be based on two complementary fiscal gap indicators that show the upfront fiscal adjustment required to achieve two specific long-term fiscal goals. Such redesign would mean that, for the purposes of S1, the Treaty reference value is understood as a long-term anchor. In fact, this would imply a return to the approach of the 2006 and 2009 Fiscal Sustainability Reports, when the 60% of GDP target was indeed to be reached in the long term. This shift in time horizon would also acknowledge the post-COVID-19 context of highly indebted countries.

Finally, the medium-term risk assessment could fully rely on the DSA, considering that it already represents the reference tool to assess medium-term risks. If a revised S1 indicator were to inform the long-term risk assessment, the DSA would become the sole determinant of the medium-term risk classification. The current update already includes methodological changes to the DSA framework (see Chapter 2, Box I.2.2).

4. ADDITIONAL AGGRAVATING AND MITIGATING RISK FACTORS

This chapter explores additional aggravating and mitigating risk factors, only partially reflected in the analysis so far, and that are critical to provide an overall assessment of fiscal sustainability risks*. To that end, an analysis of the structure of debt is presented, together with a review of government liabilities beyond (EDP) debt, in particular contingent liabilities. Last, considerations are given to government assets and net debt.*

Recent developments of the structure of government debt are overall favourable across the EU, representing a resilience factor for most countries. *In particular, a general trend of lengthening of the debt maturity is observed. The investor base is also large and diversified in many countries. Recent asset purchases' programmes by the Eurosystem also resulted in a substantial increase of the share of government debt held by Central Banks, representing a stable financing source. However, in many Member States, the share of short-term debt has increased as a result of the COVID-19 crisis, and is non negligible in some countries. Few non-EA countries are also exposed to foreign exchange risk.*

Contingent liabilities' risks remain important in the EU, in particular in the context of the COVID-19 crisis. *As a response to the crisis, many governments granted substantial support to the private sector in the form of guarantees. However, the surge in such government guarantees remained moderate in most cases, and overall lower than during the Global Financial Crisis. They are expected to ease up in 2022 according to Member States' Draft Budgetary Plans. A snapshot analysis of banking balance sheets points to contained vulnerabilities, though the impact of the COVID-19 pandemic on credit quality as well as other indicators continues to be difficult to be precisely assessed. Simulations, based on the Commission Symbol model, which try to overcome such data limitations, highlight that (implicit) contingent liabilities' risks linked to the banking sector are present in some countries, in particular under a stressed scenario.*

The holding of (large) financial assets in some countries constitutes a mitigating factor to fiscal risks. *At the same time, country rankings for indebtedness are similar when comparing gross and net debt ratios, and both indicators increased in the majority of countries over the past decade, notably reflecting the GFC and the COVID-19 crises.*

Additional aggravating and mitigating risk factors are taken into account – as a complement to the quantitative results of the framework – in order to ensure a balanced overall assessment of fiscal sustainability challenges. The previous chapters presented quantitative results on the basis of the DSA risk assessment, as well as fiscal sustainability indicators. Yet, these quantitative results need to be interpreted against additional aggravating and / or mitigating risk factors that are only partially factored-in in the quantitative results of the framework. Such factors are particularly relevant at the current juncture of still important uncertainty.

A number of key aggravating and mitigating risk factors are analysed in this chapter. Section 4.1 provides an analysis of the debt structure, notably in terms of maturity, currency denomination and holders, which gives an important indication of potential vulnerabilities (or strengths). Section 4.2 examines implicit and contingent liabilities, notably linked to the government guarantees granted as a response to the COVID-19 crisis, and those that could arise from the banking sector, including on the basis of the Commission Symbol model. Section 4.3 discuses other relevant factors, including government assets. The additional risk factors considered in this chapter are treated horizontally in the overall assessment, insofar the identified vulnerabilities or supporting factors may materialise in the short, medium or long term. ([61])

([61]) Some other factors are not examined in this chapter. This concerns in particular the quality of institutions. As shown by a rich literature, the quality of institutions is an important supporting factor of public debt sustainability. In the EU, a deeply integrated region of mainly advanced economies, evidence suggests that the quality of

4.1. RISKS RELATED TO THE GOVERNMENT DEBT STRUCTURE

The structure of government debt can play an important role in ensuring sustainable public finances in different ways. First, by determining the level and response of interest payments to changes in economic and financial conditions. Then, by influencing the degree of risks, notably refinancing and rollover risks. According to IMF (2014), an optimal government debt portfolio should minimise interest payments subject to a prudent degree of refinancing and rollover risks (cost – risk trade-off).

The debt composition needs to be analysed along several dimensions. In this section, the analysis focuses on three aspects: the maturity structure, the currency denomination composition and the nature of the investors' base. ([62]) With this aim, three main variables of debt structure are used: i) the share of short-term debt in total government debt (at original maturity); ii) the share of debt denominated in foreign currency in total government debt, and iii) the share of debt held by non-residents in total government debt.

A risk-based approach is used to capture additional vulnerabilities or mitigating capacity, stemming from the composition of government debt. The values of the three main selected variables are analysed against critical thresholds of fiscal risk obtained through the signalling approach - the same as in the computation of S0. ([63])The results are reported for all countries in the form of a joint heat map (see Table I.4.1) and separately for each country in the statistical fiches in the volume 2 of the FSR. ([64])

Table I.4.1: **Risks related to the government debt structure, by country (2020)**

	Short-term public debt (original maturity)	Public debt in foreign currency	Public debt held by non-residents
	Shares of total debt (%):		
BE	8.0	0.0	55.9
BG	0.1	82.5	48.8
CZ	1.7	8.6	32.7
DK	21.6	8.4	33.0
DE	11.8	4.3	45.4
EE	9.3	0.0	70.0
IE	10.1	0.0	55.5
EL	5.8	1.2	82.6
ES	7.5	0.0	43.9
FR	12.8	4.3	48.6
HR	6.0	71.0	32.1
IT	14.2	0.1	29.8
CY	6.6	0.0	81.9
LV	3.0	0.0	66.8
LT	0.0	0.0	69.5
LU	2.6	0.0	50.0
HU	8.2	22.0	33.2
MT	10.2	0.0	18.2
NL	14.7	0.0	37.8
AT	8.9	0.4	63.7
PL	1.8	23.4	34.5
PT	16.7	0.0	49.0
RO	3.5	52.3	50.9
SI	2.5	0.1	58.9
SK	3.5	0.0	53.6
FI	15.6	2.7	60.8
SE	29.9	17.9	20.0

(1) Upper and lower thresholds: (i) Share of short-term government debt: upper threshold 6.57%; lower threshold 5.3%; (ii) Share of government debt in foreign currency: upper threshold 31.58%; lower threshold 25%; (iii) Share of government debt held by non-residents: upper threshold 49.01%; lower threshold 40%. Spread on 10-year; government bonds vs. Germany – 2019 last value - upper threshold 231; lower threshold 185 (see also Annex A1).
(2) Share of short-term debt: based on partially missing information for Netherlands.
(3) Foreign-held debt figures are shown against a double shading that blends the colour coding of volatility risks from non-resident tenure (left side of the shaded cells) with that of sovereign risk given by the average spread on 10-year government bonds vs. Germany (right side of the shaded cells).
Source: Eurostat, ECB.

The share of short-term government debt has increased in 2000, though the average maturity of government debt remains high. With a high share of short-term debt, a government may be vulnerable to increases in monetary policy rate, and to rapid changes in financial markets' perceptions. From this angle, fiscal risks exist for several EU countries (see Table I.4.1). The share of short-term debt is particularly high in Sweden (close to 30% of total government debt), with the

institutions would be on average higher and less heterogeneous than in other parts of the world (for a literature review, see Box 1.2 of the FSR 2018).

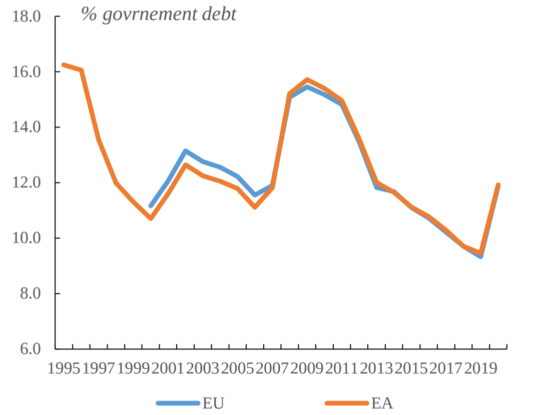
([62]) Other dimensions could also be considered such as the type of interest rates (fixed / variable), and relatedly the presence of indexation mechanisms (e.g. inflation-linked bonds), or state-contingent features, as well the nature of debt instruments (the latter is analysed to some extent in section 4.2 of this chapter).

([63]) For details on the signals approach see Chapter 1. This methodology shows that, based on historical events, the three variables appear to be relatively good leading indicators of fiscal stress.

([64]) Fiscal risk levels are determined accordingly: i) high risk (red), if the values are at or above the threshold of fiscal risk from the signals' approach; ii) medium risk (yellow), if the values are below the threshold obtained from the signals' approach, but at or above a benchmark of around 80% of the same threshold; iii) low risk (green) otherwise.

short-term debt ratio also exceeding 10% in Denmark, Portugal, Finland, Netherlands, Italy, France, Germany, Malta and Ireland. Moreover, this ratio increased in most countries in 2020, and for the EU/EA as a whole (see Graph I.4.1), as a result of the COVID-19 crisis and the need to finance large financing needs. ([65])

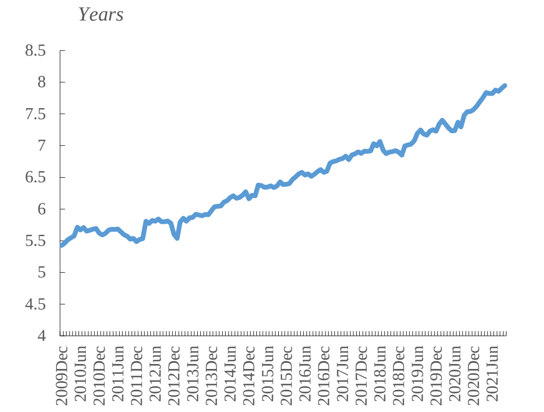
Graph I.4.1: **Share of short-term debt (% of total general government debt)**



(1) Short-term debt includes currency and deposit, short-term debt securities and short-term loans.
Source: Eurostat.

Yet, these results need to be further qualified, notably given the trend increase of the overall average maturity of government debt. The average (residual) maturity of government debt (securities) has increased over time (see Graph I.4.2), and reached a record high in 2021 (at close to 8 years on average) since 2009 (around 5½ years). This increasing trend is observed for most countries, and the maturity was particularly long in 2021 in Greece, Austria, Belgium, Ireland, Slovenia and Lithuania (see Table I.4.2). Moreover, the weight of short-term debt *as a share of GDP* is worth considering in parallel (e.g. for Sweden, given the low level as a share of GDP, this ratio is limited) ([66]). In the case of external short-term debt of non-euro area countries, the level of a country's international reserves equally deserves consideration. ([67]) Last, Treasury cash-flow management has an influence both on the headline short-term debt and the availability of other liquid financial assets, such as cash deposits, which could mitigate potential stress (see also section 4.3).

Graph I.4.2: **Average (residual) maturity of government debt (securities), simple average over EU countries**



(1) Data are missing for Estonia.
Source: ECB (Debt securities issuance and service by EU governments, October 2021).

Table I.4.2: **Average (residual) maturity of debt, general government, by EU country**

	Debt securities				All debt
	2009Dec	2020Dec	2021Oct	Increase 2021/09	2020
BE	5.5	10.4	10.9	5.4	10.4
BG	4.3	8.4	7.7	3.4	8.8
CZ	6.2	5.9	6.4	0.2	:
DK	8.1	7.3	7.9	-0.2	:
DE	5.5	6.7	7.4	1.9	7.3
EE	:	:	:	:	8.4
IE	6.3	10.9	10.7	4.5	9.1
EL	7.9	9.2	9.5	1.6	22.5
ES	6.5	7.8	7.9	1.4	7.5
FR	6.4	7.9	8.3	1.9	8.4
HR	:	5.4	5.7	:	5.1
IT	7.3	7.0	7.1	-0.3	7.4
CY	3.1	7.9	7.7	4.6	8.0
LV	3.7	8.8	9.2	5.5	8.1
LT	:	9.0	9.6	:	9.0
LU	3.9	6.3	6.2	2.2	:
HU	4.1	5.6	6.6	2.6	5.1
MT	5.3	7.7	8.6	3.3	8.7
NL	5.2	7.2	8.3	3.2	:
AT	7.3	10.9	11.5	4.2	:
PL	5.3	4.4	4.4	-0.8	:
PT	6.1	6.5	7.0	0.9	6.6
RO	2.3	7.4	7.6	5.3	7.7
SI	5.9	8.8	9.7	3.7	9.0
SK	4.5	8.3	8.7	4.3	:
FI	4.1	6.5	7.2	3.1	:
SE	5.4	4.4	4.8	-0.6	:
Average (simple)	**5.4**	**7.6**	**7.9**	**2.5**	**:**

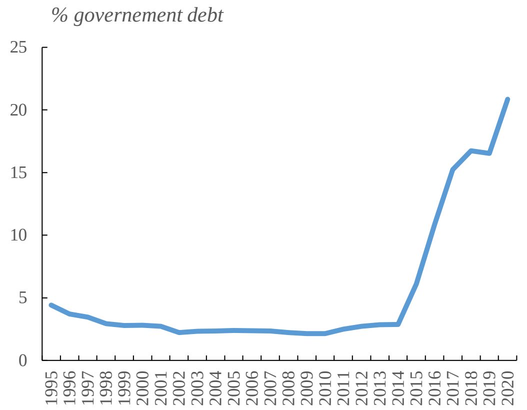
Source: ECB (Debt securities), Eurostat (all debt), national sources (all debt for EL and CY).

([65]) If the structure of debt tends to be fairly stable over time, in the wake of major crises or large scale financial innovation, changes in the debt composition can be large and sudden (see Abbas et al., 2014 and Box 3.4 of the 2018 FSR).
([66]) See S0 indicator table on fiscal variables.
([67]) The size of a country's international reserves compared with its short-term external debt shows whether it has enough resources to counter a sudden stop in capital flows and its capacity to service its short-term external debt.

The share of debt denominated in foreign currency is limited, except in few non-EA countries. As advanced economies finance themselves overwhelmingly in their own currency, currency-related fiscal risks are largely absent for the EU countries that have adopted the euro (see Table I.4.1). ([68]) Yet, foreign currency-denominated debt is large in some Central and Eastern European countries (CEEC). This is the case of Bulgaria, Croatia and Romania (with a share well above 50% of total debt), ([69]) as well as to a lesser extent Poland, Hungary and Sweden. For all these countries, hedging of foreign currency positions can mitigate potential exchange rate risks, ([70]) whereas pegs or currency boards also significantly reduce exposure to fiscal risks from the share of public debt in foreign currency. ([71]) Moreover, in these countries, the major share of foreign currency issuances are denominated in euro, and in some countries, governments have succeeded in reducing their reliance on foreign currency borrowing, e.g. in Czech Republic, Hungary, Poland and Romania (Eller and Holler, 2018).

EU countries' investor base is solid, though in some cases, the substantial share of debt held by non-residents creates vulnerabilities. ([72]) Several euro-area countries are found to have large shares of foreign held government debt, including Greece, Cyprus, the Baltic countries, Austria, Finland, Slovenia, Belgium, Ireland, Slovakia and Romania (all beyond 50% of total government debt; see Table I.4.1). However, in some cases, this high share reflects important official lending associated to past financial assistance programmes (Greece, Cyprus, Ireland and Portugal; see Graph I.4.4). In others, the large foreign investor base underlines the country's worthiness, as shown by limited sovereign bond spreads (e.g. Austria, Finland and Belgium). ([73]) In general, it may also be beneficial for financial and macroeconomic stability as a higher share of foreign investors reduces the risks of adverse loops between the sovereign and the national banking systems (Bouabdallah et al., 2017). For some other non-euro area countries such as Romania, Poland and Hungary, the significant share of foreign held debt could be more associated with a search for yield given a more emerging markets status and relatively small local-currency markets.

Graph I.4.4: **Share of government debt held by (domestic) central banks, EA aggregate**



(1) Based on Maastricht debt (at face value).
Source: ECB.

A detailed overview of government debt allocation by different holders indicates that an increasing share of government debt is held by domestic central banks (and the ECB for EA countries). By end 2020, in about half EU countries, at least one fifth of government debt was held by domestic Central Banks (see Graph I.4.4). Largest share are observed in Slovenia, Slovakia, Ireland and the Netherlands (close to 30%). For high debt countries, this share varies from less than 10% (Greece) to more than 25% (Spain).

([68]) A domestic currency denomination traditionally protects governments against currency mismatches between a government's interest expenditure and tax revenue. Yet, in some countries, the rationale behind foreign-currency-denominated debt issuance is to attract foreign investors, not willing to bear the foreign currency risk. Ultimately, this may reduce funding costs for these governments (all else being equal) by reducing liquidity premia (Eller and Holler, 2018).

([69]) Bulgaria has a currency board since 1997 and nearly all of its foreign currency debt is issued in euro. While the peg is maintained, shocks to debt in foreign currency are virtually zero. Croatia has tightly managed arrangements, also limiting exchange rate fluctuations.

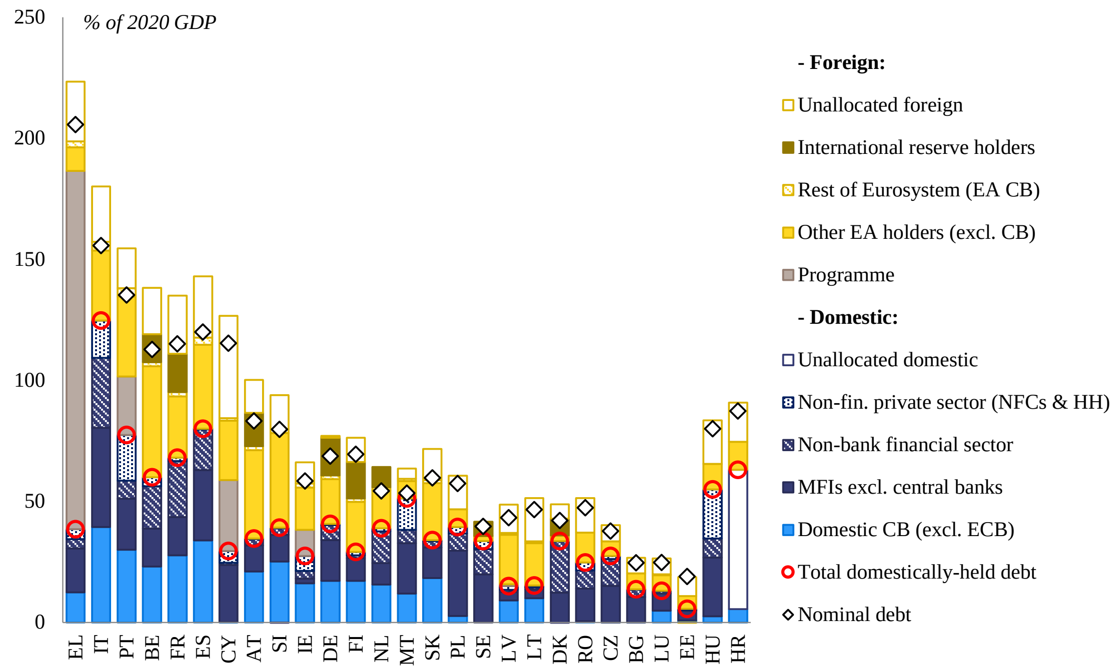
([70]) Hedging operations are not taken into account in the FSR.

([71]) On the idiosyncrasies of different exchange rate regimes and the extent to which exchange rate shocks could impact the public debt-to-GDP ratios see European Commission (2017) - Chapter 2, Box 2.2.

([72]) Indeed, the foreign investor base tends to be more volatile and prone to sudden stops in situations of heightened uncertainty.

([73]) In Table I.4.1, foreign-held debt figures are shown against a double shading that blends the colour coding of volatility risks from non-resident tenure (left side of the shaded cells) with that of sovereign risk given by the average spread on 10-year government bonds vs. Germany (right side of the shaded cells).

Graph I.4.3: **Holders of government debt, 2020-Q4, market value (% of GDP)**



(1) Debt refers to consolidated general government debt at market value, which for some countries differs from debt at nominal value (EDP debt) used in the rest of the report and represented here by white diamonds. For more details, see https://www.bis.org/publ/qtrpdf/r_qt1509g.htm and https://www.bis.org/statistics/totcredit/credgov_doc.pdf. (2) Only data for total MFIs (Monetary Financial Institutions) are reported. The split between commercial banks and central banks is an estimate based on annual nominal data. The category 'International reserve holders' represents holdings by international organisations and non-EA central banks as reserve assets. The category '(Rest of) Eurosystem' includes holdings by the ECB. The category 'Non-financial private sector' represents holdings by non -financial corporations (NFCs) and households (HH).
Source: Commission services based on ECB, Eurostat, IMF.

Moreover, at the EA aggregate, the share of debt held by (domestic) Central Banks has significantly increased since 2014 (when this share amounted to less than 3%; see Graph I.4.3), notably reflecting asset purchases' programmes (see also chapter 1).

For almost all EA countries, the signal of investor confidence (illustrated in Table I.4.1**) emerges also from the detailed overview of government debt allocation by different holders** (see Graph I.4.4). For medium size and larger EA economies, comparatively more significant shares of government debt are currently in the hands of non-EA central banks in the form of reserve assets (including Germany, France, the Netherlands, Finland, Austria, and Belgium). For smaller EA economies (e.g. Latvia, Lithuania, Slovenia and Slovakia), the *rest of the EA* financial sector has become a more important holder of government debt than these issuers' domestic financial sectors, suggesting that home bias here is disappearing or transforming as the EA grows more integrated financially and financial institutions follow harmonised prudential rules under the Single Rulebook.

While evidence of domestic versus foreign debt holdings is mixed, the latter is more likely to entail risks when the foreign tenure is not particularly safe or confidence-driven. In some countries, such as Malta, Sweden and Italy, a high share of government debt is domestically held. Conversely, in a few cases relatively larger shares of government debt held by foreign and / or unidentified investors outside the euro area that are not reserve asset holders ('unallocated') may reflect risks usually associated to this uncertain, potentially more volatile basis (e.g. Romania, Cyprus and Slovakia).

The analysis of risks arising from the debt profile needs not be confined to these indicators and the associated benchmarks. Other factors, some of which mentioned above, such as the exchange rate regime, the role of the central bank in mitigating short-term liquidity needs, the capacity of the market to absorb debt, influence as well the results of the analysis. The underlying reasons for debt profile vulnerabilities, such as contagion, incomplete credit markets, weak debt management practices, may also be important in this regard.

4.2. LOOKING BEYOND 'GOVERNMENT DEBT': RISKS RELATED TO GOVERNMENT OTHER DIRECT AND CONTINGENT LIABILITIES

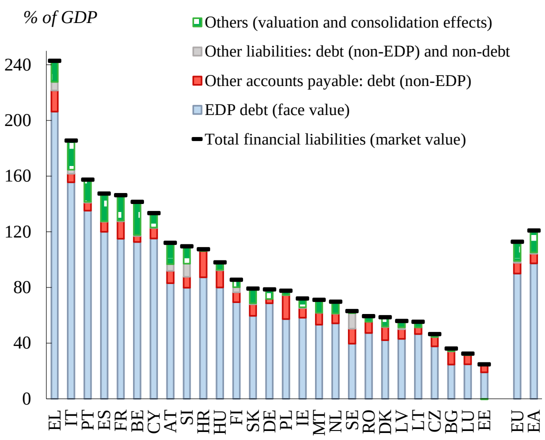
This section provides an analysis of the size and, when possible, the evolution of government liabilities other than 'EDP (or Maastricht) debt' in the EU. Such a complementary analysis allows identifying additional risk factors compared to the results of the standard debt sustainability analysis provided in this report (see chapter 2). The section looks in particular into government direct liabilities that are not included in the EDP debt (sub-section 4.2.1), while sub-sections 4.2.2 to 4.2.3 discuss risks linked to contingent liabilities. The latter are particularly important in the context of the COVID-19 crisis, including as vulnerabilities could eventually materialise in the banking sector.

4.2.1. EDP debt, other debt and non-debt financial instruments: a snapshot overview

The EDP debt liabilities were the main component of on-balance government gross liabilities in 2020 in all Member States. In the EU as a whole, the EDP debt was around 90% of GDP and accounted for more than three-quarters of total gross financial liabilities in 2020 (see Graph I.4.5). In terms of instrument coverage, debt securities, commonly in the form of bills, commercial papers and bonds, account for more than two-thirds of the government gross debt in most Member States. Contributions of loans, coins when issued by governments and deposits held by entities classified inside general government tend to be less significant across Member States. ([74])

The difference between total gross liabilities and the EDP debt varies widely across Member States. In 2020, the portion of total gross government liabilities (at market value) not reflected in the EDP debt (measured at face value) ranged from 37% to 30% of GDP in Greece, France, Italy and Slovenia, and below 10% of GDP in Estonia, Luxembourg, Czechia and Lithuania. This difference consists of other debt instruments (so-called non-EDP debt), non-debt financial instruments and a gap due to different valuation and consolidation methods applied to financial liabilities. ([75])

Graph I.4.5: **Debt and non-debt financial liabilities in EU Member States in 2020**



Source: Commission services based on Eurostat.

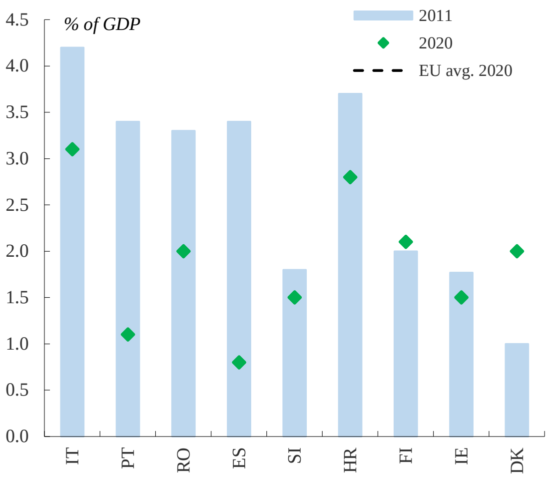
Among non-EDP debt liabilities, "other accounts payable" is the most significant component. Other accounts payable include trade credits and advances. These are in most cases outstanding short-term liabilities of the government from transactions of goods and services, and to a lesser extent other timing differences in settling obligations. During periods of financial distress, this debt instrument can become an important government financing alternative. For instance, in few Member States, such as Italy, Portugal, Romania, Spain and Slovenia, government trade debt tended to be higher during the Global Financial Crisis. Over time, stocks of trade credits and advances have receded in these Member States, while increasing

([74]) The share of loans can nevertheless be significant in some Member States, in particular in those that have benefited over the past years from financial assistance in the form of official loans.

([75]) The valuations of the EDP debt and ESA 2010 balance sheets are different. In particular, total gross EDP debt of the general government is valued at face value, while in ESA 2010, government gross liabilities are valued at market prices.

in others (e.g. Belgium and Denmark). In 2020, as a share of GDP, these liabilities were highest in Italy, (3.1%), Croatia (2.8%), Finland (2.1%), Denmark (2%) and Romania (2%), compared to an EU average of 1.6% of GDP (see Graph I.4.6). ([76])

Graph I.4.6: **Trade credits and advances in selected Member States in 2011 and 2020**



Source: Eurostat.

Other liabilities (debt and non-debt financial instruments) are typically a narrow set of total government liabilities. In 2020, these other liabilities were more relevant for Sweden (11% of GDP – of which mainly insurance, pensions and standardised guarantees), Slovenia (9.3% of GDP – of which mainly financial derivatives and employee stock options), Greece (6.1% of GDP – of which mainly financial derivatives and employee stock options), Austria, Finland, Italy and Latvia, while accounting for less than 1% of GDP in other Member States.

The gap reflecting valuation and consolidation effects can be relatively large in some Member States. Ranging from 23% to about 1% of GDP in 2020, this gap was highest in particular in Belgium, Italy, Spain, and France. In most cases, the magnitude of this gap is affected largely by the impact of different valuation bases for the EDP debt (face value) and gross financial liabilities (market value) and to a lesser extent by the impact of the consolidation method (EDP debt is consolidated both within and between the subsectors of the general government, gross financial liabilities only within subsectors). The consolidation effects are in fact small in most Member States. ([77])

4.2.2. (Explicit) contingent liabilities in the EU

As part of the analysis of contingent liabilities proposed in this report, this section contains an overview of *explicit* contingent liabilities, as reported by Eurostat. These explicit contingent liabilities comprise government guarantees, including those related to government interventions in the financial sector, and liabilities related to off-balance PPPs (public - private partnerships). ([78])

Government guarantees and PPPs prior to the COVID-19 crisis

Government guarantees represent a source of potential fiscal cost in several Member States, in case they are called. ([79]) Before the COVID-19 crisis, in 2019, the highest stock of outstanding government guarantees was recorded in Finland (more than 33% of GDP), Denmark (more than 18% of GDP) and Austria (about 6% of GDP) (see Graph I.4.8). In *Finland*, a sizeable part of the guarantees were related to export guarantees, student loans and funds for supporting housing production, and have been overall increasing since 2010 (see Graph I.4.7). In *Denmark*, most guarantees concerned social housing and state-owned enterprises such as the Danish Railways, the national broadcaster DR and the Oresund, Storebaelt and Fehmarn connections. In *Austria*, guarantees were largely provided to nonfinancial private entities for export promotion, to public and private financial institutions during the crisis, and to non-financial public corporations such as road

([76]) Eurostat (2015) and Eurostat (2021a).

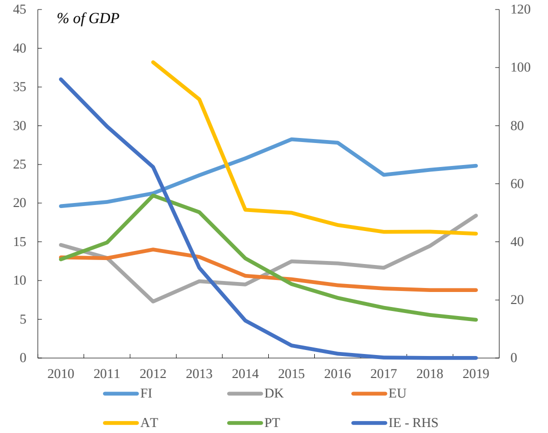
([77]) Eurostat (2021b).

([78]) This information can also be found in the statistical country fiches (see volume 2 of the FSR). Note that some of this information may be overlapping, e.g. guarantees issued in the context of government interventions in the financial sector form a subset of total government guarantees. For this reason, evaluating the total risk by summing up the indicators could overestimate the potential impact.

([79]) Government guarantees are typically designed to reimburse a lender in case of possible losses linked to the loans it has provided. Government guarantees are issued to promote economic stability or pursue other public policy objectives, with the examples of guarantees on student loans or guarantees on the losses incurred by exporters in case of non-payment by a trading partner.

and rail infrastructure companies ([80]). In the EU as a whole, public guarantees declined from around 13% of GDP in 2010 to 9% of GDP in 2019. This largely reflects a decline in the use of government guarantee schemes for financial institutions granted in the context of the financial crisis in number of EU Member States.

Graph I.4.7: **Developments in government guarantees in selected EU Member States, 2010-2019**

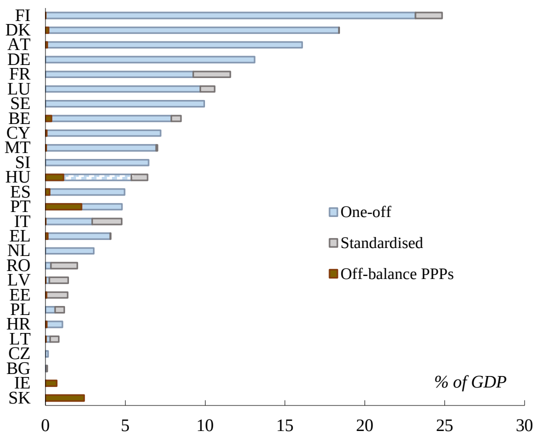


Source: Eurostat.

In most Member States, the largest category of government guarantees relates to one-off guarantees granted under individual contractual arrangements, usually involving more sizeable amounts. In 2019, the stock of *one-off guarantees* ranged from close to 32% of GDP in Finland and 16% of GDP in Austria to less than 0.5% of GDP in Romania, Lithuania, Latvia, Czechia, Bulgaria, Slovakia, Estonia and Ireland (see Graph I.4.8). On the other hand, the total amount committed in *standardised guarantee schemes* (issued in large numbers for small amounts) carries a more modest risk for future public expenditure in most Member States. These schemes account for more than 1% of GDP only in Denmark (7% of GDP), France (2.3%), Italy (1.9%), Romania (1.7%), Finland (1.7%), Estonia (1.4%) and Latvia (1.2%). ([81])

Contingent liabilities linked to off-balance public private partnerships (PPPs) are a modest source of risk for most Member States. The use of public private partnerships (PPPs) for economic and social infrastructure projects, such as for the development of transport infrastructures and hospitals, can generate additional liabilities for the government. Depending on the distribution of risks and rewards between private and public partner, assets and liabilities related to PPPs can be recorded either on government's balance sheet or on the private partner's balance sheet. The first ones (on-balance PPPs) affect government's debt directly. However, also for those PPPs where the private partner is exposed to the majority of risks and rewards, and which are therefore recorded off government's balance sheet, government may be contractually obliged to step in under certain circumstances (for example, failure of the private partner). For the EU as a whole, contingent liabilities related to off-balance PPPs have modestly accounted for no more than 0.2% of GDP since 2010 and are only affecting few Member States (see Graph I.4.8). In 2019, more sizeable contingent liabilities related to off-balance PPPs were recorded in Slovakia (2.4% of GDP), Portugal (2.3% of GDP) and Hungary (1.1% of GDP).

Graph I.4.8: **Government guarantees and off-balance PPPs in EU Member States in 2019**



Source: Eurostat.

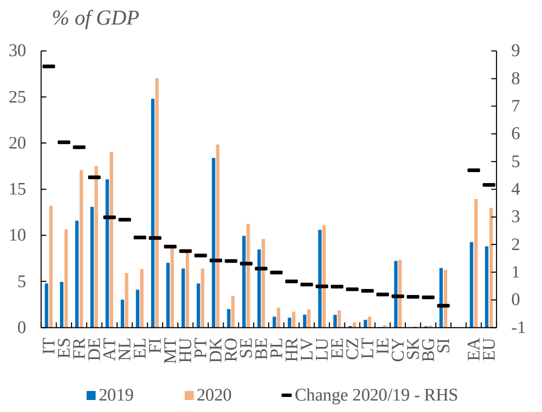
([80]) See IMF (2018).

([81]) In some cases, governments issued *standardised* guarantees in response to the COVID-19 crisis; for such guarantees, expected losses are recorded as estimated deficit impact upfront, in line with ESA 2010 rules. While high uncertainty remains, this mitigates the potential impact of the guarantees for future deficits. This was particularly the case for Italy, where the stock of guarantees increased most in 2020: as the guarantees issued in 2020 in response to the COVID-19 crisis were predominantly standardised, losses associated with the expected future guarantee calls (0.7% of GDP) were already reflected in the deficit of 2020.

Government guarantees granted in the context of the COVID-19 crisis

As a response to the COVID-19 crisis, Member States also provided significant liquidity support to households and businesses in the form of guarantees. During the COVID-19 crisis, the total stock of government guarantees for the EU as a whole increased from about 9% of GDP in 2019 to about 13% of GDP in 2020. However, large differences appear across Member States, with the highest increase recorded in Italy (about 8 pps. of GDP), Spain (less than 6 pps. of GDP), France (5½ pps. of GDP) and Germany (more than 4 pps. of GDP), while the stock of guarantees was broadly stable in 2020 in half of the Member States (with a rise by less than 1 pp. of GDP; see Graph I.4.9). In the case of Italy and Spain, the pre-crisis level was moderate at less than 5% of GDP. Hence, the surge in government guarantees remained moderate in most cases, and overall lower than during the Global Financial Crisis. Contingent liabilities arising from the provision of government guarantees to sustain economic activity and sectors particularly hit by the pandemic would in general be reflected in public debt and deficits *only if called*, except in case of standardised guarantees. It is also worth noting that the mere amount of the guarantees that have been taken up does not correlate with their probability to be called, since this is driven by other aspects, in particular the solvency of the firms that benefitted from the guarantees.

Graph I.4.9: **Stock of government guarantees, level and change 2020/19, by EU country**



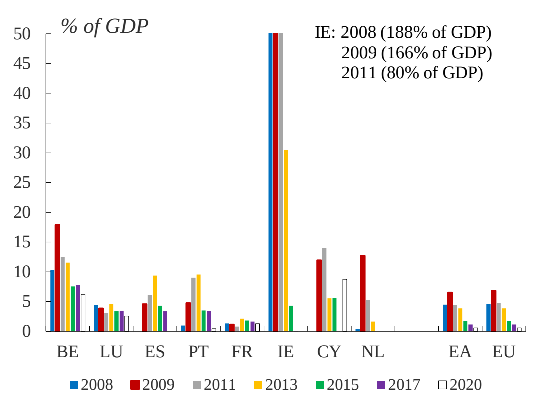
(1) The 2020-19 change shown on the RHS also captures the denominator effect (GDP drop in 2020).
Source: Eurostat.

Contingent liabilities and associated fiscal risks are expected to ease up in 2022. At time of the submission of the 2021 Draft Budgetary Plans, with containment measures phasing out and the ensuing recovery, the take-up of government guarantees related to the COVID-19 crisis was expected to have reached its peak, as many guarantee schemes had already expired. This is confirmed by information provided in the Draft Budgetary Plans (DBPs), which often foresee that the level of contingent liabilities will start declining from 2022, also reflecting the expected economic recovery (see European Commission, 2021). The information provided in the DBPs also highlights that, for some schemes, the actual take-up, reflected in government's actual contingent liabilities, remained modest compared to their initially announced maximum size.

Contingent liabilities related to government interventions to support financial institutions

A subset of contingent liabilities related to government interventions to support financial institutions have followed a downwards trend since 2013. Following an increase during and immediately after the financial crisis, the financial exposure of the government due to the financial stability schemes has been declining since 2013-14 in most Member States and in some countries already since 2012 (see Graph I.4.10). In 2020, the contingent liabilities linked to financial stability schemes were close to zero in most Member States. Exceptions are Cyprus (close to 9% of GDP), Belgium (6% of GDP), Luxembourg (2½% of GDP) and France (above 1% of GDP). Lower outstanding contingent liabilities in recent years reflect the fact that improved financial stability did not require a renewal of the expiring guarantees issued as part of support packages for financial institutions and that the creation of the Banking Union and its bank resolution framework provides a credible alternative to direct public support. Though going forward, the impact of the COVID-19 crisis on financial institutions remains uncertain (see next section).

Graph I.4.10: **Contingent liabilities linked to the financial sector interventions in the EU, 2008-2020**



Source: Eurostat.

4.2.3. Risks from contingent (implicit) liabilities related to the banking sector

A snapshot overview

In order to complement the analysis of potential (implicit) contingent liabilities, additional information is provided related to the banking sector (as in the previous report). This consists of a heat map reporting values of variables that indirectly capture potential building risks in the banking sector and that have proven in the past to be good leading indicators of banking – fiscal crises. Adverse developments in terms of private sector credit flows, bank loan-to-deposit ratios, non-performing loans and house prices, can represent substantial risks to the government's financial position in the future and thus give rise to contingent liabilities, though recent regulation, notably under the Banking Union, helps mitigate such risks.

Key financial indicators point to contained vulnerabilities, though the impact of the COVID-19 pandemic on credit quality as well as other indicators continues to be difficult to be precisely assessed. Based on available data, an overall reduction of non-performing loans (NPLs) ratios is observed (see also Graph I.4.11). Between mid-2020 and mid-2021, NPLs ratios continued to decline in most Member States, with more sizeable reductions in Greece (-15.5 pps.), Cyprus (-6.4 pps.), Italy (-2.3 pps.), Portugal (-1.5 pps.), and Bulgaria (-1.2 pps.) ([82]). As of 2021Q2, the NPL coverage ratio shows that in the majority of countries, NPLs are provisioned for in proportions of at least one third. Only in few cases, NPLs appear both high as a share of total loans, and provisioned for a level lower than 33% (e.g. Ireland – at around 28% - and Malta – at 30%). Provisions are below 50% in some countries with high legacy NPLs (Greece, with a coverage ratio at around 47% and Cyprus, with a coverage ratio at around 44%). Additional indicators point to contained vulnerabilities. Liquidity risks as indicated by the bank loan-to-deposit ratio are identified only in few Member States, e.g. in Denmark, Sweden, Finland and Luxembourg. Finally, developments of private sector credit flows and house prices flag low risks in most Member States.

Table I.4.3: **Potential triggers for contingent liabilities from the banking sector, by country**

	Private sector credit flow (% GDP)	Bank loan-to-deposit ratio (%)	NPL ratio (% of total gross loans)	NPL ratio change (pps.)	NPL coverage ratio (%)	House price nominal index change (%)
BE	1.1	97.5	1.7	-0.3	40.5	4.2
BG	4.2	66.9	6.4	-1.2	51.2	4.6
CZ	2.4	74.7	1.4	0.1	53.8	8.5
DK	4.8	288.9	2.0	0.2	27.2	5.1
DE	6.0	119.3	1.1	-0.1	35.4	7.8
EE	3.6	101.8	1.1	-0.4	27.2	6.0
IE	-1.8	77.7	3.4	-0.7	28.3	0.3
EL	5.4	67.1	14.8	-15.5	46.6	4.4
ES	4.4	103.2	3.1	0.1	40.8	2.2
FR	13.0	105.0	2.1	-0.3	49.4	5.2
HR	1.3	65.5	3.9	-0.4	62.0	7.7
IT	4.1	94.0	3.7	-2.3	53.5	1.9
CY	-2.6	54.8	9.1	-6.4	44.4	-0.2
LV	-1.8	68.0	1.7	-0.1	30.9	3.5
LT	0.3	63.1	0.9	-0.4	26.8	7.3
LU	44.1	156.2	1.5	0.4	36.7	14.5
HU	7.7	77.8	3.6	-0.8	63.8	5.0
MT	9.0	54.0	3.2	-0.3	30.0	3.4
NL	-1.3	112.6	1.7	-0.3	26.4	7.6
AT	4.7	94.9	1.9	-0.1	50.9	7.7
PL	1.5	83.7	5.2	0.3	59.8	10.5
PT	4.4	77.1	4.2	-1.5	58.4	8.4
RO	1.3	58.0	3.8	-0.4	66.9	4.7
SI	-0.9	60.8	2.6	-0.6	54.5	4.6
SK	3.7	105.2	1.8	-0.6	62.9	9.6
FI	6.5	165.3	1.4	-0.2	30.7	1.8
SE	11.6	172.5	0.4	-0.1	42.3	4.2

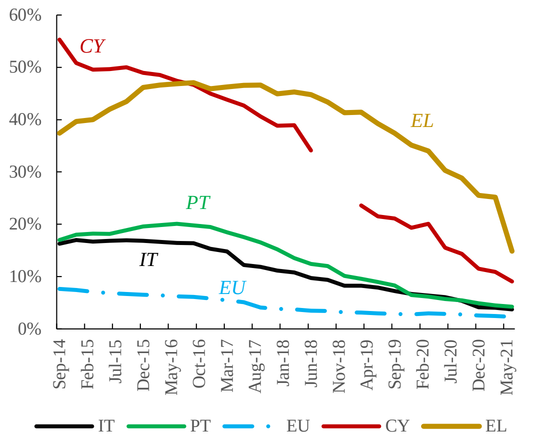
(1) Upper and lower thresholds (see Annex A1): (i) Private sector credit flow (% GDP): upper threshold 11.7%; lower threshold 9.4%; (ii). Nominal house price index (Y-o-Y Change): upper threshold 13.21%; lower threshold 11.0%; iii) Bank loans-to-deposits ratio: upper threshold 133.4%; lower threshold 107.0%; (iv). NPL ratio: upper threshold 2.3%; lower threshold 1.8%; (v). NPL ratio (Change): upper threshold 0.3 pps; lower threshold 0.2 pps; (vi) NPL coverage ratio: lower threshold 66%; upper threshold 33%.
Source: Eurostat (2020 – for private sector credit flows and change in house price nominal index), EBA(June 2021 – for other variables reported).

Caution is however warranted in interpreting these developments as the magnitude of the negative impact of COVID-19 crisis on banks'

([82]) This overall declining trend is also confirmed by ECB data.

balance sheets remains uncertain. Recent figures and risk indicators are affected by public support measures adopted by Member States (in particular, the introduction of loan moratoria and public guarantee schemes) and by monetary policy measures. ([83]) The borrower relief and liquidity support measures have mitigated the impact of the pandemic on bank balance sheets, so an increase in NPLs may have been deferred until the support measures would be phased out (European Commission, ECB and SRB, 2021). This should be borne in mind when interpreting recent figures and inferring the impact of the crisis (and of mitigating measures) on credit risk.

Graph I.4.11: **Non-performing loans ratio (% of total loans), EU average and selected countries**



Source: EBA

Implicit contingent liabilities from severe stress scenarios on the banking sector (SYMBOL model)

The analysis of potential contingent liabilities specifically related to the banking sector is completed by a 'module', based on model estimations of implicit contingent liabilities using bank stress scenarios (as in the previous reports).

The COVID 19 pandemic is a test of the European bank crisis management framework of unprecedented scale since its entry into force. While evidence points at resilience of the banks during the pandemic, validating past regulatory reform efforts, some financial stability risks remain. The COVID-19 pandemic also directly affects public finances, causing significant increases in public debt levels, and the needed measures to shelter the banks call for close monitoring, to avoid the onset of an adverse bank-sovereign 'doom loop' as seen in the past crisis.

Gauging the effect of the crisis on the banking sector is challenging as measures to offset its impact may affect the interpretability of available information. As such, in 2020, the EBA, the Commission, the ECB and the SRB ([84]) performed a useful assessments of the impact of COVID on the EU banking sector, with results pointing at a significant impact on asset quality and on non-performing loans developments.

The estimation of the potential impact on public finance ([85]) of the banks' losses presented here is estimated using SYMBOL (Systemic Model of Banking Originated Losses). The model has been developed by the European Commission's Joint Research Centre (JRC) and the Directorate General Financial Stability, Financial Services and Capital Markets Union (DG FISMA). Similarly to previous exercises, SYMBOL ([86]) uses

([83]) For a detailed discussion of this point see for instance the latest issue (November 2021) of the risk reduction monitoring report, jointly prepared by the services of the European Commission, the European Central Bank (ECB) and the Single Resolution Board (SRB), which provides a regular assessment on risk (reduction) within the Banking Union. See "Risk reduction monitoring report" https://www.consilium.europa.eu/media/52788/joint-risk-reduction-monitoring-report-november-2021-for-publication.pdf

([84]) See EBA (2020) and European Commission, ECB, SRB (2021).

([85]) Second-round effects, which would be linked to the fiscal consequences of possible bank failures, are not taken into account. As explained in European Commission (2016) Part 5.2.2 and in Part IV, Chapter 2 of European Commission (2011a), the relationship between the government's budget and banks' balance sheets is not uni-directional but rather circular and dynamic. Dynamic effects are, however, beyond the scope of the analysis presented here. It is not taken into account, for instance, that a downgrading of sovereign bonds reduces the value of bank assets and can lead to higher funding costs and further bank downgrading.

([86]) More details are reported in European Commission (2016). SYMBOL has been used by the European Commission for the ex-ante quantitative impact assessment of several legislative proposals (see Marchesi et al, 2012; European Commission, 2011b; Cariboni et al, 2012; Cannas et al, 2013; Cariboni et al, 2015), for the cumulative evaluation of the entire financial regulation agenda (ERFRA, European Commission, 2014a), and for the estimation of contingent liabilities linked to public support to the EU banking sector (European Commission, 2011a, 2012 and 2016; Benczur et al, 2015).

unconsolidated balance sheet data to assess the individual banks' losses in excess of their capital and the recapitalisation necessary to allow banks to continue to operate in case of distress. In particular, to account for the crisis environment, the SYMBOL assessment incorporates stress test results provided by the institutions mentioned above, and reports results under both a baseline and a stressed scenario (as done in the previous reports) ([87]).

The model estimates the potential residual costs on government budgets after all layers of the legal safety net available (capital, bail-in, resolution funds) have been deployed. The contingent liabilities due to a potential banking crisis are then split in government deficit and gross public debt. The implicit contingent liabilities that arise from the total funding needs, represented by the losses in excess of capital and recapitalisation needs at 10.5% of the Risk Weighted Assets (RWA), are estimated for the short term and for the long term (ten year forward) scenarios (see Table I.4.4 for the results and Annex 6 for details on the methodology). On the one hand, bank losses in excess of capital after the safety net are assumed to be covered by public injections of funds to the banking sector, affecting public deficit and gross and net debt. On the other hand, recapitalisation is deemed to be recoverable, since capital injection is done in exchange of shares (partial government ownership of the bank) being recorded as a financial transaction affecting neither the deficit nor the net debt, but only the gross debt through the stock-flow adjustment ([88]).

The COVID-19 outbreak, by disrupting economies, pose a challenge to both financial stability and public finances, heightening public debt sustainability risks, though the forceful policy response helped dampen the impact of the crisis and boost resilience. Financial reforms adopted after the great financial crisis strengthened banks risk management processes, helping address the current challenge. This also helped preserve banks credit flows to households, small businesses and corporates, cushioning the impact of the crisis and supporting the economic recovery ([89]). Coupled with direct government support to households and businesses ([90]), the improved regulatory environment mitigated the impact of the health crisis on bank balance sheets. Yet, a risk of a delayed adverse impact on the financial position of banks (e.g. non-performing loans) remains, notably as government support measures are phased out, or in case of a subdued or delayed recovery.

The analysis aims at quantifying the impact of banking losses on public finances while carefully accounting for the particular COVID 19 environment, notably its impact on the observed and potential bank's balance sheet developments. In practice, the model has been adapted to reflect increased risk of bank losses, when accounting for the fact that supportive measures are temporary. In particular, a correction for the RWA based on EBA Stress Test data is applied, and adjust risk measures for loans under public guarantees and moratoria, to better reflect risk in the banks portfolio and on the projected non-performing loans (NPL) developments. These adjustments are discusses in Box I.4.1 and based on Bellia et al 2022 (forthcoming).

Finally, to provide an up-to-date representation of the balance sheet of banks that covers important developments in 2021, we use the most recent aggregated data from the EBA Risk Dashboard (Q3 2021) to reflect such developments for loans under public guarantees, moratoria, NPLs and Regulatory Capital.

To ensure proper treatment of the impact of COVID-19 in the SYMBOL assessment, key adjustments are reflected in the baseline. This

([87]) This particular implementation of Symbol, tailored for the treatment of the COVID-19 environment, is detailed in Bellia et al, forthcoming (2022).

([88]) Under the assumption that such recapitalisations meet the following criteria of the Eurostat's decisions on the statistical recording of public interventions to support financial institutions and markets: the financial instrument used ensures a sufficient non-contingent rate of return and the State Aid rules are complied with (see March 2013 Decision and the earlier July 2009 Decision).

([89]) Regulators have allowed banks to release capital buffers, to defer the recognition of bad loans, and have recommended them to refrain from paying dividends with the final goal to deal with the consequences of the COVID-19 shock and provide lending to companies and households.

([90]) By the end of 2020, both EBA and ESRB data pointed at a substantial amount (around €500bls) of loans benefitting from (an uptake of) public guarantee, while a similar amount of loans benefitted from moratoria measures. However, according to latest figures the amount of loans covered by such measures has substantially declined.

includes reflecting the results of the EBA stress test in the SYMBOL baseline short-term scenario. Moreover, while loans under public guarantees are booked in the banks' balance sheet at a risk weight of zero, we adjust RWAs assuming such (new) loans have average riskiness to avoid understating risk of such loans in the challenging COVID-19 environment. In addition, in the SYMBOL simulation, losses associated to loans guaranteed by the state are directly transferred to public debt (without passing through the safety net cascade).

As in previous reports, NPL's effects on the banking sector is considered only in the short-term baseline scenario, as their effect is assumed to become negligible over the long-term. However, an adjustment is introduced to reflect an assumed delaying of adverse NPL developments due to moratoria ([91]). Specifically, we adjust the reported NPLs amount by adding to it the amount of Stage 2 loans under moratoria ([92]). Stage 2 loans have increased credit risk, indicating that they could become non-performing in the near future. Our adjustment reflects this fact in the NPL figure by assuming that Stage 2 loans that are under moratoria or expired moratoria would eventually become NPLs (see Box I.4.1).

The (adjusted amount of) NPLs is treated as in the previous reports. The baseline short-term scenario reflects how insufficient provisioning for NPLs may lead to overestimation of capital and to underestimation of potential losses in a banking crisis ([93]). The baseline modelling assumption is that non-collateralised NPLs count as loan losses for the system, while those that are collateralised (by immovable property) are redeemable subject to a recovery rate ([94]). Specifically, for each bank *i* and each country *j*, potential loans losses from NPLs are computed as follows:

$$NPLs\ Losses_{i,j} = \left(1 - CollShares_{i,j}\right) \times NPLs_{i,j} + CollShares_{j} \times NPLs_{i,j} \times \left(1 - RR_{j}\right) - Provisions_{i,j}$$

where *RR* is the recovery rate ([95]) and *CollShares* represents the proportion of total loans covered by collateral, i.e. implicitly assuming that this proportion is also representative for the subset of NPLs ([96]). Provisions and NPLs are, respectively, the amount of provisions and gross non-performing loans declared by banks in their balance sheet. The extra loan losses that comes from the NPLs calculated as per the above equation are then added to those coming from the SYMBOL simulation before the intervention of any safety net tools.

The results are obtained as follows. In previous reports the results where calibrated to match the severity of the 2008-2012 crisis ([97]), i.e. a severe and systemic crisis event. In this round we introduce a new yet equivalent characterisation of the crisis event, relying on the so-called Expected Shortfall approach, measured on the tail of the loss distribution, using realisation of extreme values of the common factor as a reference to calculate the losses. In practice, we select all the simulations where the factor is above a threshold (values of the common factor above 3 standard deviations) to compute the Expected Shortfall of the portfolio, namely the average value in the tail of the distribution, which represents the expected value of the portfolio losses in a crisis event. This calibration of the Expected Shortfall computation is in line with the crisis event defined in previous reports. Second, as indicated above, the impact of (existing) NPLs is considered only in the short-term. Third, a (conservative) assumption is made, whereby all simulated banks' excess losses and recapitalisation needs that cannot be covered by the safety net fall on public finances. Fourth, the

([91]) The ECB introduced a specific package concerning the treatment of NPLs, allowing banks to exercise flexibility for the classification of the debtors in the case of exposures covered by moratoria. See for details Budnik et al. (2021).

([92]) Using EBA aggregated data on loans under moratoria and under Stage 2.

([93]) The new regulation on the prudential backstop for non performing exposures is not taken into account in the current set up.

([94]) Note that this approach may entail a bias of different kind (and sign) depending on the circumstances and the type of loans – e.g. in the of difficult foreclosure of household mortgages (leading to loss underestimation) or when household's mortgages command better recovery rates than applicable to firms (leading to loss overestimation).

([95]) Based on country data provided by the World Banks in its Flagship Report "Doing Business 2020" available here.

([96]) Based on ECB data.

([97]) Bank losses and recapitalisation needs triggered by the last crisis are proxied by state aid data, in particular the total recapitalisation and asset relief provided to banks over 2008-12 (around 615 bn euro), see European Commission's DG Competition State Aid Scoreboard, European Commission (2014b) and Benczur et al. (2015).

safety net is assumed to prevent the onset of any contagion effects ([98]). Finally, in the main scenario, non-significant banks are liquidated, and significant banks might be recapitalised or liquidated. In particular, the model accounts for the possibility of liquidation of a significant entity even if supervised by the ECB. This assumption is consistent with the fact that entities under direct ECB supervision do not go automatically into resolution, as the SRB decides on a case-by-case basis whether the resolution of the bank would be in public's interest, while practical cases have confirmed the relevance of this interpretation. To model the decision on public interest, we divide the banks in three groups: GSIBs, significant entities (excluding GSIBs) and non-significant entities. We associate every group with a probability of going into resolution if failing or likely to fail. For GSIBs and their subsidiaries this probability is set to 100% (i.e. GSIBs will be always resolved); for significant entities we take into account a 80% resolution probability and the remaining institutions will always go into insolvency when failing (i.e. with resolution probability equal to 0%) ([99]).

The stressed scenario is constructed with the following features:

As in previous reports, to mimic a fire sales mechanism, increased asset correlation is calibrated in line with the importance of common shocks. During a financial crisis, banks will sell assets to keep their liquidity positions. If many banks are exposed to the same shock, this will have a negative impact on the asset value (i.e. fire sales environment). The intensity of this mechanism is linked to size of the common shock, which underpins the degree of asset correlation.

As in previous reports, NPLs losses are modelled by linking the level of recovery rates to the level of the common shock. This hypothesis takes into account that markets force banks to clean up their balance sheets during a financial crisis. NPLs are liquidated and the losses arising from this forced sale depends on the recovery rate for NPLs. The higher the common shock, the larger the markets pressure is to clean up balance sheets. As pointed out before, the amount of NPL is increased to take into account the current moratoria on loans.

Under all scenarios, the required level of recapitalisation is set at 10.5% of RWA, for each bank, representing the minimum level of capital and capital conservation buffer set by the CRDIV. The extra capital buffers built for G-SIIs are also to be recapitalised ([100]).

In term of results, Table I.4.4 **shows that under the short-term (2022) baseline scenario ([101]) the estimated budgetary impact of a major crisis, ([102]) is negligible for all countries, with losses not exceeding 1% of the GDP. Similarly, in the long-term (2032) baseline scenario, where current NPL stocks' effects are assumed negligible, final losses are negligible for most countries.**

Hence, under the baseline, results show that contingent liabilities does not have a significant impact on public finances under the short-term and long-term baseline scenario.

Under the more extreme (stressed) scenario, results are more severe, with combined losses and recapitalisation needs exceeding 1% of GDP in many countries and largest effects witnessed for Cyprus, Spain, Greece and Luxembourg (i.e. all above 2% of GDP). In the long-term stressed scenario, only Spain and Luxembourg have losses that exceed 1% of GDP, although linked to recapitalisation needs rather than excess losses, which partly reflects the large size of the banking sector in these countries.

([98]) Potential contagion across banks through bail-in (some of the losses absorbed by the safety net re-entering the banking system) is disregarded due to scarce data. Contagion across GSIBs due to the bail in has been already addressed by the new banking package, where cross-holdings of TLAC instruments are to be deducted between G-SIBs.

([99]) Up until last year, for DSA exercises, the standard assumptions were either that only significant institutions go into resolution, or that all banks go into resolution. The current set up is thus more favorable to resolution funds, because a share of the significant banks (20%) is now supposed to go into liquidation.

([100]) O-SIIs buffers are not taken into account due to unavailability of data and technical limitation in identifying the subsidiaries of all OSI.

([101]) With loans under public guarantees, moratoria, NPLs and Regulatory Capital reflecting data up to 2021Q3, provided by EBA.

([102]) That is impact due to excess bank losses and recapitalization needs, after cascade intervention of regulatory tools.

Table I.4.5 **presents the *probability* of having implicit contingent liabilities of higher than 3% of GDP hitting public finances (**[103]**).** The colour coding of the heat map reflects the relative magnitude of the theoretical probabilities of such an event (see Annex 6 for the details of heat map calculation and calibration). Contingent liabilities would not have a potentially significant impact on public finances, under the baseline scenario for any country. Under the more extreme (stressed) scenario, some countries post some probability of their public finances being hit by losses of (at least) 3% of GDP.

Table I.4.4: **Implicit contingent liabilities from banks' excess losses and recapitalisation needs, under alternative scenarios (% GDP 2020)**

	Initial (2022) short term scenarios				Final (2032) long term scenarios			
	Baseline		Stressed		Baseline		Stressed	
Scenarios:	(a)		(b)		(a)		(b)	
	Excess losses	Recap needs 10.5%	Excess losses	Recap needs 10.5%	Excess losses	Recap needs 10.5%	Excess losses	Recap needs 10.5%
	To deficit and debt	Directly to debt	To deficit and debt	Directly to debt	To deficit and debt	Directly to debt	To deficit and debt	Directly to debt
AT	0.0%	0.2%	0.1%	0.9%	0.0%	0.1%	0.0%	0.3%
BE	0.0%	0.2%	0.1%	0.8%	0.0%	0.1%	0.0%	0.4%
BG	0.0%	0.1%	0.1%	0.5%	0.0%	0.0%	0.0%	0.1%
CY	0.1%	0.5%	0.4%	4.8%	0.0%	0.1%	0.1%	0.5%
CZ	0.0%	0.1%	0.1%	0.3%	0.0%	0.0%	0.0%	0.2%
DE	0.0%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.2%
DK	0.0%	0.1%	0.1%	0.3%	0.0%	0.1%	0.0%	0.2%
EE	0.0%	0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%
ES	0.2%	0.6%	0.3%	2.6%	0.0%	0.2%	0.1%	1.1%
FI	0.0%	0.1%	0.1%	0.4%	0.0%	0.0%	0.0%	0.2%
FR	0.1%	0.3%	0.2%	1.4%	0.0%	0.1%	0.1%	0.6%
EL	0.1%	0.5%	0.3%	3.0%	0.0%	0.2%	0.1%	1.0%
HR	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.1%
HU	0.1%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	0.1%
IE	0.0%	0.2%	0.1%	1.4%	0.0%	0.1%	0.1%	0.6%
IT	0.2%	0.3%	0.3%	1.4%	0.0%	0.1%	0.0%	0.6%
LT	0.0%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.1%
LU	0.1%	0.8%	0.2%	3.9%	0.0%	0.3%	0.2%	1.9%
LV	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
MT	0.1%	0.1%	0.1%	0.5%	0.0%	0.0%	0.0%	0.2%
NL	0.0%	0.2%	0.1%	0.9%	0.0%	0.0%	0.0%	0.3%
PL	0.1%	0.1%	0.1%	0.4%	0.0%	0.1%	0.0%	0.2%
PT	0.1%	0.2%	0.1%	1.0%	0.0%	0.1%	0.0%	0.6%
RO	0.0%	0.1%	0.1%	0.3%	0.0%	0.0%	0.0%	0.1%
SE	0.0%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	0.1%
SI	0.0%	0.1%	0.1%	0.8%	0.0%	0.0%	0.0%	0.3%
SK	0.0%	0.1%	0.1%	0.4%	0.0%	0.0%	0.0%	0.2%

Source: Commission services.

([103]) The theoretical probability of public finances being hit by more than a certain share of GDP is directly linked with the magnitude of implicit contingent liabilities presented earlier, the results in the heat map are highly correlated with those in Table 5.2. However, other factors such as a high concentration of a banking sector may also increase the theoretical probabilities presented in the heat map.

Table I.4.5: **Theoretical probabilities of public finances being hit by more than 3% of GDP, in the event of a severe crisis (i.e. involving excess losses and recapitalisation needs in at least three different EU countries)**

	Initial (2022) short term scenarios		Final (2032) long term scenarios	
	Baseline	Stressed	Baseline	Stressed
	(a)	(b)	(a)	(b)
AT	0.02%	0.38%	0.00%	0.20%
BE	0.05%	0.54%	0.03%	0.38%
BG	0.00%	0.17%	0.00%	0.07%
CY	0.19%	4.49%	0.03%	0.45%
CZ	0.01%	0.17%	0.00%	0.10%
DE	0.01%	0.13%	0.00%	0.08%
DK	0.07%	0.25%	0.03%	0.16%
EE	0.02%	0.13%	0.00%	0.06%
ES	0.30%	2.26%	0.10%	1.01%
FI	0.04%	0.32%	0.02%	0.25%
FR	0.10%	0.84%	0.04%	0.45%
EL	0.21%	2.62%	0.07%	0.95%
HR	0.00%	0.04%	0.00%	0.04%
HU	0.01%	0.06%	0.01%	0.04%
IE	0.08%	0.94%	0.04%	0.49%
IT	0.07%	0.85%	0.03%	0.43%
LT	0.01%	0.10%	0.00%	0.03%
LU	0.39%	2.53%	0.14%	1.30%
LV	0.00%	0.01%	0.00%	0.01%
MT	0.04%	0.39%	0.02%	0.22%
NL	0.08%	0.64%	0.02%	0.28%
PL	0.00%	0.14%	0.00%	0.12%
PT	0.04%	0.59%	0.02%	0.46%
RO	0.00%	0.05%	0.00%	0.02%
SE	0.04%	0.17%	0.02%	0.06%
SI	0.01%	0.33%	0.00%	0.12%
SK	0.01%	0.14%	0.00%	0.10%

(1) Green: low risk (probability lower than 0.50%), Yellow: medium risk (probability between 0.50% and 1%); Red: high risk (probability higher than 1%).
Source: Commission services.

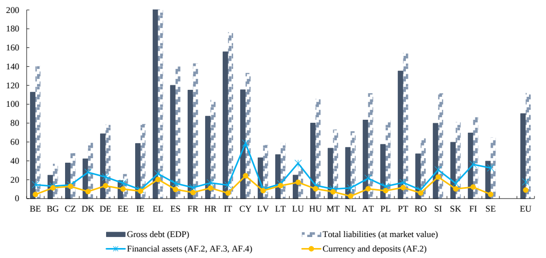
4.3. GOVERNMENT ASSETS AND NET DEBT

In 2020, net debt ([104]**) was close to 18 pps. of GDP lower than gross debt in the EU, with differences varying between 9 pps. of GDP and close to 60 pps. of GDP for individual Member States.** This essentially reflects the large variation of government financial assets across Member States, which is due to the set-up of pension systems, the past materialisation of contingent events, or country-specific fiscal policies such as maintenance of large cash buffers. The difference between gross and net debt was more than 30 pps. of GDP for Slovenia, Sweden, Finland, Luxembourg and Cyprus (see Graph I.4.12) and 20-30 pps. in the cases of Austria, Germany, Greece and Denmark. For Luxembourg, among the

([104]) Measured as the difference between, on the one hand, EDP debt and, on the other hand, financial assets in the form of currency and deposits (AF.2), debt securities (AF.3) and loans (AF.4).

Member States with the lowest gross debt, net debt is even negative as the value of financial assets exceeds the outstanding government debt at face value. The difference between gross and net debt is less than 10 pps. of GDP for Romania, Ireland and Latvia. Among the Member States considered, for those with the highest government debt, i.e.. Greece, Italy, Portugal, Spain and France, net debt is around 15 pps. of GDP lower than gross debt (though for Greece, the difference is higher at more than 25 pps. of GDP due to large cash buffers). Also in net terms, these countries have the highest debt burden among EU Member States. Overall, country rankings for indebtedness are similar when comparing gross and net debt.

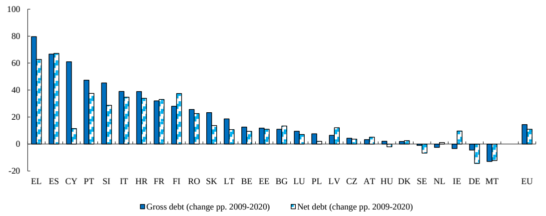
Graph I.4.12: **Gross debt, total liabilities, and financial assets in 2020 (% of GDP)**



Source: Commission services, based on Eurostat.

Some exceptions aside, gross and net debt rose synchronously over the past decade in the EU (see Graph I.4.13). In Malta, Germany and Sweden, both variables decreased between 2009 and 2020. In the majority of Member States, debt increased under both gross and net terms over the last decade. A large (positive) difference between changes in gross and net debt is found for Cyprus. In this country, gross debt rose by more than 60 pps. of GDP between 2009 and 2020, while over the same period, net debt only increased by 12 pp. of GDP. The large-scale financial sector rescue operations led to higher deficits and debt but also involved the accumulation of financial assets. This example illustrates how net debt figures help interpret increases in gross debt that result from financial assistance to the private sector.

Graph I.4.13: **Change in gross and net government debt ratio (pp. of GDP, 2009-20)**



(1) The following financial assets are considered for the calculation of net debt: currency and deposits (AF.2), debt securities AF.3) and loans (AF.4).
Source: Commission services, based on Eurostat.

Box I.4.1: Details on SYMBOL adjusted data: RWA, Guarantees and Moratoria

This box presents adjustments to SYMBOL-based analysis to address specificities of the COVID-19 ([1]). The crisis and the associated government measures deployed affect the development and the (direct) interpretability of a set of key indicators underpinning SYMBOL-based analysis. To account for these aspects in the SYMBOL-based analysis, adjustment was introduced for the treatment of information relating to Risk Weighted Assets (RWA), loans under public guarantees and loans under moratoria. Moreover, in order to capture most recent developments for NPLs, guarantees, moratoria and Regulatory Capital, most recent aggregated data (Q3 2021) reported by EBA are used.

1. REGULATORY MEASURES AND REPRESENTATIVENESS OF THE ACTUAL RISK WEIGHTED ASSETS

Balance sheet data for Q4 2020 point at a decrease in RWA density compared to 2018. At EU level, the RWA density goes from 40.9% in 2018 to 37.6% in 2020. Given the strong economic downturn due to the COVID-19 crisis, this development is likely to be driven by the extraordinary measures put in place by the regulators, as those have a substantial impact on internal risk evaluation for reporting purposes. As such, reported RWAs by banks potentially underestimate actual riskiness of banks' portfolios.

To account for a potential bias on the reported RWAs, we apply a correction coefficient based on the results of the most recent EBA stress test ([2]). The EBA performed a stress test exercise to evaluate the impact on banks of adverse market developments, under a baseline and an adverse scenario, at different time horizons (from end of 2021 to end of 2023). The correction applied to RWAs ensure that, in the short term, riskiness of banks are in line with the adverse scenario depicted by EBA.

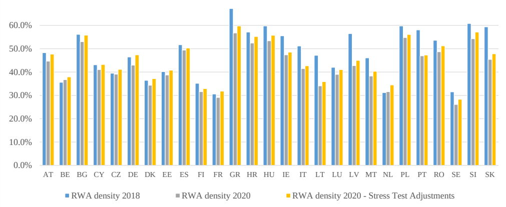
Table 1 shows the impact of the correction on RWAs levels. The average increase for the RWAs of banks is around 5%, though for some Member States (notably DE, FR, and NL) the RWA would increase by more than 9%, following the EBA-based correction. Noteworthy, despite this correction, RWAs density still remain lower than in 2018 in most cases (see Graph 1).

Table 1: **EBA stress test based adjustment of RWAs**

AT	+6.7%	IE	+2.4%
BE	+3.2%	IT	+2.9%
BG	+5.3%	LT	+5.3%
CY	+5.3%	LU	+5.3%
CZ	+5.3%	LV	+5.3%
DE	+10.2%	MT	+5.3%
DK	+8.3%	NL	+9.1%
EE	+5.3%	PL	+2.4%
ES	+1.8%	PT	+0.7%
FI	+4.1%	RO	+5.3%
FR	+9.2%	SE	+8.5%
EL	+5.3%	SI	+5.3%
HR	+5.3%	SK	+5.3%
HU	+4.4%		

(1) Percentage change adjustment of RWAs based on adverse EBA scenario (end of 2021).
(2) In red, missing data replaced by standard assumption: we assume average increase of available data for the Member States included in the stress test exercise.
Source: Elaboration on EBA stress Test data (2021).

Graph 1: **RWAs in 2018 compared to 2020 unadjusted data and EBA-adjusted data.**



Source: Commission services.

2. PUBLIC GUARANTEES SCHEME

Loans guaranteed by the State during the COVID-19 crisis bear a zero risk weight. Yet losses on such loans would directly impact public finances. Risks associated to such loans, which likely increased due to the crisis, would need to be

([1]) The analysis presented here is based on Bellia et al (forthcoming 2022).
([2]) The EBA Stress Test, released on 30/07/2021, contains data on 50 banks from 15 EU and EEA countries and covers around 70% of the EU banking sector assets. See https://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing

(Continued on the next page)

Box (continued)

properly reflected, notably via an adjustment of the bank's RWAs.

Relying on EBA ([3]) aggregated data on new loans under guarantee as of Q3 2021 (Table 2), we measure the increase in losses in SYMBOL simulations that would prevail if an average risk weight would be assumed for these loans. This adjustment proceeds as follows. First, for each bank in our sample we adjust the RWA, assuming that the new loans under guarantee bear same average riskiness as observed for other loans in the bank's portfolio. Second, SYMBOL is used to measure the increased losses that these adjusted RWAs for all banks would imply.

The additional losses related to adjusted (i.e. increased) risk weight of loans under guarantee are directly transferred to public finances. As losses on guaranteed loans are covered by the guarantor (i.e. the state), the additional (gross) losses do not impact the capital of the concerned institution. Instead, simulations directly transfer losses to deficit (excess losses) or debt (recapitalisation) ([4]).

([3]) Data for loans under guarantees come from the EBA risk dashboard, see https://www.eba.europa.eu/risk-analysis-and-data/risk-dashboard.

([4]) Since the actual portfolio of loans includes both positions with and without guarantees, we subtract the guaranteed loans (with zero risk weight) from the total amount of gross loans to have an accurate representation of the riskiness for the banks' portfolio. The updated amount of gross loans serves as a reference to estimate the RWA amount for the credit risk without public guarantees.

Table 2: **Data used for Guarantee-based adjustment of RWAs**

	RWA credit risk (EBA sample)	GL (EBA sample - Excluding Guarantees)	New loans guaranteed (EBA sample)	RWA (EBA sample)	New RWA (EBA sample)	Guarantee-based adjustment of RWAs
	A	B	C	D	E = (A/B)*C	E/D
AT	252.05	562.73	4.19	298.47	1.88	+0.63%
BE	330.38	900.82	1.42	400.12	0.52	+0.13%
BG	18.03	29.62	0.37	19.70	0.23	+1.15%
CY	16.94	26.90	0.40	19.32	0.25	+1.31%
CZ	44.74	136.67	2.04	53.22	0.67	+1.26%
DE	783.20	2,545.21	12.52	1,027.63	3.85	+0.37%
DK	157.60	621.95	0.78	190.77	0.20	+0.10%
EE	14.28	37.97	0.04	15.97	0.01	+0.08%
ES	1,183.99	2,275.38	106.19	1,381.08	55.26	+4.00%
FI	179.72	514.48	1.43	222.14	0.50	+0.23%
FR	2,202.72	5,325.80	114.03	2,588.65	47.16	+1.82%
EL	147.94	204.60	5.56	165.30	4.02	+2.43%
HR	22.84	41.15	0.10	25.60	0.06	+0.22%
HU	45.99	62.96	2.04	51.96	1.49	+2.87%
IE	191.41	221.50	1.31	224.52	1.14	+0.51%
IT	837.71	1,739.01	116.51	1,004.05	56.13	+5.59%
LT	8.00	25.31	0.01	9.02	0.00	+0.03%
LU	88.11	142.29	0.10	101.89	0.06	+0.06%
LV	5.20	13.32	0.00	5.85	0.00	+0.01%
MT	7.83	16.24	0.29	8.76	0.14	+1.62%
NL	509.43	1,848.89	3.33	648.87	0.92	+0.14%
PL	94.95	115.68	3.87	110.12	3.17	+2.88%
PT	147.75	242.08	7.42	170.28	4.53	+2.66%
RO	19.31	33.57	1.21	25.45	0.70	+2.73%
SE	146.21	798.39	0.10	247.85	0.02	+0.01%
SI	16.76	23.39	0.23	19.68	0.17	+0.85%
SK	21.81	46.21	0.70	24.00	0.33	+1.37%

Source: Commission services on EBA data.

3. LOANS UNDER MORATORIA AND NPLS

Despite the challenge posed by the COVID-19 environment, NPL ratios continued to decline in most countries (see Graph 2). These developments are underpinned by the regulatory measures introduced in the midst of the crisis. In particular, the treatment of NPLs was revised to allow flexibility with regard to the classification of debtors in the event of moratoria. Similarly, loans under guarantee that become non-performing have a preferential prudential treatment in terms of loan loss provisioning ([5]). These measures affect interpretability of reported NPL amounts. In addition the amount of NPL in the balance sheet of banks have strongly decreased in some cases due to securitization ([6]).

([5]) See Budnik et al. (2021).

([6]) Notably in the case of Greece, where the NPL ratio decrease from 41.2% in 2018 to 10.49% as of Q3 2021, as discussed in the Enhanced Surveillance Report for Greece (November 2021) linked below: https://ec.europa.eu/info/publications/twelfth-enhanced-surveillance-report_en.
While details on the Greek securitization program are described in the corresponding state-aid decision (SA.53519(2019/N)), available here: https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_53519.
Details on a similar, notable, securitization program in Italy are described in the corresponding state-aid decision (SA.43390 (2016/N)), available here: https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_43390.

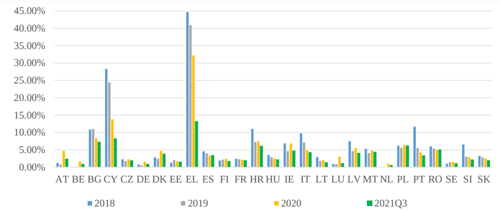
(Continued on the next page)

Box (continued)

Regulatory measures rolled-out during the crisis tend to substantially delay the process of loans under moratoria eventually turning into an NPL. To illustrate, if a new loan is under moratorium and the debtor default on the first payment, it would take (at least) six months for the loan to be registered as NPL, under the (adjusted) rules.

Given the timeline of the rollout of moratoria (and guarantee) schemes, end-2020 balance sheet data are likely severely under-reporting NPLs. Such schemes were rolled out mostly throughout 2020 and considering the time needed to process, disburse and start repaying new loans (usually at least 3 months), only a limited amounts of new NPLs would be registered in 2020, due to the extended time needed for loans to be registered as NPL under the new agreed standards.

Graph 2: **Historical NPL Ratio (NPL over Gross Loans)**



Source: Commission services, Orbis Bankfocus data.

To address the potential significant delay in NPL reporting we rely on Stage 2 loans data. Stage 2 loans identify loans where credit risk has increased significantly, though they are not yet registered as NPLs. EBA provides the following useful loan breakdown, per country (Table 3):

– Amount of loans that are under moratoria or where the moratoria has expired.

– Amount of loans that are in Stage 2.

– Amount of loans that are already non-performing.

To identify the issue of NPL reporting delays associated to new rules on moratoria, we use data on loans under moratoria that are also Stage 2. Table 3 reports recent loans under (active or expired) moratoria in column B, while column C reports the amount of those loans that are also Stage 2. These loans are seen as potential NPL, although the registering of these as such is delays by the fact that they were under moratoria. The share of loans under moratoria that are also Stage 2 is shown in column D. This share is around 30% on average although significant difference exist for that proportion across countries.

To adjust the NPL stock for the delay due to the moratoria, we refer to the share of loans that are under moratoria and are Stage 2, in proportion of total loans (Table 3 **column E).** We assume that this share provides a proxy for the relevance of this issue for a given country. That is, for a given country the larger the share of its loans being under moratoria and Stage 2 the larger the amount of NPL reporting that are delayed due to the new moratoria rules. This share is thus directly used to adjust upwards the amount of reported NPL for the year 2020. To illustrate this adjustment in terms of NPL amounts, Graph 3 report unadjusted and moratoria-adjusted NPLs.

Table 3: **Data used for Moratoria-based adjustment of NPLs**

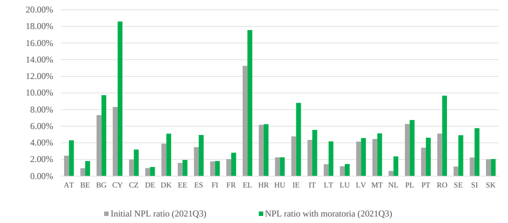
	Total Loans	Loans Under Moratoria (Non expired and expired)	Loans Under Moratoria that are Stage 2	Proportion of Loans Under Moratoria that are Stage 2	Moratoria-based adjustment of NPLs
	A	B	C	D = B/C	E = C/A
AT	566.92	27.35	10.50	38.4%	+1.9%
BE	902.24	36.10	7.73	21.4%	+0.9%
BG	29.99	2.19	0.72	33.0%	+2.4%
CY	27.30	8.42	2.80	33.3%	+10.3%
CZ	138.72	-	-	-	+1.2%
DE	2557.73	20.01	3.73	18.6%	+0.1%
DK	622.74	-	-	-	+1.2%
EE	38.00	0.70	0.14	19.8%	+0.4%
ES	2381.57	159.96	34.75	21.7%	+1.5%
FI	515.91	7.49	0.17	2.2%	+0.0%
FR	5439.82	217.49	42.28	19.4%	+0.8%
EL	210.16	23.19	9.04	39.0%	+4.3%
HR	41.25	3.97	0.03	0.8%	+0.1%
HU	65.00	13.55	0.00	0.0%	+0.0%
IE	222.81	19.94	8.98	45.0%	+4.0%
IT	1855.52	154.56	51.03	33.0%	+2.8%
LT	25.32	0.27	0.07	24.9%	+0.3%
LU	142.39	3.19	0.61	19.1%	+0.4%
LV	13.32	0.28	0.09	32.0%	+0.7%
MT	16.54	1.16	0.29	25.1%	+1.8%
NL	1852.22	42.13	9.00	21.4%	+0.5%
PL	119.54	12.82	5.45	42.5%	+4.6%
PT	249.50	35.81	9.42	26.3%	+3.8%
RO	34.78	2.56	1.23	47.9%	+3.5%
SE	798.49	26.23	0.28	1.1%	+0.0%
SI	23.62	2.24	0.44	19.8%	+1.9%
SK	46.90	3.69	1.32	35.7%	+2.8%

(1) In red, missing data replaced by standard assumption: we assume an increase of 1.5%, which corresponds to the weighted of data available for the other Member States.
Source: Aggregated data from EBA risk dashboard, reference date 2021Q3.

(Continued on the next page)

Box (continued)

Graph 3: **Impact of adjustment of NPL to account for delaying effect of moratoria**



Source: Aggregated data from Orbis Bankfocus and Commission services, reference date 2021Q3.

Box I.4.2: Gross and net debt: concepts and measures

The debt concept used in this report is general government debt, also referred to as 'Maastricht debt' or 'EDP debt' (1)**.** It comprises financial liabilities related to the following debt instruments: currency, deposits, debt securities and loans (2). The stock of *gross consolidated* debt at year-end is measured at *nominal* (face) value rather than at market value. Making use of gross debt means that government-owned assets vis-à-vis counterparts outside the general government are not netted out. The fact that figures are consolidated across the general government sector means that any liability of which the counterpart is another general government unit is netted out.

The use of gross government debt, which is central in the EU's fiscal surveillance framework, has a number of advantages. The choice of gross debt as benchmark indicator was laid down in the Treaty (3). It is a widely used concept, allowing for international comparison. When assessing risks of fiscal stress, gross debt is the obvious starting point considering that it summarises governments' contractual financial obligations and reveals the magnitude of eventual refinancing needs.

Yet, government assets also impact public finances in several ways and might provide useful supplementary insights. On the one hand, government-held assets can become a source of fiscal risks. This is, for example, the case when state-owned companies run into financial difficulties. On the other hand, government assets generate revenue, such as interests or dividends, which are included in the structural balance calculations and thus accounted for in debt projections, as well as in the S1 and S2 indicators. In addition, government assets can theoretically help to reduce debt when sold off. In practice however, effective control, marketability, liquidity, earmarking of financial means and societal concerns can limit this possibility. In addition, the valuation of assets is intricate, in particular for non-financial assets (4).

Net government debt offsets gross debt with certain types of financial assets. It is defined as "gross debt minus financial assets corresponding to debt instruments" (IMF, 2013). Net debt thus provides a measurement of how much gross debt would remain after liquidating financial assets to redeem part of the outstanding debt. It should be noted that financial assets are marked-to-market when possible. As a result, in the EU context, net debt entails adding up two items that are valued in a different way as EDP debt is valued at nominal value. This also means that valuation effects will be present only for the marked-to-market financial assets and will fluctuate along the economic cycle. Because of the differences in valuation of assets and liabilities, and, most importantly, given the conceptual shortcomings for policy use, Eurostat does not publish official net debt figures. However, Eurostat does publish total government liabilities, measured at market value, which are generally higher in percent of GDP than the Maastricht debt ratio due to both larger scope (5) and valuation effects included on the liabilities side.

Net debt is found to have a significant effect on financing costs and the occurrence of fiscal crises, though the direct impact of

(1) General government includes central government, state government, local government and social security.
(2) Maastricht debt does thus exclude monetary gold and SDRs; equity and investment fund shares; insurance, pensions and standardised guarantee schemes; financial derivatives; and other accounts payable such as trade credits.
(3) Art. 126 and Protocol 12 of the Treaty on the Functioning of the European Union.
(4) See Box 5.1 of the FSR 2018.
(5) For more details on the differences in scope and definition between EDP debt (Maastricht definition) and total government liabilities, please see Box 5.1 of the DSM 2019.

(Continued on the next page)

Box (continued)

assets is less clear. According to Gruber and Kamin (2012), there is a robust and significant effect of fiscal positions, including net debt, on long-term bond yields for OECD countries. Relatedly and in line with previous research, Berti et al. (2012) highlight that net debt is an important predictor of fiscal stress episodes (the European Commission's S0 early-detection indicator of fiscal stress includes the variable). Ichiue and Shimizu (2015) confirm that net debt helps explain forward rates for a group of advanced economies but find that assets as such do not ([6]). Henao-Arbelaez and Sobrinho (2017) find that the presence of financial assets does not significantly reduce sovereign spreads and the probability of debt crises in advanced economies, contrary to what is the case for emerging economies.

The difference between gross and net debt can be substantial. For instance, when governments sell financial assets, this may not immediately affect their gross debt figures (Eurostat, 2014). Alternatively, when governments intervene to recapitalise financial institutions, gross debt rises but the parallel acquisition of a portfolio of financial assets might fully or partly neutralise the operation's impact on net debt ([7]). Evidently, asset quality could be an issue in such a scenario and the marketability of such assets would realistically be limited in the near term. Moreover, the valuation of financial assets is based on observed market values. As a result, their value might drop substantially in the event of rising market pressures. The sale of large amounts of government assets might itself induce negative effects on market valuation. Also maturity mismatches between liabilities and assets need to be reckoned with. In sum, interpreting net debt indicators requires caution and case-by-case analysis.

Which financial assets should be considered to compute a concept of net debt that would be relevant for assessing debt sustainability, varies depending on their capacity to mitigate risks. In keeping with the Maastricht debt definition, the net debt concept discussed in this chapter considers financial assets in the form of currency, deposits, debt securities and loans, i.e. the same categories that compose gross debt on the liability side, while debt is measured at nominal (face) value. A more risk-based approach would be to restrict assets to those that are considered highly liquid, such as currency and deposits and certain debt securities, which could be more relevant for determining the capacity to pay debt obligations in stressed situations and assessing liquidity position to honour high gross financing needs. The challenge of conducting the debt sustainability analysis based on a concept of net debt is in determining the appropriate scope and valuation of assets/liabilities ([8]).

([6]) Assets matter, however, for resilience during crisis episodes: IMF (2018a) found that countries that enter recessions with strong balance sheets seem to experience shallower and shorter recessions.

([7]) Only the operations which are considered to take place at market price are recorded as financial transactions, resulting in acquisition of assets, whereas any excess paid by the government over the market price would require recording of government expenditure (capital transfer). Moreover, even when an operation is deemed to take place at market price, it would impact the net debt calculation used in this chapter when the underlying instruments are debt securities or loans, but not in the case of equity holdings.

([8]) See for a more detailed discussion, Box 5.1, Chapter 5, 2018 Fiscal Sustainability Report.

Part II

Special issues

1. INCORPORATING THE NEXTGENERATIONEU IN THE DSA FRAMEWORK

As of this round, the DSA accounts for the impact of NGEU (NextGenerationEU) investment. *The latter, notably via its Recovery and Resilience Facility (RRF) component, will affect national government debt significantly over the medium term via a number of channels, including by fostering economic growth and via favourable financing cost effects. The expected favourable impact of structural reform efforts under the RRF however remains beyond the scope of the DSA framework.*

The impact of NGEU investment is reflected in the DSA framework as follows: *first, the Commission's short-term economic forecast accounts for the NGEU impact, thus providing a starting point for the medium-term debt projections that reflects this impact. Then, methodological adjustments were made to adequately factor-in the impact of NGEU investment beyond 2023 (i.e. beyond the forecast horizon). In particular, the standard 'T+10' medium-term GDP growth projections, usually used in the Commission's DSA, have been adjusted, on the basis of Commission's Quest estimations, to reflect the NGEU investment profile of each country beyond 2023 – i.e. the portion of the NGEU funds still to be absorbed beyond the forecast in each country.*

The incorporation of the effect of NGEU investment in the DSA relies on a set of stylised assumptions. *These notably relate to the degree of 'additionality' of NGEU-financed measures and on the quality of investment. Monitoring of the RRF implementation will allow sharpening those assumptions over time. Importantly, RRF-induced structural reforms, which have the potential to substantially boost GDP growth, have not been reflected in the estimates given inherent difficulties of such exercise. Last, the overall NGEU investment impact is not directly computable because of the difficulty to proxy a counterfactual without NGEU. A comparison of the pre-NGEU GDP growth with the current GDP growth projections that underpin the Commission's DSA sheds some light on this issue but provides only an imperfect proxy of this impact.*

The COVID-19 outbreak and the forceful policy response are highly relevant developments from a DSA perspective. The crisis caused sharp recessions and some temporary financing tensions in some EU Member States, resulting in a temporary deterioration of the interest-growth rate differential (see Part II, Chapter 3). These developments and the necessary supportive fiscal policies caused an increase of governments' fiscal deficit and debt, with heterogeneous effects across countries. Alongside national policies, EU-level policies, of an unprecedented scale, were put into place, including in particular NextGenerationEU (NGEU), the EU recovery plan. These policies aimed not only at cushioning the impact of the crisis, but also at accelerating the green and digital transition, strengthening economic and social resilience and fostering convergence among the EU.

The DSA framework is well-suited to reflect those developments. The Commission short-term economic forecast, which reflects those developments, serves as the starting point for the DSA debt projections. Moreover, forward-looking information, notably contained in financial indicators (i.e. forward interest and inflation rates), are used in the projections. Yet, properly accounting for the unprecedented scale of the EU-level policy response, notably NGEU, over the medium-term calls for some adjustments of the DSA assumptions.

As of this round, the DSA accounts for the impact of NGEU, including the investments under the Recovery and Resilience Facility (RRF), on GDP growth ([105]), ([106]). For that purpose, the regular 'T+10' GDP projections usually used in the Commission's DSA have been adjusted to factor-in the NGEU payments beyond

([105]) This also ensure consistency with the Commission's economic forecast. Details on how the Commission Economic forecast fully accounts for the NGEU is provided in Box I.5.1 of the Autumn 2021 forecast report.

([106]) On the other hand, the GDP projections used in the DSA do not take into account the expected favourable impact of structural reforms under the RRF, an aspect admittedly difficult to quantify.

2023, on the basis of Commission's Quest simulations ([107]).

The rest of this thematic chapter is organised as follows. First, the chapter recalls key features of the NGEU (section 1.1) and the channels through which it is expected to affect debt developments (section 1.2). Then, it describes the methodology developed to reflect it in the DSA framework (section 1.3). Some comparisons of GDP growth projections before and after the inclusion of NGEU investments are also provided (section 1.4).

1.1. NGEU FROM A DSA PERSPECTIVE

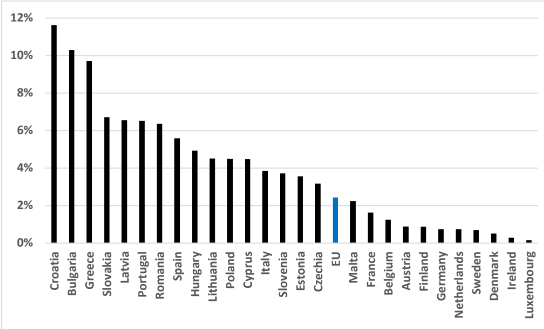
This section recalls the key features of NGEU (section 1.1.1) and the channels through which it is expected to affect government debt developments (section 1.1.2) ([108]).

1.1.1. Key features

Among the policy responses deployed to cushion the COVID-19 crisis impact, NGEU stands out as an unprecedented concerted effort at the EU level. It amounts to EUR 750 billion (in 2018 prices) over the years 2021-2026. The NGEU centrepiece, the Recovery and Resilience Facility (RRF) ([109]), is financed by a temporary increase in the EU's budget (the multiannual financial framework, 2021-2027) ([110]). The RRF accounts for almost 90% of the NGEU package, and is composed of both grants (EUR 312.5 billion) and loans (up to EUR 360 billion) ([111]).

The RRF notably aims at accelerating the green and digital transition, strengthening economic and social resilience and fostering economic convergence in the aftermath of the COVID-19 crisis. Economies with a high rate of (pre-crisis) unemployment and that suffered a deep negative impact of the crisis will receive a relatively large amount of grants ([112]). Such asymmetric support is relevant from a debt sustainability perspective, as countries more economically vulnerable tend to face more fiscal sustainability risks (see Graph II.1.1).

Graph II.1.1: **RRF grants per Member State (% of pre-crisis country GDP 2019)**



(1) RRF grant allocation as indicatively based on the European Commission's 2020 Autumn Forecast.
Source: Commission services.

The RRF is also a performance-based instrument, providing financing for identified investments and reform efforts. Payments under this facility are conditioned to the achievement of agreed milestones and targets, related to specific investments and reforms, as spelled-out in the Recovery and Resilience Plans (RRPs). Importantly, this set-up strengthens incentives to invest and implement major economic, social and

([107]) The regular T+10 GDP projections are the official medium-term GDP projections, computed using the EU Commonly Agreed Methodology (EUCAM).

([108]) See Afman et al. (2021).

([109]) The RRF was proposed by the EC on 27 May 2020. On 21 July 2020 the European Council reached a political agreement on NGEU (and the 2021-2027 long-term EU budget) and by December 2020 a final agreement was reached with the European Parliament on the RRF.

([110]) The NGEU also includes: the Recovery Assistance for Cohesion and the Territories of Europe (REACT-EU) initiative, which adds EUR 47.5 billion support over 2021-2022 to extend crisis response/repair measures, disbursed via the European Regional Development Fund (ERDF), the European Social Fund (ESF), the European Fund for Aid to the Most Deprived (FEAD), and EUR 30 billion of support via further European programmes or funds such as Horizon2020, InvestEU, rural development or the Just Transition Fund (JTF).

([111]) The respective RRF amounts in current prices are EUR 338 billion for grants and EUR 385.8 for loans.

([112]) For the RRF, 70% of the total amount of support Member States are entitled to is allocated on the basis of the Member States' unemployment record from 2015-2019, inverse GDP per capita and population share. For the remaining 30% of the total envelope, the impact of the crisis is taken into account based on the drop in real GDP in 2020 and, in equal proportion, the cumulative loss in real GDP over 2020 and 2021. For details see Annex I-III of the RRF Regulation (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0241&qid=1613983930651&from=EN).

environmental reforms. The strengthening of institutional capacities, via reforms, complements and increases the effectiveness of investments, setting in motion favourable self-reinforcing dynamics.

The RRF is well underway. The Council adopted, on 13 July 2021, implementing decisions on the RRPs of Austria, Belgium, Denmark, France, Germany, Greece, Italy, Latvia, Luxembourg, Portugal, Slovakia and Spain. On 28 July 2021, Croatia, Cyprus, Lithuania and Slovenia also received approval for their plans, while on 8 September 2021, the Council adopted Czechia's and Ireland's plans, on 5 October Malta's plans and on 29 October the plans of Romania, Finland and Estonia. Hence, as of 10 December 2021, 26 EU Member States (all but the Netherlands) had submitted their RRPs, 22 plans were adopted by the Council, while 4 (BG, HU, PL and SE) were still being assessed by the Commission. Seven countries have also requested loans on top of the grant allocation (Greece, Italy, Poland, Portugal, Slovenia, Cyprus and Romania). Italy, Greece and Romania have requested the maximum loan allocation (IT: EUR 122.6 billion; EL: EUR 12.7 billion RO: EUR 14.9 billion), whereas Poland, Portugal, Slovenia and Cyprus requested less than the maximum.

To finance NGEU, the European Commission, on behalf of the EU, borrows on the capital markets. EU's high credit rating, which allows the Commission to borrow at favourable financial conditions, is an advantage that will be passed on to the EU Member States directly, when providing them loans, or indirectly via the EU budget, overall fostering lower interest rate payments on borrowing to finance recovery and resilience spending. The financing will be concentrated between mid-2021 and 2026, corresponding to the RRF life span. Loans will be repaid by the borrowing Member State and grants via the EU budget, while in connection with the repayment of the latter, the Commission proposes new 'own resources' to the EU budget. All funds raised by the EU in relation to the RRF will be repaid by 2058.

1.2. DEBT IMPACT CHANNELS

NGEU represents a multi-year fiscal impulse synchronised across EU Member States, whose impact on national government debt in the medium term will depend on a number of factors and channels ([113]). Those channels include direct effects on public finances and indirect effects, via the fostering of economic growth and favourable financing cost effects. The nature and size of these effects will depend on certain aspects such as the degree of 'additionality' of measures financed by NGEU, the 'quality' of the investment it finances and the use of loans or grants to finance these measures ([114]). Timing mismatches between the release and use of earmarked funds may also (temporarily) affect debt developments. In the description of the channels, we focus on the RRF, as it features both grants and loans and fosters investment and structural reforms, aspects that are all important to highlight the various channels.

1.2.1. Direct impact channel

Three sources of direct NGEU impact on the amount of public debt can be distinguished. They relate to whether or not the measures financed by NGEU fund are fully 'additional' or not, whether some measure are financed through (RRF) loans and whether there is some timing mismatch between the release and the use of funds.

RRF grants represent additional source of public revenue for national governments to finance investments and support reform efforts set out in their RRPs. Under the statistical principle of budgetary neutrality ([115]), grants from the RRF will be recorded at the time when the expenditure funded by the RRF occurs, thereby 'neutralising' the impact of any leads or lags in the

([113]) See also Box 5.1: "The implications of the RRF for debt sustainability: some first elements", in *The 2020 Debt Sustainability Report*.

([114]) Additionality here refers to the fact that NGEU funds would serve to finance measures that would otherwise not have been considered. Instead, in the regulation, additionality implies that RRF funds do not substitute for recurring national expenditures nor for other EU funds (see RRF regulation (final compromise text) recital 10a, art. 4a and art. 8).

([115]) See Eurostat's guidance: https://ec.europa.eu/eurostat/documents/1015035/11337978/Draft_guidance_note_on_the_statistical_recording_of_the_recovery_and_resilience_facility.pdf cash payments. However, if RRF grants are used to finance measures that would exist in a counterfactual scenario without the RRF, then the budget balance (and also government debt) would directly be improved by comparison to that counterfactual.

The (RRF) loan component could also directly affect government debt. If the RRF loans are used to finance 'additional' expenditure, the stock of government debt will increase. Importantly, the increase in debt via this channel would however be mitigated to the extent that the government benefits from more favourable financing conditions to engage such measures than with market financing. By contrast, if the RRF loan is used to finance spending that would have taken place without the RRF – i.e. in case of no additionality – then, a *favourable* impact on debt, through lower interest expenditure, is expected.

Direct impacts on government debt can also arise due to timing mismatches between the disbursement and use of NGEU funds. While in ESA 2010, the budget balance is recorded in accrual terms ([116]), government debt is directly affected by cash flows. Therefore, the direct impact of NGEU funds on government debt will depend on their disbursement profile with respect to the timing of related outflows. For instance, if grant-funded expenditures take place before the release of funds, the government will have to issue (short-term) debt to finance this additional spending. In case of (full) additionality, such issuance will add – at least temporarily – to the debt burden ([117]). Yet, such a potential impact should be short-lived and contained.

1.2.2. Indirect impact channel

The main indirect NGEU impact on debt would relate to its favourable GDP growth impact. The additional expenditure will not only boost aggregate demand during the implementation period (up until 2026), it is also expected to increase potential growth over the medium term, to some extent, especially if this expenditure increases the physical and human capital. Favourable spillover effects are also expected to reinforce favourable economic effects. According to the Commission QUEST model simulations, described in Box II.1.2, the impact of NGEU investment on EU GDP growth will be significant ([118]) and remain positive over the medium term (with a still positive impact in 2032, i.e. beyond the implementation period). Moreover, as stressed above, structural reforms are expected to amplify these positive effects.

The size and persistence of these effects on GDP growth will however depend on a number of aspects. First, the impact of the NGEU-financed measures will depend on the degree of 'additionality' of these measures. The higher the 'additionality', the larger the incremental impact on economic activity, notably as crowding-out effects, stemming from potentially adverse effects on financing conditions, should be limited at the current juncture. In addition, public investment has the potential to crowd in private investment in some activities. Potential import-leakages are also mitigated by the fact that the NGEU is a coordinated common EU-wide fiscal expansion. As regards the persistence of economic effects – i.e. the impact of NGEU on potential growth – it will depend on the quality of reforms and investment projects fostered by NGEU ([119]). The fact that NGEU contributes to cushioning the effect of the economic crisis – i.e. dampening persistent adverse impacts that would otherwise possibly materialise (i.e. so-called hysteresis effects) – also contributes to the favourable indirect NGEU effect on debt, via fostering a more favourable economic outlook.

QUEST-based results, discussed in Box II.1.2**, point at sizeable and persistent positive impacts of NGEU investment on EU's economic activity and on convergence across the EU ([120]).** Such protracted positive impact on growth is expected to improve significantly debt dynamics over the medium term. In addition to providing a fiscal impulse, the medium term structural reform efforts

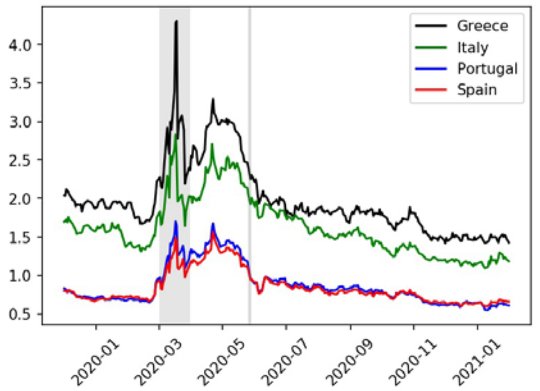
([116]) This means that revenue and expenditure – including interest payments – are recorded when they are incurred, regardless of when the money is actually received or paid.
([117]) As the budget balance (in accrual terms) will not be affected, these amounts will be recorded in stock-flow adjustments.
([118]) Real GDP in the EU is estimated to be up to 1.3% higher during the years of the NGEU's active operation, compared to a no-policy change baseline, see Box II.1.1.
([119]) In the literature, the average output elasticity of public capital is estimated at around of 0.12 (see Bom and Lighthart, 2014).
([120]) See Pfeiffer et al. (2021) for details.

induced by the RRF could provide substantial additional (supply-side) support over the medium-term horizon, e.g. by boosting growth via increased labour market participation, enhanced allocative efficiency and improved business environment.

Positive spillovers represent an important aspect of the indirect NGEU impact. Importantly, it ensures that even economies with smaller grant allocations are also expected to benefit from NGEU, given significant cross-country spillovers in the highly integrated EU economy. Such positive spillovers should contribute to fostering economic activity in those countries and result from the fact that the NGEU is an EU-wide policy.

The adoption of the NGEU package – combined with other policy actions – also contributes to generate indirect benefits by reducing risk premia. This already materialised through a reduction in government financing costs, following NGEU's announcement (see **Graph** II.1.2**).** Such confidence effects should persist, also contributing to stimulate consumer and investment spending, thereby further boosting the indirect GDP channel. Finally, given its long maturity, the NGEU package also contributes to an overall lengthening of average debt maturity across the EU, further insulating Member States' financing costs from short-term fluctuations and thereby reducing rollover risks.

Graph II.1.2: **10 year government bond yields against German bonds**



(1) Shaded areas highlight the COVID-19 outbreak (March 2020) and the NGEU proposal by the European Commission release (27 May 2020).
Source: Bloomberg

1.3. NGEU INCORPORATION IN THE DSA

By its size and nature, the NGEU package is set to have significant implications for the analysis of debt sustainability. As NGEU mitigates the impact of the crisis, fosters convergence across the EU and supports stronger and more resilient recovery, via investment, reforms and positive spillovers, it affects the macroeconomic and fiscal outlook of those countries.

The NGEU impact is reflected in the Commission DSA. First, as the Commission's short-term economic forecast accounts for the NGEU impact, it provides a starting point for the debt projections that reflects this impact. The use of market-based indicators to set projection targets for (inflation and) interest rates also ensures that the anticipated NGEU impact on the developments of those variables is reflected in the DSA. Importantly, this ensures that the impact of NGEU (and other policies) on risk premia developments is accounted for in the DSA.

Beyond these effects, methodological adjustments have been made in this report to adequately factor-in the impact of NGEU investment beyond 2023. Such adjustment primarily relates to ensuring that projected debt developments properly account for the implementation of the NGEU investment beyond the forecast horizon. Several aspects matter in this respect. In particular, the regular 'T+10' medium-term GDP growth projections, usually used in the Commission's DSA, ([121]) have been adjusted to reflect the spending profile beyond 2023. This adjustment, particularly important for countries that either strongly front-loaded (or back-loaded) NGEU implementation, relies on the use of specific QUEST simulations devised for the DSA purpose as explained in Box II.1.1. The remainder of this section presents these various methodological aspects in detail.

([121]) The official 'T+10' medium-term GDP growth projections are estimated by DG ECFIN, using the European Union's Commonly Agreed Methodology (EUCAM), agreed by the Economic Policy Committee's Output Gap Working Group and the EPC. For details on this methodology see Havik et al. (2014).

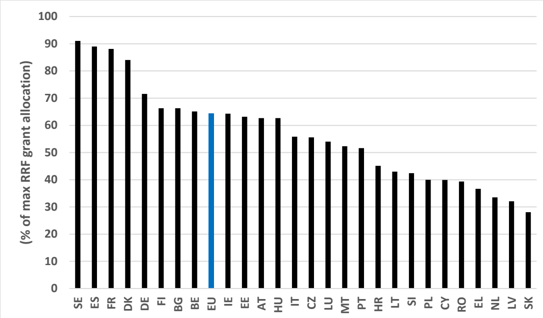
1.3.1. NGEU impact in the forecast

In the DSA, attempt is made to factor-in the expected NGEU implementation profile. The DSA takes the Commission short-term forecast as the starting point of the projections. Beyond the short-term forecast horizon, only the remainder portion of the NGEU investment package, assumed not to have been spent by 2023, is considered for each country.

The forecast accounts for the (RRF-financed) measures incorporated in the RRPs as submitted to the Commission ([122]). The cash disbursement are commensurate to the progress in the achievement and the time profile of milestones and targets as specified in the Plans (and – if adopted – the relevant Council Implementing Decisions) ([123]). The inclusion of transfers from the EU in revenue projections and the time profiles of cash disbursements included in the forecast is based on the assumption of a timely completion of milestones and targets. Any expenditure or other costs financed with RRF grants is neutralised in revenue forecasts by matching transfers received from the EU ([124]).

The Autumn 2021 forecast figures point at a total RRF grants absorption at EU level by 2023 of around 65% of the total RRF financing, while in unweighted terms the average absorption is 55%. This indicates significant front-loading of the use of RRF grants across Member States, according to the assessment embedded in the Commission forecast, especially among larger countries (Graph II.1.3). Among the large Member States, the forecast for France and Spain assumes such significant frontloading of RRF grant financed expenditures (close to 90% of their total RRF grant allocation would be absorbed by 2023), while Germany and Italy would have spent around 70% and 55% of their RRF grant allocation by 2023, respectively. In terms of composition of expenditure, the highest allocation of the EU's RRF funding by 2023 goes to capital transfers (44%), predominantly supporting private investment, followed by general government investment (32%) while the remainder would finance other spending. The forecast also incorporates growth effects linked to the RRF, with RRF-financed investments and accompanying structural reforms expected to push productivity growth to a strong pace of 2.9% next year and 1.6% in 2023, although such quantification is assessed to be surrounded by uncertainty, notably with the role of structural reforms remaining difficult to assess and reflect in the forecast ([125]).

Graph II.1.3: **Absorption of RRF grants up to 2023 (% of total allocation)**



(1) Based on Autumn 2021 Commission Economic forecast.
(2) The graph reports the EU weighted average.
(3) For the EU unweighted average the value is 55%.
Source: Commission services.

1.3.2. NGEU impact included in the DSA beyond the forecast

Building on the Commission short-term forecast, the DSA projections beyond 2023 factors-in the impact expected from the implementation of the remainder of the NGEU funds. In particular, the different degrees of NGEU implementation (i.e. front- versus back-loading) across countries, are reflected in the medium-term projections.

The GDP medium-term projections are based on specific additionality assumptions. Consistently with the standard stylised assumptions retained in the QUEST model, the following assumptions are retained ([126]):

([122]) See Box I.5.1: Some technical elements behind the forecast in the Autumn 2021 Commission Economic Forecast report.
([123]) In cases where the RRP was not yet endorsed by a Council Implementing Decision, the incorporation of the RRP in the forecast rests on the working assumption of a positive assessment by the Commission and future endorsement by a Council Implementing Decision.
([124]) Hence, transactions related to the RRF in the forecast are recorded in line with Eurostat's 'Guidance note on the statistical recording of the Recovery and Resilience Facility' of 7 October 2021.
([125]) See Autumn 2021 Commission Economic Forecast report.
([126]) The adjusted GDP medium-term projections are based on specific QUEST simulations devised for the DSA purpose,

1. We assume full 'additionality' of (remaining) grants and 50% 'additionality' of (remaining) loans.

2. We assume that remaining funds are released linearly over the period 2024-2026 ([127]).

3. We assume that remaining NGEU financed (investment) measures are linearly enacted over the period 2024-2026.

NGEU direct impact

The direct impact of NGEU investment on debt should be limited for most countries. This reflects the fact that grants, which represent the bulk of NGEU in most countries and which are meant to finance 'additional' measures, have a budget neutral impact. As discussed, RRF loans are assumed to be only partially additional, limiting their direct impact on the budgetary balance and debt. Moreover, the impact on the budget of 'additional' measures financed by loans are expected to be partly offset by favourable cost of financing effects ([128]).

NGEU indirect impact

To account for the NGEU impact on growth a new methodology has been developed, relying on adjusted medium-term GDP growth paths compared with the regular 'T+10' projections (see Box II.1.1**).** This adjustment allows accounting for the effect of NGEU disbursements beyond the forecast horizon, and in particular, for different implementation paces across countries (i.e. the degree of front- versus back-loading).

The regular 'T+10' GDP growth estimates tend to imply only a gradual waning of the NGEU investment reflected in the forecast over time. Yet, countries featuring strong front-loading (back-loading) would witness a sharp deceleration (acceleration) of NGEU investment in 2024-2026 (i.e. the remaining NGEU implementation years, beyond the forecast horizon).

1.4. GDP GROWTH PROJECTIONS BEFORE AND AFTER THE INCLUSION OF NGEU INVESTMENTS

The overall NGEU impact is not directly computable in the DSA framework because of the difficulty to proxy a counterfactual without NGEU. Specifically, this relates to the fact that the Commission DSA builds on the short-term forecast, which reflects part of the NGEU impact (up to 2023), while not reporting the magnitude of that impact, for each country.

To gauge the NGEU impact, we compare the current GDP projections with pre-NGEU GDP projections reported in the Debt Sustainability Monitor (DSM) 2020. This provides only a proxy of the NGEU impact. Yet the DSM 2020 is a relevant benchmark as it already incorporated the impact of the COVID-19 crisis but not yet any impact of NGEU investment, including in the short-term forecast ([129]).

Comparing potential GDP figures underpinning the current DSA with those that underpinned the DSM 2020 points at a significant and long-lasting NGEU impact (Graph II.1.4**).** The top panel shows that potential growth is higher once accounting for NGEU investment in all years, except in 2027 when the programme ends, corresponding to a sharp drop in investment intensity that year. The bottom panel illustrates the long-lasting impact on the potential GDP level.

Interpretation of such comparison however warrants caution. The incorporation of the

as explained in Box II.1.2). These simulations are built around the same principles as the Quest simulations run for the assessment of the Recovery and Resilience Plans (see Box II.1.1).

([127]) Note that the standard stylized QUEST assumptions assume a linear NGEU implementation profile over the period 2021-2026 (see Box II.1.1). This assumptions is however amended here when using QUEST to adjust the T+10 medium-run GDP projections, to account for the NGEU, with the QUEST assumption accounting for the portion of NGEU implementation already reflected in the forecast in that case (see Box II.1.2). It is this second QUEST assumption for the NGEU implementation which is relevant here, in the context of incorporating NGEU in the DSA framework.

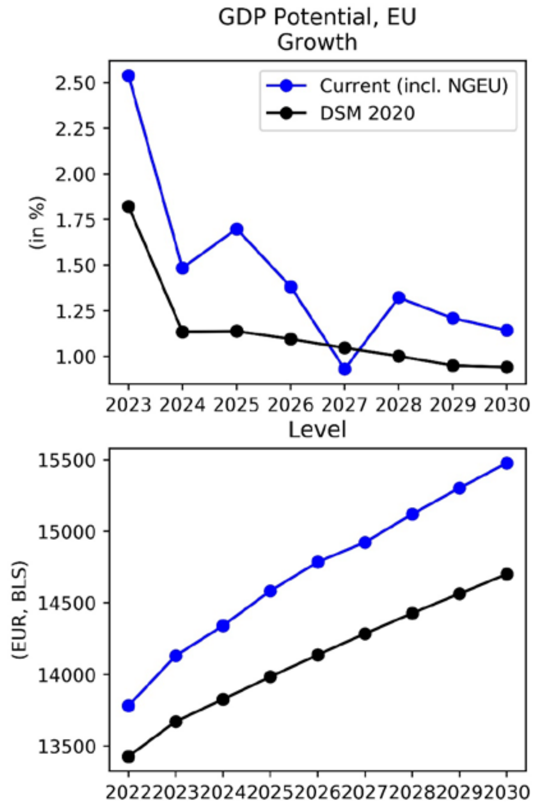
([128]) Moreover, for the few Member States that requested RRF loans, such loans are to be lent on to the private sector in some countries, thus being budget neutral.

([129]) For details on this see Box 5.1 entitled: "The implications of the RRF for debt sustainability: some first elements", in the 2020 Debt Sustainability Monitor and Box I.4.3 entitled: "The inclusion of Next Generation EU and its Recovery and Resilience Facility in the forecast", in the Commission 2020 autumn forecast Report.

NGEU impact is not the sole driver of difference across these vintages. Indeed, such comparisons are also affected by revisions to the assessment of the impact of the crisis.

In terms of impact on national debts, stylised QUEST simulations pointed at close to 5 pps of GDP debt-reducing effect for the EU as a whole, by 2032 (see Box II.1.2**).** This magnitude is relevant in the context of the DSA as incorporation of NGEU impact builds on the use of such QUEST simulations, adapted to account for the NGEU implementation profile assumed under the forecast, as explained in this section.

Graph II.1.4: **Potential GDP compared to the previous report**



Source: Commission services.

Box II.1.1: NGEU adjusted T+10 medium term GDP growth estimates

A variant of the regular 'T+10' medium-term GDP estimates has been constructed which tries to account for the NGEU implementation pace reported in the forecast for each country ([1]). These adjusted 'T+10' medium-term GDP estimates rely on the use of QUEST simulations similar to those described in Box II.1.2 but tailored for the purpose of adjusting the 'T+10' medium-term GDP estimates. Specifically, the steps to adjust the 'T+10' medium-term GDP paths are as follows ([2]):

1. A QUEST-based simulation estimates the impact on GDP of implementing the NGEU embedded in the forecast, for each country. This is used to estimate the carry-over effect that is implicitly reflected in the (unadjusted) regular 'T+10' GDP paths, given the (implicit) assumption of persistence effects on investment in the years beyond the forecast horizon, when relying on the standard 'T+10' method.

2. A second QUEST-based simulation is run using the remainder of the NGEU funds to be implemented beyond the forecast horizon, for each country. This estimate aims at providing the effect on GDP that the NGEU implementation would yield beyond the forecast horizon.

3. The difference between (2) and (1) is the adjustment that is applied to the regular 'T+10' GDP paths to help account for the NGEU implementation profile in each country, i.e. the degree of front- or back-loading embedded in the forecast and the corresponding pick up or deceleration of NGEU investments beyond the forecast.

Graph 1 **shows the regular and the adjusted 'T+10' medium-term GDP level paths, for the EU and Latvia, to illustrate to impact of the adjustment.** It shows that for the EU as a whole, the medium-term GDP level paths are broadly similar and consequently the regular T+10 projections, which draw on ECFIN's desk officer forecasts up to 2023, are in line with the model simulations at the aggregate EU level. This implies that at aggregate levels the persistent NGEU impact embedded in the regular 'T+10' medium-term GDP level paths adequately accounts for the remaining NGEU effects beyond the forecast horizon. This conclusion does not however apply to some countries, due to large differences in the timing of the disbursement of NGEU funds over the total period up to 2026. For example, if a country features strong NGEU implementation back-loading, such as Latvia (deemed to have implemented 30% of its NGEU package by 2023), the paths can differ. In that case, the adjusted 'T+10' medium-term estimate accounts for an acceleration of NGEU-induced investments beyond the forecast horizon (2024-2026), causing a sharp increase in GDP growth in 2024. Overall, this causes a permanent increase of the (relative) GDP level over the projection horizon (2024-2032). An opposite (though contained) effect occurs for countries featuring NGEU implementation front-loading under the adjusted 'T+10' medium-term GDP paths.

Graph 1 **also shows an abrupt decline in the GDP level for the adjusted T+10 path, coinciding with sharp changes in the NGEU implementation pace.** Year 2027 shows a kink in all cases as it coincides with the end of NGEU-induced investments. As such, GDP growth tends to decelerate that year. This effect is especially strong in countries that were still implementing a significant part of their NGEU investments in 2026, namely countries such as Latvia, which had back-loaded their NGEU implementation. In contrast, countries that had front-loaded their NGEU implementation, such as Spain, witness a milder deceleration in 2027, as by 2026 their implementation was already milder. Instead, those countries tend to witness a sharp drop in NGEU induced investments in 2024 and a corresponding drop in growth that year, reflecting the sharp change in the NGEU implementation pace beyond the forecast horizon.

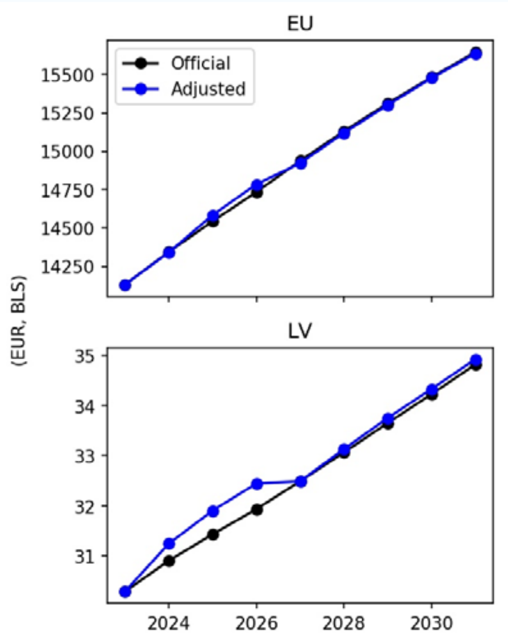
([1]) The regular T+10 GDP projections are the official medium-term GDP projections, computed using the EU Commonly Agreed Methodology (EUCAM).

([2]) The adjustment of the standard 'T+10' GDP paths is spilt across the potential output and the output gap, preserving a smooth path for potential output.

(Continued on the next page)

Box (continued)

Graph 1: **NGEU-adjusted medium-term GDP level path, for the EU and Latvia**



(1) The regular medium-term GDP level paths are those estimated by DG ECFIN, using the European Union's Commonly Agreed Methodology (EUCAM), agreed by the Economic Policy Committee's Output Gap Working Group and the EPC. For details on this methodology, see Havik et al. (2014).

(2) The NGEU-adjusted medium-term GDP level paths account for the differentiated NGEU implementation pace across countries, reported in the Commission forecast, as explained in this Box.
Source: Commission services

Box II.1.2: NGEU impact in a stylised QUEST-based simulation

Simulations based on the Commission's QUEST model provide a stylised quantitative assessment of NGEU's macroeconomic impact ([1]). These simulations incorporate key features of the NGEU, namely the allocation of EU grants to Member States, access to (RRF) loan at favourable conditions and new issuance of debt by the EU with repayment assumptions. The multi-country structure of the model also accounts for spillover effects.

These simulations rely on a number of stylised assumptions regarding NGEU implementation: (i) They consider a total package amounting around 4% of EU GDP with EUR 396 billion in grants with country allocation following largely the RRF allocation key ([2]). (ii) The simulations account for EUR 166 billion in RRF loans, based on requests by seven Member States (as of July 2021) ([3]). (iii) The analysis considers two stylised (linear) implementation profiles, a four-year "fast" scenario (2021-2024) and a six-year scenario (2021-2016). (iv) 100% 'additionality' is assumed for NGEU grants and 50% 'additionality' for RRF loans ([4]). By assuming full 'additionality' of grants and no timing mismatch between the release and the use of funds the direct NGEU impact on public finances plays a limited role in those stylised simulations, reflecting only the 50% additionality of RRF loans (contracted by a limited set of seven countries), considered only for a limited set of countries. (v) The productivity of investment assumption is in line with the literature ([5]). (vi) All Member States repay the EU level debt from 2027 to 2058 based on current GDP shares ([6]). Member States receiving RRF loans repay them from 2031 to 2050 ([7]).

Importantly, this QUEST-based assessment concentrates on the fiscal stimulus alone and does not factor in the positive impact of **structural reforms** on potential growth, which is expected to boost GDP further and in a permanent way ([8]). The simulations also do not take into account **reductions in risk premia or positive confidence effects**, which could further increase the growth effects of NGEU.

Stylised growth impact

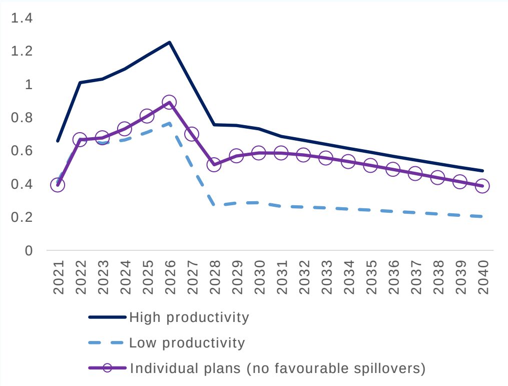
The stylised QUEST-based simulations point at a substantial growth effects of NGEU investments (see Graph 1). For a six-year NGEU scenario, with evenly distributed spending between 2021 and 2026, the level of annual real GDP in the EU would peak around 1.3% higher than it would have without NGEU investments by 2026. As public capital is productive, the additional investment boosts aggregate demand *and* increases potential growth. The latter supply-side effects last beyond the implementation phase and can lead to high long-term cumulative multiplier effects. Even in 20 years' time, EU GDP could be around 0.5% higher than it would have been without NGEU. **Despite differences in the modelling approach, these results are broadly in line with those of other models,** notably an ECB analysis based on the EAGLE model finding that NGEU could increase real GDP in the euro area by around 1.5% over the medium term ([9]).

([1]) See Pfeiffer et al. (2021) and Afman et al. (2021).
([2]) The amount refers to 2019 prices. Besides the RRF grants, the total NGEU grant volume includes other instruments such as ReactEU and the Just Transition Fund (JTF). The allocation across Member States follows the current RRF maximum grant allocation. For ReactEU and the Just Transition Fund, we apply the specific allocation key based on current information. For the other instruments (Horizon Europe, InvestEU, Rural Development, RescEU), we applied the 70%-RRF allocation key.
([3]) The RRF loan volume, based on current information (July 2021), is expected to increase as several Member States have indicated that they intend to apply for a loan at a later stage.
([4]) In the simulations, non-additional loans finance general spending (which would take place anyway) but are repaid in full (i.e. they are not financed via new national debt), thereby reducing the debt burden eventually.
([5]) The main scenarios calibrate the output elasticity of public capital based on a meta-study (0.12). The sensitivity analysis also looks at a lower productivity scenario. See, Bom, P., and Ligthart, J. (2014).
([6]) QUEST simulations also keep track of EU debt which will need to be reimbursed by EU's 'own resources' (Graph 3).
([7]) All repayments follow a linear schedule and are based on lump-sum contributions.
([8]) On this, see Varga, J., and in 't Veld, J. (2014).
([9]) See, Bańkowski et al. (2021).

(Continued on the next page)

Box (continued)

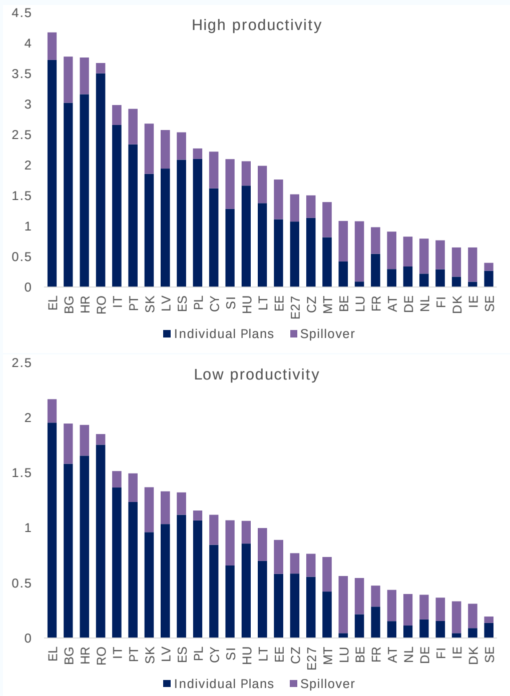
Graph 1: **NGEU GDP impact in QUEST, EU aggregate**



(1) This graph reports the NGEU impact on level of real GDP in per cent deviation from a no-NGEU baseline assuming.
(2) The dark purple line (with circles) shows the results if NGEU plans were enacted unilaterally, implying less favourable spillover effects across the EU and export leakages for each country, while still assuming high productivity of investment.
Source: Pfeiffer et al. (2021).

The simulations also highlight important positive spillover effects (see Graph 1 and 2). Simultaneous investment thus increases the effectiveness of this policy. Open economies with smaller grant allocation benefit significantly via the positive spillover channel. According to the modelling, spillover effects could account for around one third of the growth on average. Simply aggregating the individual effects of Member States' plans would thus substantially underestimate the macro effects of the NGEU (see the breakdown in Graphs 2), confirming that all countries benefit from a positive NGEU impact on GDP.

Graph 2: **NGEU GDP impact in QUEST, EU countries**



(1) The graph shows peak effects on real GDP in 2024 expressed in per-cent deviation from a no-policy change baseline for a fast NGEU profile spanning 2021 to 2024 under the assumption of high or low productivity. The dark bars show simulation results for a standalone investment stimulus in each Member State (NGEU). The spillover (light bars) is defined as the difference between the coordinated simultaneous NGEU stimulus in all Member States and the standalone simulations of national plans.
Source: Pfeiffer et al. (2021).

Stylised debt impact

The stylised simulations point at a significant debt reducing effect (see Graph I.13, solid lines). The debt impact shows a small kink when the NGEU spending phase ends (in 2027, for the six-year scenario) but debt remains on a downward path beyond the NGEU implementation phase.([10]) The model also tracks the impact on total debt, including EU level NGEU related debt (see Graph I.13, dashed lines), which Member States repay from 2027 to 2058, based on current GDP shares in those simulations.

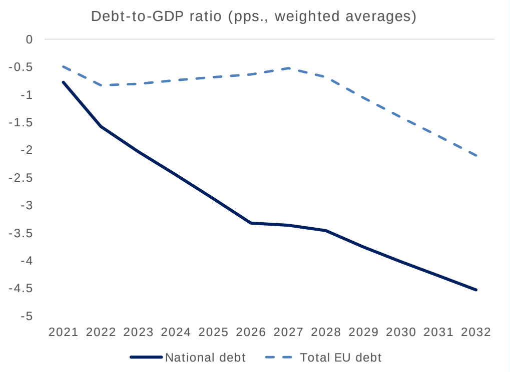
([10]) The assumed interest-rate growth differential matters for the long-run debt trajectory. All scenarios assume a (real) steady-state growth rate of 1.7% and a long-run real interest rate for government bonds of 0% (both in annual terms).

(Continued on the next page)

Box (continued)

The stylised simulations also highlight the sensitivity of the results to key assumptions. Aside from considering the faster (4-year) and the slower (6-year) pace of implementation, notably to provide evidence on the impact of delaying implementation (e.g. by not reaching milestones and targets), results flag the impact of a less effective use of NGEU funds, via assuming the financing of less productive investment, yielding milder growth effects (Graph 1) ([11]).

Graph 3: **NGEU debt impact in QUEST, EU aggregate**



(1) This graph reports the QUEST-based NGEU impact on debt-to-GDP ratios in percentage point deviation from a no-NGEU baseline. The solid (dashed) lines show the average debt ratios abstracting from EU debt (explicitly including EU debt used for grant financing). Note that these stylised model-based debt projections differ from the Commission's Debt Sustainability Assessment, which follows a different methodology.
Source: Pfeiffer et al. (2021) and Commission services.

([11]) See also the details in Pfeiffer et al. (2021).

2. STRESS TESTS ON THE FISCAL IMPACT OF EXTREME WEATHER AND CLIMATE-RELATED EVENTS

Climate change is likely to lead to increasing physical risks, endangering both human and other natural systems. *This may either occur via more intense and frequent extreme weather and climate-related events (acute physical risks) or more gradual (and, often, irreversible) transformation of the environment (chronic physical risks). Both sources of risks underpin several economic and fiscal consequences. Adverse economic impacts from physical risks may occur through shocks to the supply and demand side of the economy caused, among others, by damage and disruption to critical infrastructure and property, reduced labour productivity, lower consumption and investment, and disruption to global trade flows. Public finances are likely to be equally affected via, for instance, increased public spending, materialisation of contingent liabilities, and/or output losses.*

In line with the action points of the new EU Climate Adaptation Strategy, in this chapter we aim to assess the potential impact of climate-related risks on public finances. *In particular, we focus on acute physical risks from climate change, as we aim to capture fiscal (debt) sustainability impacts associated with extreme weather and climate-related events. This is done by providing first, stylised, stress tests, in the context of the standard European Commission's Debt Sustainability Analysis framework, for selected EU Member States. Climate-related aggravating factors to fiscal (debt) sustainability are captured by relying on a global natural disaster database (EM-DAT) as well as forward-looking estimates of economic losses from different climate events (PESETA IV; JRC).*

In our stress tests, we adopt a comparative approach. We illustrate, in a given country, the deviation from the Commission's 10-year baseline debt-to-GDP projections, should a past extreme event reoccur in the medium term. To account for potential interactions between climate change and the expected intensity/frequency of extreme events, the impact is further calibrated according to different global warming scenarios (1.5°C and 2°C). *In each scenario, we assume the specific extreme event to simultaneously exert: i) a direct impact on government accounts (i.e. via the primary balance), affecting the debt level; and ii) an indirect impact via GDP (growth and level) effects (also affecting the debt ratio, via denominator effects). Based on specific triggering criteria, we run stress tests on debt projections of 13 EU Member States: Spain, Spain, Romania, Portugal, Czechia, Hungary, Poland, Greece, Italy, Austria, France, Belgium, Germany and The Netherlands.*

Our results highlight that extreme weather and climate-related events may pose risks to countries' fiscal (debt) sustainability in several countries, although remaining manageable under limited global warming scenarios*. In particular, the simulated extreme event exerts a significant and persistent negative impact on debt projections. The adverse fiscal impact increases in higher projected warming scenarios. Overall, our results appear to be heterogeneous across countries and remain, nevertheless, surrounded by large uncertainties. In addition, while not (yet) macroeconomically large compared to other existing fiscal challenges, our findings emphasise the relevance of implementing large-scale, rapid, and immediate climate mitigation and adaptation measures to dampen the adverse economic and fiscal impacts of (potentially) more frequent and intense extreme events, thereby reducing countries' exposure, vulnerabilities, and their fiscal (debt) sustainability risks.*

Several caveats need acknowledgment*. Due to current data and methodological limitations, the present assessment necessarily builds on several simplifying assumptions. In addition, it only provides a partial perspective of climate-related fiscal (debt) sustainability risks, given our focus on fiscal impact of acute physical risks. Moreover, our results are likely to represent an underestimation of the expected fiscal impact. This is due to potential underreporting of economic losses in both global disaster databases and in forward-looking estimates of projected economic losses, unaccounted risks from non-linearities and tipping points, potential negative feedback effects across sectors, and/or adverse spillover effects across countries, combined with our medium-term perspective. Going forward, besides risks from direct physical events, a broader assessment will need to encompass the fiscal impact of mitigation policies aimed at supporting the transition to climate-neutral economies, as well as of adaptation policies aimed at anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause.*

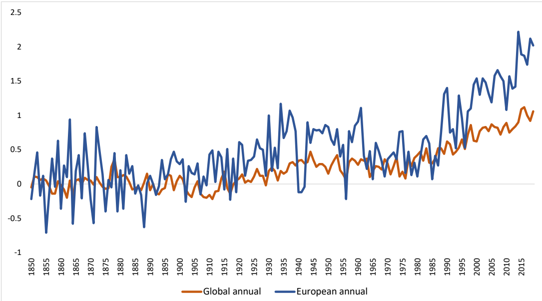
2.1. INTRODUCTION

2.1.1. Climate change is accelerating and requires decisive policy action

Climate change is one of the biggest challenges of our times. There is broad scientific consensus that human activities are unequivocally responsible for the observed increases in greenhouse gases (GHGs) concentration in the atmosphere (IPCC, 2021). The rise in anthropogenic GHGs represents a unique and global negative externality of the consumption of carbon-intensive goods (130), making climate change 'the greatest market failure that the world has ever seen' (Stern, 2007).

As a result, global temperature has been increasing markedly over the past century. According to the IPCC (2021), emissions of GHGs from human activities are responsible for approximately 1.1°C of warming since 1850-1900, increasing at a rate of 0.2°C per decade since the 1970s. The impact has intensified over the last decade. Over 2010-2019, the global mean near-surface temperature was 0.9°C to 1.03°C warmer than the pre-industrial level. European land temperatures have increased even faster, by 1.7°C to 1.9°C, over the same period (see Graph II.2.1).

Graph II.2.1: **Global and European temperature anomalies, 1850-2019**



(1): Temperature anomalies (i.e., degree Celsius differences) are presented relative to a 'pre-industrial' period between 1850-1899.
Source: European Commission, based on the European Environment Agency, Annual Global (Land and Ocean) temperature anomalies – HadCRUT (degrees Celsius) provided by Met Office Hadley Centre observations datasets.

Large-scale, rapid, and immediate mitigation measures have the potential to limit climate change and its related effects. According to the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report (AR6; IPCC, 2021), average global temperature is expected to already reach or exceed 1.5°C of warming within the next 20 years. Under high (SSP3-7.0) and very high (SSP5-8.5) projected GHGs emission scenarios - i.e. assuming the world would take a carbon-intensive pathway, in the absence of adequate mitigation policies - global warming of about 3°C to more than 5°C higher might occur by the end of the century (IPCC, 2021).

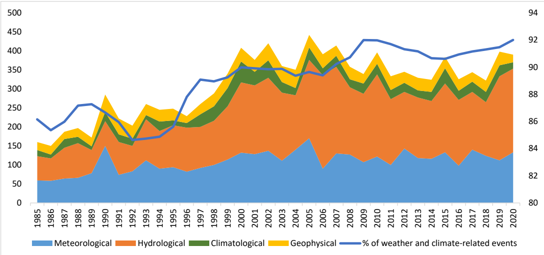
Human-induced climate change has increased the risks of *physical* hazards, which will continue to intensify and interact with other risks, endangering both human and other natural systems (IPCC, 2022). (131) This may either occur via a gradual (and, often, irreversible) global warming-driven transformation of the environment (e.g. ecosystem collapse, global sea level rise, and melting ice sheets – so called *chronic physical risks*), or via more intense and frequent extreme weather and climate-related events (e.g. storms, floods, droughts, heat waves – so called *acute physical risks* - see Graph

(130) Externalities can be seen as effects of production or consumption of goods on agents who do not participate in the production or consumption decision of those respective goods (Solow, 1971). In that sense, the market price of carbon-intensive goods does not reflect the social cost of carbon, resulting in substantial negative externalities from GHGs emissions (Pigato, ed., 2019; Krogstrup and Oman, 2019).

(131) Natural hazards become *disasters* when 'human lives are lost, and livelihoods damaged or destroyed' (CRED, 2020, pp. 8). In this chapter, we focus on natural *hazards* and *disasters* caused by 'extreme weather or climate-related' events. Earthquakes are not included in our definition.

II.2.2). ([132])([4]) Limiting global warming to 1.5°C is expected to reduce risks to ecosystems and human activities. Every additional 0.5°C of global warming is likely to exert a significant increase on both the *intensity* and *frequency* of extreme weather and climate-related events, such as severe heatwaves, heavy precipitation, and drought (IPCC, 2021).

Graph II.2.2: **Global number of natural disasters, 1985-2020**



(1) LHS: Number of meteorological (e.g., extreme temperature, storm), hydrological (e.g., floods), climatological (e.g., droughts, wildfires), geophysical (e.g., earthquake) events.
(2) RHS: The % (in terms of total natural disasters) of extreme weather and climate-related events (i.e., meteorological, hydrological, and climatological) is represented as a 5-year moving average.
Source: European Commission, based on the Emergency Events Database (EM-DAT; CRED, UCLouvain).

Moreover, the risk of non-linearities and tipping points may increase the likelihood for catastrophic and irreversible outcomes to occur. Nowadays, there is widespread agreement that tail-risks are real and the risk of catastrophic and irreversible disaster is rising (Lenton et al., 2019; Krogstrup and Oman, 2019; IPCC 2018, 2014), implying 'potentially infinite costs of unmitigated climate change' (Krogstrup and Oman, 2019, pp.11; Weitzman, 2011), with no backstop in the event of catastrophic climate change (Aglietta et al., 2018). Hence, unless a sharp decline in GHG emissions occurs before the mid of this century, global warming is very likely to have catastrophic consequences for entire ecosystems and exert negative impacts on our society, particularly on the most vulnerable (IPCC, 2019).

The adoption of the 2015 Paris Agreement on Climate Change marks an ambitious landmark to combat climate change and adapt to its effects, committing to hold the increase in the global average temperature in the 21st century to well below 2°C (above pre-industrial levels) and pursue efforts to limit the increase to 1.5 °C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change. The recent COP26 UN Climate Change Conference in Glasgow has resulted in an agreement to revisit commitments to remain on track for 1.5°C of warming, maintaining the upper end of ambition under the Paris Agreement. This should also be achieved via further efforts to phase-down unabated coal power and inefficient fossil fuel subsidies and recognising the need for support towards a just transition (UNFCCC, 2021).

At the EU level, decisive initiatives have been taken with a view to deliver on these targets. The recent European Climate Law sets the binding objective, initially set out in the European Green Deal, to make Europe's economy and society 'climate-neutral' by 2050. The law also sets the intermediate target of reducing net GHG emissions by at least 55% by 2030, compared to 1990 levels. To this purpose, the European Commission has adopted the 'Fit for 55 package' to make the EU's climate, energy, land use, transport and taxation policies fit for reducing net GHG emissions. Additional efforts relate to the Next Generation European Union (NGEU)'s Recovery and Resilience Facility (RRF). Following the commitment by the European Council to achieve a climate mainstreaming target of 30% for both the multiannual financial framework and the NGEU, each Recovery and Resilience Plan (RRP) has to include a minimum of 37% of expenditure related to climate. In addition, Member States' proposed reforms and investments need to respect the 'do no significant harm' principle, by not being detrimental to climate and environmental objectives. In February 2021, the European Commission adopted its new EU Adaptation Strategy to climate change. The new strategy sets out how the EU can adapt to the unavoidable impacts of climate change and become climate resilient by 2050 and sets out four main objectives: to make adaptation smarter, swifter and more

([132]) The distinction between *extreme weather* and *extreme climate* events is not clear-cut and mainly depends on the adopted time scale (IPCC, 2012). In particular, 'extreme weather events are associated with changing weather patterns, that is, within time frames of *less than a day* to a *few weeks*'. Instead, 'extreme climate events happen on *longer time scales*, and can be the accumulation of (extreme or non extreme) weather events (such as the accumulation of moderately below-average rainy days over a season leading to substantially below-average cumulated rainfall and drought conditions' (IPCC, 2012, pp. 117).

systemic, and to step up international action on adaptation to climate change. ([133])

2.1.2. Climate change is expected to have significant macroeconomic and fiscal impacts

Climate change commonly entails two sources of risks, with economic and fiscal consequences. On the one hand, *physical risks*, defined as 'those risks that arise from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability of exposure of human and natural systems, including their ability to adapt' (Batten et al., 2016, pp.5). *Physical risks* are distinguishable in *acute* and *chronic*. *Acute physical risks* identify extreme weather and climate-related events, which tend to cause immediate damage and lead to potential short- and medium-term consequences. Instead, *chronic physical risks* may cause permanent damage over the medium and long term, as they reflect more gradual, and often irreversible, transformations of the environment due to global warming. On the other hand, *transition risks*, related to *mitigation* policy efforts, may arise from the economic and fiscal consequences stemming from the transition to a low-carbon economy (Batten et al., 2020). In spite of such conceptual distinction (which we rely upon throughout the chapter), *physical* and *transition risks* 'are not independent of each other but tend to interact' (Batten et al., 2020; pp. 3), as inadequate policy actions to fight climate change can aggravate *physical risks* and, in turn, intensify *transition risks* (European Commission, 2021b; NGFS, 2020).

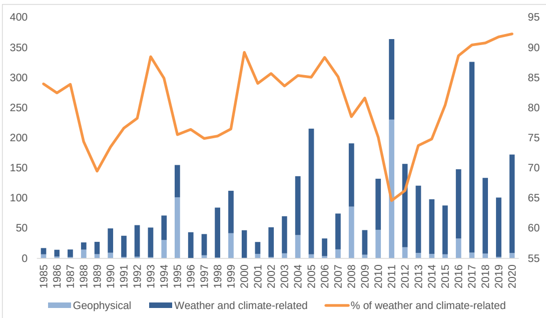
Physical risks

The *physical risks* from climate change are overall increasingly associated with adverse economic impacts, mostly occurring through shocks to the supply and demand sides of the economy. This is particularly the case for *acute physical risks*, stemming from extreme weather and climate-related events (see Graph II.2.3). The latter may cause, among others, damage and disruption to the capital stock, loss of hours worked due to extreme events, disruption to trade flows, as well as reduction in consumption and investment (see section 2.2 for more details).

([133]) See European Commission (2021a), COM(2021) 82 final.

Similarly, *chronic physical risks* (i.e. due to gradual global warming) may adversely affect the economy via, for instance, loss of hours worked due to extreme heat, resource diversion from investments in productive capital to climate change adaptation, and shifts in investment and consumption patterns ([134]) (see Batten et al., 2020; Batten, 2018; for a thorough review). The most adverse impacts are likely to be borne by communities located in areas with high exposure to climate disasters, as well as in those with lower capacity to prepare for and cope with such events. Sectors heavily reliant on natural resources and stable climate conditions (e.g. agriculture, fishing) for the good functioning of their economic activities are expected to experience greater impacts (USGCRP, 2018).

Graph II.2.3: **Global economic losses from natural disasters (Mls USD,m, current value), 1985-2020**



(1) LHS: Weather and climate-related events include meteorological (e.g., extreme temperature, storm), hydrological (e.g., floods), and climatological (e.g., droughts, wildfires) events. Geophysical events (e.g., earthquakes).
(2) RHS: The % (in terms of total natural disasters) of extreme weather and climate-related events (i.e., meteorological, hydrological, and climatological) is represented as a 5-year moving average.
Source: European Commission, based on the Emergency Events Database (EM-DAT; CRED, UCLouvain).

The macroeconomic impacts from *physical risks* are expected to be heterogeneous across the EU. In Europe, the overall exposure has not (so far) been as large as in other parts of the world. In addition, the impacts have varied greatly across individual years, countries, and regions. For instance, between 1980 and 2019, a large share

([134]) Nevertheless, in specific sub-regions (e.g. *Northern* ones), some positive economic impacts from gradual global warming might potentially occur via, for instance, benefits on the agriculture (e.g. new crop varieties and higher crop productivity) and/or tourism sectors (European Commission, 2021b; Feyenet al., 2020; Farid et al, 2016; EEA, 2012).

(more than 60%) of total reported economic losses from weather and climate-extremes in Europe has been caused by a small number (less than 3%) of all unique registered events (European Commission, 2021b). ([135]) Recent models also show that the economic burden from *physical risks* is expected to exhibit a clear regional divide. In particular, *Southern regions* in Europe are likely to experience much larger negative impacts through the effects of heatwaves, water scarcity, droughts, and forest fires (e.g. via increased human health risks and mortality, reduced labour productivity, agricultural losses, energy availability, reduced suitability for tourism). On the contrary, *Northern parts of Europe* could generally experience positive impacts from a warmer temperature, with benefits on sectors such as agriculture (e.g. new crop varieties and higher crop productivity), energy supply, and tourism. ([136]) As a result, aggregate losses in *Southern regions* are expected to be several times larger compared to those in the *north of Europe* (European Commission, 2021b; Feyen et al., 2020; Farid et al, 2016; EEA, 2012).

Nevertheless, the overall assessed economic impact of *physical risks* from climate change may suffer from underestimation. This may be due to simplifying underlying assumptions on both the (expected) negative and positive impacts, the potential exclusion of catastrophic outcomes possibilities, the exclusion of significant, but not easily includable, phenomena (e.g. ecosystem degradation and collapse), as well as other complex interactions (Stern, 2013). Bottom-up (i.e. sectoral) approaches typically provide a partial equilibrium perspective (i.e. not covering all relevant impacts in the economic system). On the contrary, top-down approaches (such as the damage functions generally used in climate-economic Integrated Assessment Models - IAMs) often suffer from methodological caveats (e.g. adequate common metric for costing different elements, choice of the discount rate; European Commission, 2021b, 2020; Dimitrijevics et al., 2021; Dietz et al 2020). Hence, while they provide qualitative indications on how complex systems behave, accurate quantitative predictions are not yet available.

Adverse macroeconomic developments from *physical risks* could also pose challenges to the sustainability of public finances. Public finances are likely to be affected in multiple ways by climate change. First, *directly*, such as increased public spending to replace damaged assets and infrastructures, to support vulnerable households or firms, as well as via the materialisation of both *explicit* (e.g. relief or disaster-specific transfers to local governments, government guarantees for firms and public-private partnerships) and *implicit* contingent liabilities (e.g. public support to distressed financial institutions). *Indirect* impacts on public finances are also likely to occur in several instances, such as reduced tax revenue due to output losses following disruptions of economic activity in climate-sensitive sectors and regions. Vulnerability to climate change might even generate increasing risks of uncertainty, affecting the creditworthiness and the international financial accessibility of a given country (see Section 2.2; Radu, 2021; Zenios, 2021; European Commission, 2020). The fiscal impact of *physical risks* is also entwined with countries' ability to adapt, by anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause. Adaptation, aimed at increasing resilience to adverse weather effects in the long term and reducing the severity of climate damages to more moderate effects, is expected to require significant public expenditure (including investment) in climate-proofing infrastructure, among others. ([137]) ([138])

([135]) The five most expensive climate extreme events in EU Member States were the following, in decreasing order of magnitude (2017 values): the 2002 flood in Central Europe (over EUR 21 billion in losses); the 2003 drought and heat wave (almost EUR 15 billion in losses); the 1999 winter storm Lothar (around EUR 13 billion in losses); the October 2000 flood in Italy and France (around EUR 13 billion in losses), the 2013 floods in central Europe (almost EUR 11 billion in losses) (European Commission, 2021b; based on reinsurer Munich Re's NATCATService; see https://www.eea.europa.eu/ims/economic-losses-from-climate-related).

([136]) However, negative impacts on the agricultural and forestry ecosystems in the north of Europe may also occur, mainly through increasing risks of pests and diseases, nutrient leaching, and reduced soil organic matter (EEA, 2012).

([137]) Examples of *adaptation* measures include modifying construction regulation for making buildings resilient to higher temperature and/or extreme weather events, developing drought-tolerant crops, promoting forestry practices that could reduce vulnerability to storms and fires (European Commission, 2020).

([138]) See COM(2021) 82 final.

Transition risks

Besides risks from direct *physical* impacts, the *transition* to a low-carbon economy is also expected to exert significant effects on the economy and public finances (i.e. *transition risks* from climate change)**.** Despite exerting different positive pressures on climate change itself or on resilience to climate, the different range of *mitigation* policy options ([139]) are also likely to have specific impacts on the economy. The overall macroeconomic impact is expected to depend on the timing and design of policies to support the transition. The conventional argument is that *transition risks* underpin, at least in the short term, a trade-off between reduction of current emissions, which comes at a direct mitigation cost, and long-term environmental quality (Baur et al., 2021; Zenios, 2021; Feyen et al., 2020; NGFS, 2020; Batten, 2018; OECD, 2015). While this does not necessarily mean that economic growth will decline, the transition is expected to lead to asymmetrical impacts and adjustment costs at sectoral level and for parts of the society (European Commission, 2018). ([140]) Additionally, the climate transition may potentially affect the underlying composition of growth, with more resources devoted to investment and less to consumption, given the expected accelerated obsolescence of certain existing capital stock (Pisani-Ferry, 2021; European Commission, SWD(2020) 176 final).

While public finances will play a central role in the climate transition, they are also likely to be subject to significant challenges. On the one hand, mitigation efforts should reduce the risks and economic and fiscal costs from climate change in the long term, with milder impacts in terms of damages, growth, and borrowing needs (Zenios, 2021). On the other hand, such policies are expected to result in an upward pressure on public finances in the short and medium term. For example, higher public expenditure is likely to be required in the form of public subsidies supporting a clean energy transition as well as other social and compensatory policies. At the same time, additional revenue will be raised through carbon pricing instruments (Pisani-Ferry, 2021; European Commission, 2020a,b). For the EU as a whole, the overall additional investment needs for the green transition have been estimated to around EUR 520 billion per year for the period up to 2030 (European Commission, 2021c). ([141]) More specifically, the additional energy system investment needs (including transport) to reach the 55% emissions reduction target have been estimated to around EUR 390 billion per year during 2021-2030 relative to 2011-2020. The public sector will play an important role in carrying out part of these investments directly and in cooperating and/or providing support for private investors, e.g. via private-public partnerships and State aid schemes in support of the deployment of renewable energy or the decarbonisation of industry. ([142])

2.1.3. Climate change and fiscal sustainability frameworks

Despite its considerable relevance, the analysis of climate-related risks has often been absent from fiscal sustainability frameworks of official institutions, notably due to inherent difficulties in conceptualising and quantifying such aspects. Notwithstanding these difficulties, modules tentatively examining potential implications from climate-related risks on the sustainability of public finances have recently seen a surge. Recent analyses on the matter relate to the United Kingdom OBR (2021) and the Swiss Federal Department of Finance (2021). ([143]) At the EU level, notable initiatives on fiscal matters and climate change relate to ongoing work on 'green budgeting' (Battersby et al., 2021; Bova, 2021),

([139]) Examples of *mitigation* policies include carbon taxation, emission trading schemes, specific regulations or tax incentives that promote the use of clean energy, (e.g. renewable energy or zero-emission transport), or more efficient energy use (i.e. scaling up the energy efficiency of domestic appliances or buildings).

([140]) For instance, a contraction in economic activity in the mining and extraction of fossil fuels is expected. An impact on energy-intensive industries or the automotive sector can also be expected, as these sectors will need to be structurally transformed. Other sectors, such as renewable energy or construction, are expected to face stronger demand, but they may face bottlenecks. In addition, lower and higher-income households will be differently affected, due to their budget constraints but also their borrowing capacity that influence their capacity to procure more efficient assets. At the same time, the transition is expected to spur growth in new sectors (i.e., 'green growth'). See European Commission (2018), COM(2018) 773 final.

([141]) See European Commission (2021c), COM(2021) 662 final.

([142]) See SWD(2021) 621 final, Table 7.

([143]) For an overview of official institutions encompassing climate risks into fiscal sustainability and financial stability frameworks, see European Commission (2020a).

disaster-risk financing (Radu, 2021), and disater risk-management (European Commission, 2021d). Moreover, the 2019 Debt Sustainability Monitor (European Commission, 2020a) provides a conceptual framework on how to encompass climate change impacts on growth and public finances in the standard European Commission's Debt Sustainability Analysis (DSA).

On this basis, this chapter aims to provide an assessment of the potential impact of climate-related risks on public finances from an EU perspective. This is in line with the action points of the new EU Climate Adaptation Strategy. In particular, we focus on *acute physical risks* from climate change, as we aim to capture fiscal (debt) sustainability impacts associated with extreme weather and climate-related events. This is done by providing first, stylised, stress tests, in the context of the standard European Commission's Debt Sustainability Analysis framework for selected EU Member States. To build our debt stress tests, we adopt a stepwise approach. We begin with a comprehensive review of the theoretical and empirical literature on the macroeconomics of natural disasters (Section 2.2.1). We then explore available global natural disaster loss databases and provide stylised facts on Europe (Section 2.2.2). Our assumptions and modelling approach (Section 2.2.3), alongside our main results (Section 2.2.4), are subsequently illustrated. Finally, Section 2.2.5 concludes with an overview of potential caveats to our analysis and related way forwards.

2.2. STRESS TESTS ON THE FISCAL IMPACT OF EXTREME WEATHER AND CLIMATE-RELATED EVENTS

2.2.1. The macroeconomics of disasters

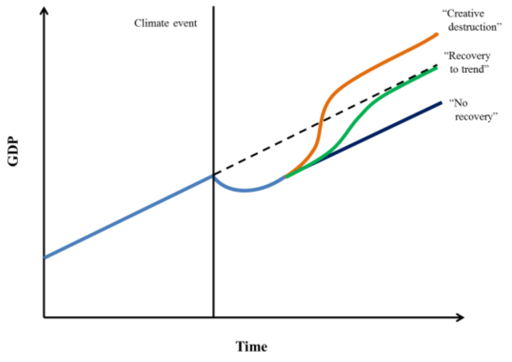
Climate-related disasters are expected to exert significant economic and fiscal impacts. In this section, we provide an overview of the theoretical and empirical research on the macroeconomics of natural disasters (Batten, 2018). While still at its infancy, this literature provides a useful starting point to examine the economic and related fiscal impacts of extreme weather and climate-related events. Our aim is to define a set of evidence-based assumptions for our debt stress tests.

The emerging consensus in the literature is that natural disasters tend to exert, on average, adverse impacts on economic growth in the short term. The latter may occur via several transmission channels, affecting the main growth drivers through unanticipated shocks to the supply and demand side of the economy. On the supply side, for instance, extreme weather and climate-related events may significantly affect the agriculture sector, but also cause loss or damage to buildings, technology and relevant infrastructure. More generally, extreme events may lead to capital stock loss or disruption, with consequent impacts on labour productivity, input shortages, and price volatility. Concurrently, losses from extreme events may lead to shocks on the demand side of the economy, via reductions in wealth and financial assets, thus affecting consumption and investment. Global interactions with affected trading partners may further cause reduced trade flows, value chain disruptions, and inflationary pressures. ([144]) Ultimately, supply and demand shocks are expected to interact and entail, at least in the short term, an immediate disruption to output and growth.

However, in the medium and long term, countries' macroeconomic dynamics may be expected to follow three, alternative, pathways (see Graph II.2.4 – Batten et al., 2020; Batten, 2018; Hsiang and Jina, 2014):

([144]) See Batten et al., (2020) and Batten (2018) for more a detailed decomposition and review of the macro-economic impacts (as well as implications for monetary policy) of climate change.

Graph II.2.4: **Long-term macroeconomic impacts of extreme weather and climate-related disasters**



(1): The figure exemplifies GDP growth trends (y-axis) over time, before and after a given climatic event occurs.
Source: Batten (2018).

1. ***Creative destruction***: after an initial shock following a disaster, a period of faster growth might occur. This is the outcome of reconstruction efforts, aimed at replacing lost capital with new, modern, and innovative units. The economy is set to be on a higher path than before the event.

2. ***Recovery to trend***: if growth is expected to slow down in the aftermath of a disaster, output should gradually converge to its pre-disaster trend via a catching-up effect. The negative impact on growth is therefore only temporary.

3. ***No recovery***: a disaster is expected to restrain growth via destruction of productive capital and durable consumption goods. Under this scenario, output does not rebound, remaining permanently lower in the long term.

Despite mixed empirical evidence, most studies appear to confirm the immediate negative impact on growth in the aftermath of a high-intensity disaster. In the medium and long term, the ‘no recovery’ hypothesis is the most supported. ([145]) However, recent works clearly emphasise the relevance of adequate disaster insurance coverage to counteract such drawbacks. In particular, *uninsured* losses appear to be the main driver behind the adverse macroeconomic shocks of natural catastrophes, both on impact and over the long term, insofar as productive capital is not replaced. On the contrary, sufficiently insured losses are shown to be inconsequential in terms of foregone output. Disaster insurance coverage plays an important cushioning role, minimising the adverse shock to output and, at the same time, supporting recovery (Fache Rousová et al., 2021; Von Peter et al., 2012). In particular, not only does adequate insurance coverage supports post-catastrophe recovery (e.g. funding reconstruction projects), but it also appears to cushion the contemporaneous impact of the disaster (i.e. contributing to prevention and disaster risk management *ex-ante*). ([146])

In turn, natural disasters are likely to have different impacts on public finances (see Table II.2.1). ([147]) In the case of extreme weather and climate-related events, this may occur *directly*, via an upward pressure on public expenditure. This could be due to costs incurred to replace damaged (and/or lost) assets and infrastructure, social transfers to affected populations, and relief aid to affected industries and businesses. Extreme events may further lead to the materialisation of both *explicit* (e.g. relief or disaster-specific transfers to local governments, government guarantees for firms and public-private partnerships) and *implicit* contingent liabilities (e.g. public support to distressed financial institutions). At the same time, *indirect* impacts on public finances might also arise. This may be due to reductions in tax revenue losses, following disaster-driven disruptions to economic activity in climate-sensitive sectors and regions. Funding reconstruction projects and post-disaster outcomes through budgetary resources reallocation and/or additional domestic/external

([145]) For an overview of the empirical evidence around the short- and long-term economic impact of natural disasters, see Hallegatte et al. (2020), Batten et al., (2020), and Batten (2018).

([146]) This may be due, for instance, to insurance companies requiring specific building codes and disaster risk management practices to (also) limit the extent of their own liabilities (Von Peter et al., 2012, pp. 16) () This section focuses on the economic and fiscal impacts of extreme weather and climate-related disasters. However, public finances may also be subject to (direct and indirect) impacts from climate change policies (i.e. adaptation and/or mitigation). For an overview of these, see European Commission (2020a).

() This section focuses on the economic and fiscal impacts of extreme weather and climate-related disasters. However, public finances may also be subject to (direct and indirect) impacts from climate change policies (i.e. adaptation and/or mitigation). For an overview of these, see European Commission (2020a).

borrowing might also affect the sovereign capacity to meet debt payments over the medium term. Relatedly, vulnerability to natural disasters might generate increasing risks of uncertainty, affecting the creditworthiness and the international financial accessibility of a country (Radu, 2021; Zenios, 2021; European Commission, 2020a).

Table II.2.1: **Some instances of fiscal impacts from natural disasters**

Direct impacts	Indirect impacts
Damaged and\or lost assets, infrastructure	Reduction in tax revenues
Social transfers to affected populations	Budget reallocation to post-disasters projects
Relief aid to industries and businesses	Reduced capacity to meet debt payments
Contingent liabilities	Reduced creditworthiness, ratings downgrade

(1): The list is non-exhaustive and illustrates some of the potential impacts of natural disasters on public finances.
Source: European Commission (2020a).

Empirical evidence on the fiscal impact of natural disasters, especially for advanced economies, is quite limited and often based on selected case studies. Recent initiatives relate to the macro-fiscal impacts of earthquakes and floods in EU member states (World Bank, 2021) ([148]) and to the role of fiscal policy to moderate the effects of natural disasters in US states (Canova and Pappa, 2021). Other existing works tend to highlight a relatively small, although negative, fiscal impact, with respect to the size of the economy. In particular, an overall fiscal impact between 0.3% and 1.1% of GDP is found for selected natural disasters occurring in the US and the EU (Heipertz and Nickel, 2008). Studies on a wider sample of countries find similar results, with a fiscal deficit increase between 0.23% and 1.4% of GDP, depending on the country group (Lis and Nickel, 2010). ([149]) Moreover, the fiscal response is found to be heterogeneous across disasters and degrees of insurance coverages (Melecky and Raddatz, 2011). Nevertheless, such estimates may suffer from significant downward bias, mostly due to inherent difficulties in quantifying economic and fiscal outcomes. This may be due to the use of simplifying assumptions, differences in data, estimation methods, and identification approach. ([150]) More importantly, all such estimates, based on past data, may be somewhat outdated, given the recent and expected increasing risk of relevant natural disasters driven by human-induced climate change.

2.2.2. Data and stylised facts

This section describes the past and current exposure of EU countries to extreme weather and climate-related events, associated economic losses, as well as their corresponding insurance coverage. Our aim is to identify the most vulnerable countries for which triggering 'extreme event stress tests' in the Debt Sustainability Analysis (DSA) would be most relevant. To do so, we rely on the Emergency Event Database (EM-DAT); a global, publicly accessible, database held by the Centre for Research on the Epidemiology of Disasters (CRED, UCLouvain, Belgium). ([151]) This database provides worldwide geographical (e.g. location, country), human (e.g. fatalities, affected), and economic (e.g. economic losses, insured value) information, from 1900 to present,

([148]) The report provides valuable evidence on the disaster risk-financing in the EU. Nevertheless, some limitations should be acknowledged. These mainly relate to the coverage of natural disasters (i.e. focus on earthquakes and floods), assumptions on the real sector impacts, as well the ability of the model to correctly estimate the impact of natural disasters on public debt. This is mainly due to the fact that the impact on expenditure is more easily describable than the one on revenue. In turn, this may affect the accuracy of the estimation of the fiscal balance, increasing the forecasting error for public debt.

([149]) The identification of natural disasters differs across studies, depending on data availability. Heipertz and Nickel (2008) focus on of the 4 most extreme weather events in the EU since 1990 and of the 2 most extreme events that occurred in the US since 1990, for which the direct budgetary impact could be gathered. Lis and Nickel (2010) only consider large-scale events which satisfy at least one of the following criteria: (i) the number of persons affected is no less than 100,000, (ii) the estimated damage costs of the extreme weather events are no less than 1 billion US dollars (in constant 2000 dollars), (iii) the number of persons killed is no less than 1,000, (iv) the estimated damage costs are above 2% of GDP.

([150]) For instance, Heipertz and Nickel (2008) only focus on selected natural disasters and rely on long-term averages of budgetary elasticities to translate the economic damage (as % of GDP) into implied deficit increase. More sophisticated estimation methods data structures are used in both Lis and Nickel (2010) as well as in Melecky and Raddatz (2011). However, the former are not able to distinguish between direct and indirect fiscal impacts of extreme events. Instead, the fiscal response to natural disasters using annual (rather than higher frequency data), as in Melecky and Raddatz (2011), may lead to potential identification issues.

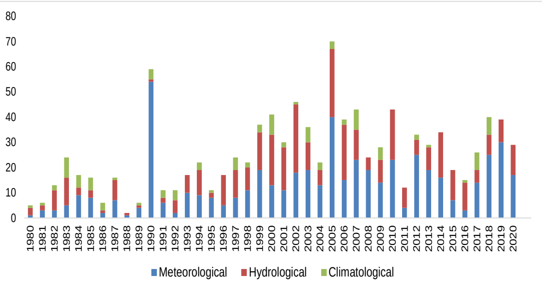
([151]) We have also explored alternative global natural disaster databases, namely NatCat (MunichRE) and SIGMA (SwissRE). However, neither is publicly available, beyond aggregate figures, and could not be used to illustrate sufficiently detailed (i.e. year- and country-specific) stylised facts on natural disasters for the EU (see Box II.2.1).

on six types of natural (i.e. geophysical, meteorological, hydrological, climatological, biological, and extra-terrestrial) and three types of technological (i.e. industrial, transport and miscellaneous accidents) disasters, at the country level. ([152]) In the database, weather- and climate-related disasters are reported under the categories of meteorological (e.g. extreme temperatures, storms), hydrological (e.g. floods), and climatological events (e.g. droughts, wildfires).

Historical trends and taxonomy of extreme events in the EU

For the period 1980-2020 ([153]), EM-DAT reports 1,117 natural disasters in the EU, of which 1,040 are weather and climate-related. The yearly number of natural disasters (meteorological, hydrological, and climatological) is shown in Graph II.2.5.

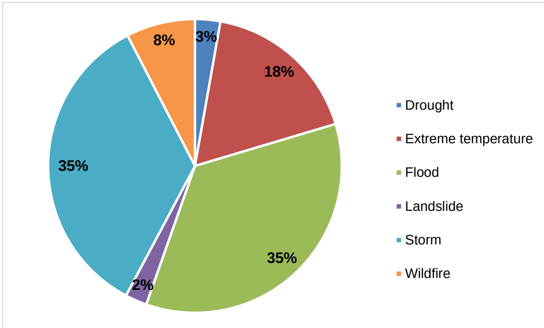
Graph II.2.5: **Number of weather and climate-related disasters in the EU, by disaster subgroup, 1980-2020**



(1) Meteorological (e.g., extreme temperatures, storms), hydrological (e.g., floods), climatological (e.g., droughts, wildfires).
Source: European Commission, based on The Emergency Events Database (EMDAT; CRED, UCLouvain).

Meteorological events have been the most reported, with 543 total disasters over the entire period, followed by hydrological (389) and climatological (108) disasters, respectively. Storms and floods account for almost 70% (i.e. 35% each) of total reported disasters, alongside extreme temperature episodes (18%) and, to a lesser extent, wildfires (8%), droughts (3%), and landslides (2%) (see Graph II.2.6).

Graph II.2.6: **Weather and climate-related events, by disaster type, 1980-2020 (% of total)**



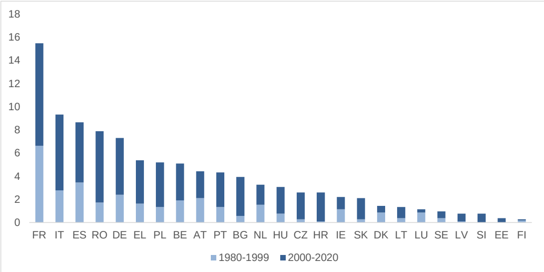
Source: European Commission, based on The Emergency Events Database (EMDAT; CRED, UCLouvain).

A country-level analysis shows that the distribution of events has been quite uneven across countries, over the 1980-2020 period (see Graph II.2.7). For instance, France represents the most hardly struck country, with around 15% of total reported events, followed by Italy (9.3%), Spain (8.7%), Romania (7.8%), and Germany (7.3%). An average of around 5% of total disasters has affected Greece, Poland, Belgium, Austria, and Poland, respectively. The remaining countries follow, with an average of around 3% each, with the exception of Sweden, Latvia, Slovenia, Estonia, and Finland, where only a negligible impact (i.e., less than 1%) is reported.

However, over the past 20 years, a significant increase in the number of disasters has mainly concerned Central-Eastern European countries. This has been particularly the case for Croatia, Czechia, Latvia, Slovakia, Bulgaria, Romania, and Hungary; alongside some Southern European countries (i.e. Italy, Greece, and Portugal) (see Graph II.2.8).

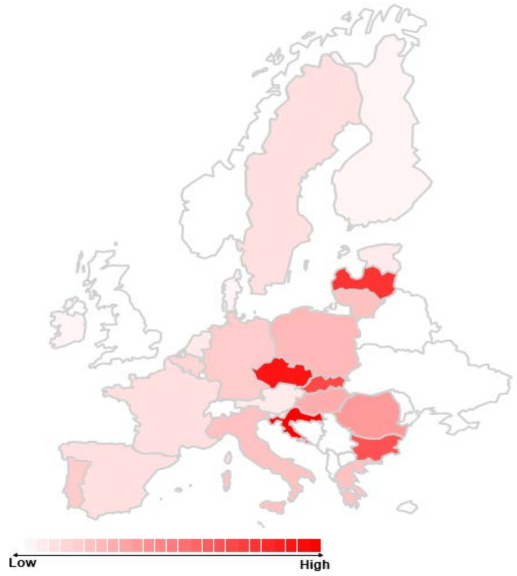
([152]) In the EM-DAT database, only disasters conforming to one of the following criteria are included: i) 10 or more people deceased; ii) 100 or more people affected; iii) a declaration of a state of emergency; iv) a call for international assistance. For an overview and comparison of existing natural disaster databases, see Box II.2.1.
([153]) We focus on data from 1980 onwards, due to risks of significant underreporting in the past.

Graph II.2.7: **Geographical distribution (% EU total) of weather and climate-related events in the EU, per decade**



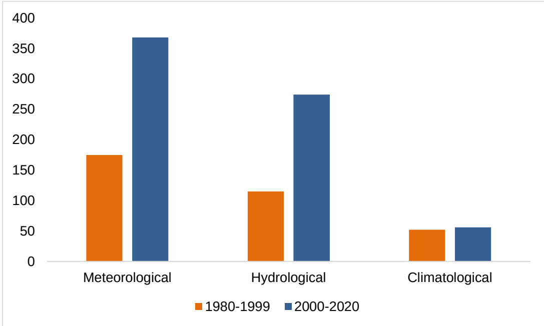
(1): Information for Malta and Cyprus is missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

Graph II.2.8: **Increase in weather and climate-related disasters, by country, 2000-2020**



(1): Information for Cyprus and Malta is missing.
Source: European Commission, based on the Emergency Events Database (EMDAT; CRED, UCLouvain)

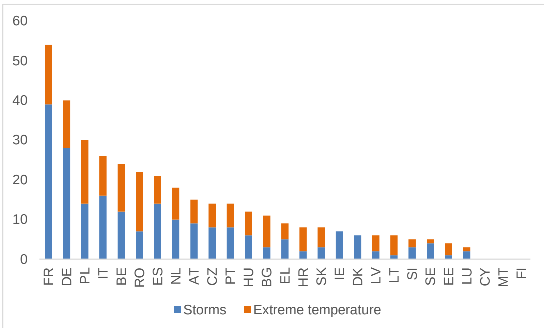
Graph II.2.9: **Number of weather and climate-related events, by disaster subgroup,1980-1999 vs. 2000-2020**



(1) Meteorological (e.g., extreme temperatures, storms), hydrological (e.g., floods), climatological (e.g., droughts, wildfires).
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

Meteorological and hydrological events have been mostly responsible for such an increase (see Graph II.2.9). In particular, over the period 2000-2020, a total of 368 meteorological events (*versus* 175 in the period 1980-1999) and 274 hydrological events (*versus* 115) have been reported. On the contrary, the amount of reported climatological events appears to have remained stable over time. ([154])

Graph II.2.10: **Number of meteorological events, by disaster type and country, 2000-2020**



(1): Information for Malta and Cyprus is missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

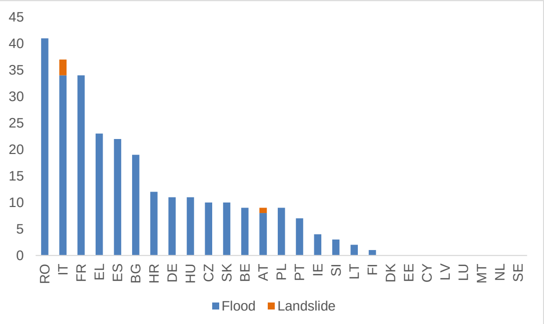
A disaster-based analysis over the past 20 years also reveals a quite heterogeneous incidence across the EU. Within meteorological events, the

([154]) However, such figures may suffer from underreporting, given significant data gaps around specific disaster types, such as heatwaves (reported under 'Meterological' events), and the difficulty to measure some disasters, such as droughts (reported under 'Climatological' events) (CRED, 2020).

greatest incidence has been reported in France (54 events), Germany (40 events), Poland (30 events), Italy (26 events), and Belgium (24 events). In all cases, storms have been the most relevant disaster type, affecting almost 60% of the total. Overall, the incidence seems to have been stronger in Central and Southern European countries (see Graph II.2.10).

Recent hydrological events have been disproportionately driven by floods, representing almost the totality of reported disaster types (see Graph II.2.11). In this respect, Romania represents the most struck country (41 events), together with Italy and France (34 events). In addition, an average of around 22 events is reported for Greece, Spain, and Bulgaria. Overall, a higher occurrence of floods is reported in Central and Central Eastern European countries. Moreover, relatively few episodes of landslides are found in Italy and Austria (i.e., around 1%).

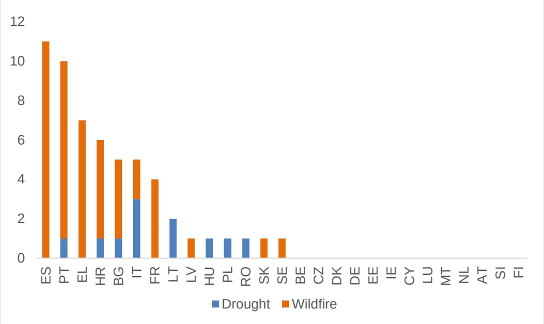
Graph II.2.11: **Number of hydrological events, by disaster type and country, 2000-2020**



(1): Information for Malta and Cyprus is missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

Climatological events have followed a relatively regional pattern (see Graph II.2.12), as wildfires represent the most relevant disaster (i.e., around 80% of the total) in Southern European countries. Overall, severely affected countries have been Spain (11 events) and Portugal (10 events), followed by Greece (7 events), Croatia (6 events), Bulgaria and Italy (5 events). The occurrence of droughts has been slightly more widespread, with episodes reported in Central, Southern European, as well as some Baltic countries.

Graph II.2.12: **Number of climatological events, by disaster type and country, 2000-2020**



(1): Information for Malta and Cyprus is missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

Future trends

Looking ahead, climate change is expected to lead to a significant increase in the frequency and strength of many types of weather and climate-related extremes (IPCC, 2021, EEA, 2017). Existing projections are mainly based on academic studies and reports and are surrounded by large uncertainty. This mainly reflects challenges in modelling assumptions and in unaccounted risks of potential non-linearities and climate tipping points. Evidence from existing literature shows projected increases in severity, duration, and/or extent of several events, particularly for heat waves, heavy precipitations, floods, droughts, and wildfires. However, the impacts are not evenly dispersed across Europe (EEA, 2017).

In particular, extremely high temperatures are projected to become more frequent and last longer during this century, **with the strongest waves expected in Southern and South-eastern Europe** (EEA, 2017; Russo et al., 2014). At the same time, over the course of the 21st century, a progressively warmer atmosphere is likely to lead to a higher intensity of precipitation as well as longer dry spells in Europe (EEA, 2017; Hov et al., 2013a; Seneviratne et al., 2012). This implies an increase in heavy daily precipitation across most of Europe in winter, but an equally remarkable decrease (especially for southern and south-western Europe) in summer (EEA, 2017; Jacob et al., 2014). Consequently, in regions with higher likelihood of heavy precipitation, the frequency and/or the intensity of landslides is also expected to increase (EEA, 2017; Stoffel et al., 2014).

Relatedly, simulations highlight a significant expected increase in floods in specific European regions for the end of the 21st century (i.e. north-west and southeast France, northern Italy, some parts of southeast Spain, the Balkans, and the Carpathians). Milder increases are expected for central Europe. On the contrary, decreased events are projected in large parts of north-eastern Europe (due to milder winter temperature, lower snow accumulation and, consequently, less melt-associated flood) (EEA, 2017; Alfieri et al., 2015; Rojas et al., 2013, 2012).

When considering droughts, most models project drier conditions for southern Europe for the mid-21st century. In contrast, droughts occurrence is projected to decrease in most parts of northern Europe (EEA, 2017; Henrich and Gobiet, 2012; van der Linden and Mitchell, 2009). In turn, increases in warming, droughts, heatwaves, and dry spells are expected to affect the length and severity of wildfires, particularly in southern European countries (EEA, 2017; Moreno, 2014; Arca et al., 2012; Carvalho et al., 2011; Dury et al., 2011; Vilén and Fernandes, 2011; Lindner et al., 2010).

Economic losses from extreme events

Economic losses due to extreme events remain limited on average but mask important variations and are set to increase

Current available data show a contained average economic impact due to extreme events. According to EM-DAT, over the period 1980-2020, total economic losses from extreme weather and climate-related events accounted for around 3% of GDP on average across EU countries. The *annual* average economic losses amount to less than to 0.1% of GDP in the EU. ([155]) The total estimated economic losses are defined as the value of all damages to property, crops, and livestock, as well as other losses related to the disaster. ([156]) While such figure may not yet appear as macro-economically significant, it is also very likely to represent an underreporting of the actual effects of natural hazards. Aside from data collection challenges, this also relates to the specific aim of the existing global natural disaster databases (see Box II.2.1). In addition, annual economic losses underlie significant distributional impacts, with important variations across time and country, depending on the occurrence of natural disasters.

Past economic losses have been more significant in some EU countries and years. In particular, total economic losses, over the period 1980-2020, range from almost 8% of GDP in Spain to 7% of GDP in Czechia, 5% in Romania and Portugal, to less than 1% of GDP for The Netherlands, Estonia, Lithuania, Sweden, Belgium, and Ireland. ([157]) In addition, the contribution of natural disasters to the overall economic losses is not homogeneous across countries and time as, quite often, single events have managed to cause a significant share of total reported economic losses (see Table II.2.2).

([155]) The 3% figure represents the average of *total* economic losses (% of GDP), reported over the period 1980-2020, across EU countries. The annual average economic losses (in % of GDP) roughly corresponds to the figure reported in the NatCat (MunichRE) database (not publicly available at detailed level), with an *annual* average of around 0.1% of GDP for the EU over the period 1980-2019 (European Commission, 2021b). The small difference is mainly attributable to reporting (see Box II.2.1)..

([156]) The registered figure corresponds to the value at the moment of the event (https://www.emdat.be/Glossary).

([157]) However, such figures remain an underestimation, given worldwide underreporting of disaster-related losses (CRED, 2020).

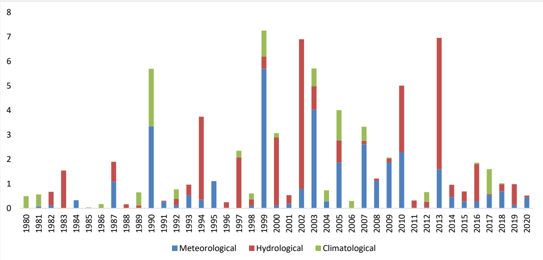
Table II.2.2: **Selected major extreme events and associated economic losses, by country, type, and year**

Country	Year	Disaster type	Related economic losses, % GDP	Total economic losses over 1980-2020, % GDP
BE	1990	Storm	0.5	0.8
BG	2005	Flood	1.5	3.3
CZ	1997	Flood	3.0	6.9
DK	1999	Storm	1.5	3.0
DE	2002	Flood	0.6	2.2
EE	2005	Storm	0.9	0.9
IE	1990	Storm	0.2	0.6
EL	1990	Drought	1.0	3.6
ES	1983	Flood	2.3	7.7
FR	1999	Storm	0.8	2.8
HR	2000	Extreme temp.	1.1	2.6
IT	1994	Flood	0.9	3.2
LV	2005	Storm	1.9	1.9
LT	2006	Drought	0.7	0.9
LU	1990	Storm	2.9	3.1
HU	1986	Drought	2.0	4.3
NL	1990	Storm	0.5	1.2
AT	2002	Flood	1.1	2.4
PL	1997	Flood	2.2	4.3
PT	2003	Wildfire	1.0	4.9
RO	2000	Drought	1.3	5.0
SI	2007	Storm	0.8	1.7
SK	2004	Storm	0.9	2.4
FI	1990	Storm	0.0	0.0
SE	2005	Storm	0.7	0.8

(1) Related economic losses are the economic losses associated to the selected extreme event reported in the table. Total economic losses are the total reported for the country over the period 1980-2020. Data on CY and MT are missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

Over the entire 1980-2020 period, the economic impacts in the EU have been heterogeneous across disasters. The majority of losses from extreme events seems to have been associated with hydrological and meteorological disasters, respectively. The impact has also increased over the past 20 years, with weather and climate-related events accounting for a cumulative 50% of total reported economic losses from natural disasters, compared to a value of around 29% observed during the 1980-1999 period (see Graph II.2.13).

Graph II.2.13: **Economic losses from extreme weather and climate-related events in the EU (% of total events), by disaster subgroup, 1980-2020**



(1) Meteorological (e.g., extreme temperatures, storms), hydrological (e.g., floods), climatological (e.g., droughts, wildfires).
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

Future trends

Some recent studies have also tried to quantify the projected economic impacts of extreme events. Some illustrative projections are provided by the European Commission's Joint Research Centre PESETA project, which provides multi-sectoral assessment of the impacts of climate change in Europe. ([158]) The latest update (PESETA IV) relies on a combination of process-based and empirical models to assess the expected economic impacts (i.e. economic losses) of a subset of natural catastrophes (droughts, costal floods, river floods, windstorms), under three future global warming scenarios. For each selected event, expected economic losses are projected under the mitigation benefits of achieving the Paris Agreement targets (1.5°C and 2°C) as well as higher warming scenarios (3°C – expected to occur only in the long term, in absence of adequate mitigation), and compared to baseline climate conditions (Feyen et al., 2020). ([159]) The evaluation of economic impacts is made within a specific setting of the

([158]) PESETA stands for 'Projection of Economic Impacts of Climate Change in Sectors of the European Union based on bottom-up Analysis'. Similar projections of economic impacts can also be found in the context of the COACCH (CO-designing the Assessment of Climate Change costs), an innovative research project that gathers leading experts on climate change sciences from 13 European research institutions. In this chapter, we focus on the results from the PESETA IV project.

([159]) The basis for projections of economic losses is the period 1981-2010 (Feyenet al., 2020). The projected economic impacts presented in this chapter (and extracted from the PESETA IV project) assume no adaptation measure is in place. However, in the PESETA IV study, the costs and benefits of adaptation options for selected events (i.e. floods) are also modelled. For the remaining events, this has not been feasible at pan-European scale.

state of the economy. In particular, projections of economic losses (in 2015 values) are provided on the basis of a 'dynamic assessment', that is, evaluating how natural catastrophes combined with different global warming levels would impact EU society 'as projected for 2050 and 2100 according to the ECFIN Ageing Report 2015 projections of population and the economy' (JRC, 2020, pp. 15; European Commission, 2014). ([160])

Economic losses from natural disasters are projected to increase at least two-to-threefold in the EU, by mid-century. By the end of the century, losses may become a further multiple. In particular, the PESETA IV projections show that economic losses are expected to be 1.9 times bigger than under the baseline climate, if the more ambitious Paris Agreement target (1.5°C) were to materialise by mid century. The impact would be 2.5 times bigger under the 2°C target, within the same horizon. The expected factor increase in projected economic losses for EU regional aggregates are shown in Table II.2.3. ([161])

([160]) The PESETA IV project also adopts a 'static' approach, comparing how global warming and climate change would impact today's population and economy. However, the absolute damage figures may be unrealistic (and highly conservative), as they do not consider the long-term dynamic growth of the overall economies (Feyen et al, 2020; pp. 15).

([161]) Yet, it is important to stress that such aggregate figures mask significant heterogeneity across countries and climate events and they represent an underestimation of the expected economic impacts from climate events. The PESETA IV projects does not fully capture the effects of extreme events or the risks of passing tipping points. The purpose of its estimates is to provide the general patterns of climate change impacts across the EU and the potential benefits of climate policy actions (Feyen et al., 2020).

Table II.2.3: **Factor increase (FI) in economic losses for the 1.5°C and 2°C warming scenarios, by mid-century, regional aggregates**

Regional aggregate	MF 1.5°C scenario	MF 2°C scenario
Mediterranean	x2.0	x2.3
Atlantic	x2.3	x3.4
Continental	x1.7	x2.1
Boreal	x1.6	x2.3
EU	**x1.9**	**x2.5**

(1) Following PESETA IV, the following countries are included in the different sub-groups: *Mediterranean* (Portugal, Spain, Italy, Malta, Cyprus, Slovenia, Croatia, Greece); *Atlantic* (Ireland, France, Belgium, The Netherlands, Luxembourg); *Continental* (Austria, Germany, Denmark, Poland, Czechia, Slovakia, Romania, Bulgaria, Hungary); *Boreal* (Finland, Sweden, Lithuania, Latvia, Estonia).
(2) Factor increases are built with respect to the baseline (1981-2010) used in the PESETA IV project, and represent the expected increase in economic losses from natural catastrophes under different global warming scenarios.
Source: European Commission computations, based on the PESETA IV project (Feyen et al., 2020).

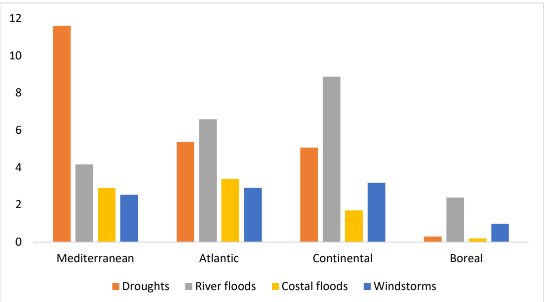
In the longer term (by the end of the century), meeting the Paris target of 1.5°C will prove essential to contain increases in economic losses (see Table II.2.4). The latter are expected to rise threefold under the more favourable warming scenario, but be almost eight-to-fifteen times higher in the 2°C and 3°C warming scenarios, respectively. This outcome is largely linked to the greater exposure of people and assets, driven by the future socioeconomic development. Moreover, such figures mask significant heterogeneity across regional aggregates. In both the medium and long term, compared to the 1.5°C scenario, increasing global warming is likely to exert stronger economic impacts on *Atlantic* countries (i.e. Ireland, France, Belgium, The Netherlands, Luxembourg). This is mainly related to higher expected vulnerability of such areas to flooding episodes. More intense and frequent floods also appear to be behind the projected increase for *Boreal* (i.e. Finland, Sweden, Lithuania, Latvia, and Estonia) and *Continental* (i.e. Austria, Germany, Denmark, Poland, Czechia, Slovakia, Romania, Bulgaria, Hungary) ones. Conversely, droughts are expected to be mostly responsible for the higher projected losses in *Mediterranean* (i.e. Portugal, Spain, Italy, Malta, Cyprus, Slovenia, Croatia, Greece) countries (see Graphs II.2.14-II.2.16).

Table II.2.4: **Factor increase (FI) in economic losses for the 1.5°C, 2°C, and 3°C warming scenarios, by the end of the century, regional aggregates**

Regional aggregate	MF 1.5°C scenario	MF 2°C scenario	MF 3°C scenario
Mediterranean	x3.2	x6.6	x10.8
Atlantic	x3.8	x13.9	x25.1
Continental	x2.6	x5.4	x11.0
Boreal	x2.6	x5.6	x12.8
EU	**x3.0**	**x7.9**	**x14.9**

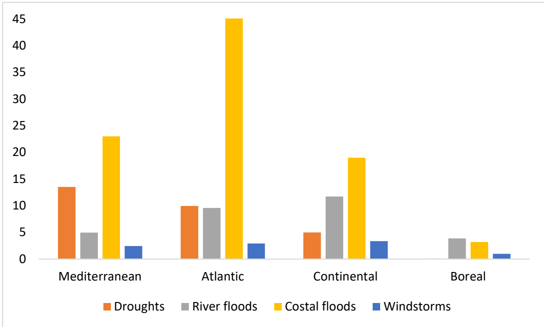
(1) Following PESETA IV, the following countries are included in the different sub-groups: *Mediterranean* (Portugal, Spain, Italy, Malta, Cyprus, Slovenia, Croatia, Greece); *Atlantic* (Ireland, France, Belgium, The Netherlands, Luxembourg); *Continental* (Austria, Germany, Denmark, Poland, Czechia, Slovakia, Romania, Bulgaria, Hungary); *Boreal* (Finland, Sweden, Lithuania, Latvia, Estonia).
(2) Factor increases are built with respect to the baseline (1981-2010) used in the PESETA IV project, and represent the expected increase in economic losses from natural catastrophes under different global warming scenarios.
Source: European Commission computations, based on the PESETA IV project (Feyen et al., 2020).

Graph II.2.14: **Projected economic losses (EURb) by the end of the century, 1.5°C scenario, by regional aggregate and disaster type**



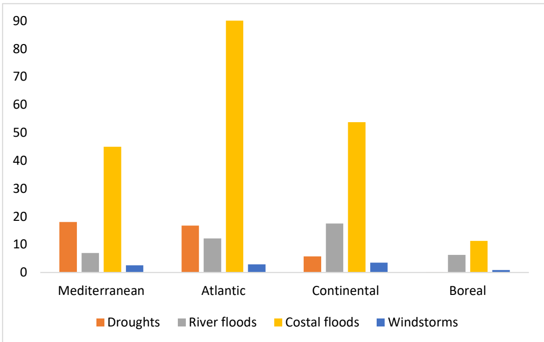
(1) Following PESETA IV, the following countries are included in the different sub-groups: *Mediterranean* (Portugal, Spain, Italy, Malta, Cyprus, Slovenia, Croatia, Greece); *Atlantic* (Ireland, France, Belgium, The Netherlands, Luxembourg); *Continental* (Austria, Germany, Denmark, Poland, Czechia, Slovakia, Romania, Bulgaria, Hungary); *Boreal* (Finland, Sweden, Lithuania, Latvia, Estonia).
Source: European Commission computations, based on the PESETA IV project (Feyen et al., 2020).

Graph II.2.15: **Projected economic losses (EURb) by the end of the century, 2°C scenario, by regional aggregate and disaster type**



(1) Following PESETA IV, the following countries are included in the different sub-groups: *Mediterranean* (Portugal, Spain, Italy, Malta, Cyprus, Slovenia, Croatia, Greece); *Atlantic* (Ireland, France, Belgium, The Netherlands, Luxembourg); *Continental* (Austria, Germany, Denmark, Poland, Czechia, Slovakia, Romania, Bulgaria, Hungary); *Boreal* (Finland, Sweden, Lithuania, Latvia, Estonia).
Source: European Commission computations, based on the PESETA IV project (Feyen et al., 2020).

Graph II.2.16: **Projected economic losses (EURb) by the end of the century, 3°C scenario, by regional aggregate and disaster type**



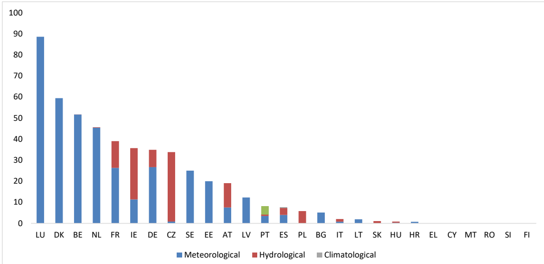
(1) Following PESETA IV, the following countries are included in the different sub-groups: *Mediterranean* (Portugal, Spain, Italy, Malta, Cyprus, Slovenia, Croatia, Greece); *Atlantic* (Ireland, France, Belgium, The Netherlands, Luxembourg); *Continental* (Austria, Germany, Denmark, Poland, Czechia, Slovakia, Romania, Bulgaria, Hungary); *Boreal* (Finland, Sweden, Lithuania, Latvia, Estonia).
Source: European Commission computations, based on the PESETA IV project (Feyen et al., 2020).

While providing useful projections, the economic impacts included in the PESETA IV project are not comprehensive of all potential consequences from climate changes. In particular, they do not include other key items (e.g. irreversible damage to nature and species losses) nor, especially, the consequences of passing tipping points. In addition, they do not manage to capture the full effects of extreme events in all sectors. Hence, such projections are only meant to serve as a *lower bound* of the expected adverse economic impacts from climate change in the EU (Feyen et al., 2020). Nevertheless, such future trends corroborate the relevance of concerted action towards the ambitious 1.5°C Paris Agreement target, to counteract disproportional increases in economic losses due to rising *frequency* and *intensity* of extreme events.

The role of insurance coverage

Adequate insurance coverage can reduce the adverse economic impacts of natural disasters. While not preventing the loss of assets, well-designed climate risk insurance policies help to better manage and mitigate the economic impact of disasters, by acting as a safety net and buffer after an extreme event while, at the same time, promoting risk awareness (Cebotari and Youssef, 2020; Schäfer et al., 2016; European Commission, 2013). ([162]) In this respect, the situation is quite heterogeneous across the EU (see Graph II.2.17). Overall, almost 80% of insurance coverage concerns meteorological disasters, followed by hydrological ones. The coverage rate for extreme weather and climate-related events ranges from around 90% in Luxembourg to around 60% in Denmark, 50% in both Belgium and The Netherlands. An average of 35% of losses receive cov8erage in France, Ireland, Germany, and Czechia, 20% in Sweden, Estonia, Austria, and Latvia. At the other end of the spectrum, we find countries (mostly Southern and Eastern European) with either quite small (i.e. less than 6%) or almost negligible coverage rates (i.e. an average of 1%). ([163]) ([164])

Graph II.2.17: **Insurance coverage rate of extreme events, by disaster subgroup and country, 1980-2020**



(1) Information for CY and PT is missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

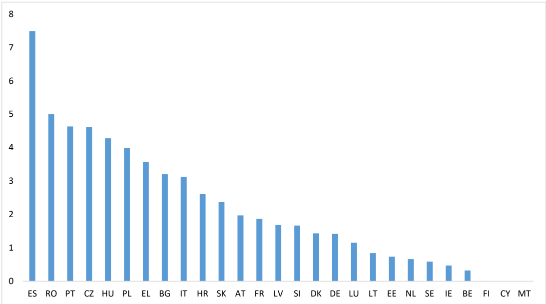
In turn, the distribution of *uninsured* economic losses, or the 'climate protection gap' provides a more comprehensive overview of EU countries' past relative economic exposure to extreme weather and climate-related events (see Graph II.2.18). In particular, in terms of countries' economic size, the most exposed countries appear to have been mostly Southern and Eastern European ones. This is the case for Spain (cumulated uninsured economic losses representing 7.5% of GDP over 1980-2020), Romania (5% of GDP), Portugal, Czechia, Hungary (4.5% of GDP), followed by Poland (around 4% of GDP) and an impact ranging from 3% to 3.5% of GDP for Greece, Bulgaria, and Italy. On the contrary, a more modest exposure tends to be found in countries exhibiting sufficient insurance coverage, despite relatively high occurrences of natural disasters (e.g., Germany, Belgium, and Austria).

([162]) For European Commission (2013), see COM(2013) 213 final

([163]) It is important to stress that, similarly to economic losses, also insured losses may suffer from partial underreporting in the EM-DAT database. For instance, publicly available information from the NatCat (MunichRE) dataset highlights even higher insurance coverage in Germany and France (i.e., around 50% - https://www.eea.europa.eu/ims/economic-losses-from-climate-related). However, the available NatCat figures only provide an aggregate picture, without access to public information on the country-based, yearly, distribution of (economic and insured) losses to be used in our analyses.

([164]) A notable recent initiative on the insurance protection gap for natural catastrophes in Europe relates to the 'Pilot dashboard on protection gap for natural catastrophes', https://www.eiopa.europa.eu/document-library/feedback-request/pilot-dashboard-insurance-protection-gap-natural-catastrophes_en.

Graph II.2.18: **Cumulated uninsured economic losses from extreme weather and climate-related events (% of country GDP), by country, 1980-2020**



(1): Information for CY and MT is missing.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain).

2.2.3. Stress tests calibration

Given the unavoidable rise of climate pressures in the years ahead, a thorough analysis of potential fiscal sustainability implications from climate change is of great importance. Current budgetary frameworks often present limitations to assess fiscal risks associated to climate change. ([165]) In what follows, we aim to provide first stylised stress tests on the fiscal impact of *acute physical risks* from climate change (i.e. extreme weather and climate-related events). This is done by drawing upon the conceptual framework introduced in the 2019 Debt Sustainability Monitor (European Commission, 2020a), our review of the literature, and the stylised facts presented above. Our purpose is to capture risks associated with *one-off* extreme weather and climate-related events over the medium term, in the form of aggravating factors to debt sustainability.

In our 'extreme event stress tests', we adopt a comparative approach. We illustrate, in a given country, the deviation from the Commission's 10-year baseline debt-to-GDP projections, should a past extreme event reoccur in the medium term. To account for potential interactions between climate change and the expected intensity/frequency of extreme events, the impact is further calibrated according to different global warming scenarios (1.5°C and 2°C). In each scenario, we assume the specific extreme event to simultaneously exert: i) a *direct* impact on government accounts (i.e. via the primary balance), thus affecting the debt level; and ii) an *indirect* impact via GDP (growth and level) effects (also affecting the debt ratio, via denominator effects). ([166])

Assumptions and methodology

The *direct* shock to public finances (via the primary balance) is constructed based on past country-specific exposure to extreme events, augmented by the expected increase in economic losses from extreme events due to climate change. In particular, we first rely on the annual distribution (from 1980 to 2020) of the *uninsured* economic losses (% of GDP) available for all EU countries from the EM-DAT database. ([167]) Then, for each country, we identify the *maximum* of the annual distribution as an instance of 'extreme' (or 'tail event') occurrence. ([168]) Subsequently, in order to account for the likely increase in economic losses from climate events due to a warmer climate, we compute the overall *direct* fiscal impact by interacting the country-specific extreme value (i.e., the *maximum*) with a given Factor Increase (FI).

Our FI is constructed, on a regional basis ([169]), relying on estimates of expected economic losses from extreme events associated with future global warming levels, and provided in the context of the European Commission's JRC PESETA IV project (see Section 2.2.2 for details). In the PESETA IV study, economic losses are projected for both the medium (under the assumption of 1.5°C and 2°C higher

([165]) See the European Commission (2020a).

([166]) The intuition behind our 'extreme event stress test' scenarios draws upon the International Monetary Fund (IMF) and the World Bank, that have recently introduced, in their revised Joint Debt Sustainability Framework for Low-Income Countries (IMF/WB LIC DSF), a tailored stress test for natural disasters (see Joint IMF/WB LIC DSF, 2017). Their 'natural disaster' stress test relies on the EM-DAT database and is only triggered for countries vulnerable to such risks and tailored to the country-specific history, while not being directly linked to future expected effects of climate change. However, our stress tests differ with respect to calibration methodology and country selection criteria.

([167]) Information on Malta and Cyprus is not provided in the EM-DAT database.

([168]) While there is no single definition for what is meant by extreme events, the latter are generally defined as 'either taking *maximum* values or *exceedance* above pre-existing high thresholds' (Stephenson, 2008; pp. 12).

([169]) Following PESETA IV, we identify four regional aggregates: *Mediterranean*, *Atlantic*, *Continental*, and *Boreal*.

temperature), and the long term (where global warming of 3°C higher is also assumed). In our stress tests, we only apply a medium-term perspective. Hence, our fiscal shock is constructed by relying on the FI in economic losses projected for the medium-term 1.5°C and 2°C scenarios (see Table II.2.2 and Table II.2.3), respectively ([170]). In each scenario and country, our assumed *direct* fiscal impact (i.e. extreme value interacted with the respective FI – see Table II.2.5) is translated into a *one-off* adverse shock on the debt trajectory, via an impact on the primary balance, applied in the first year after the European Commission's government debt forecast horizon (i.e. in 2024). ([171]) ([172])

([170]) In particular, the PESETA IV study projects economic losses under the 1.5°C and 2°C scenarios as expected to occur by mid-century. Economic losses associated with the 3°C scenario are only projected for the end of the century. While the medium-term projections (i.e., by mid-century) are more forward-looking than our debt projection horizon (2021-2032), recent evidence shows that the 1.5°C limit is already likely to be reached as early as 2030 and the early 2050s, unless concerted action to reduce greenhouse gas emissions is taken (IPCC, 2018). The absence of any significant mitigation measures may also increase the likelihood of a closer 2°C warming scenario.

([171]) A country's (initial) primary balance may already include some provisions for natural disasters, and the existence of common emergency funds (e.g. EUSF) may partly cover some damages. However, for the sake of simplicity, we show what would be the approximate overall impact on public finances, should a past extreme event reoccur in the medium term, in the absence of significant climate mitigation measures. The calibration of the shock based on *uninsured* losses allow to already account for some risk sharing between private and public sector. Moreover, the historical data used for the initial calibration are likely to be affected by underreporting (as explained in the previous section).

([172]) For references of alternative assumptions used in existing empirical studies on the fiscal impact of extreme events, see Footnote 142 and European Commission (2020a).

Table II.2.5: **Assumed direct fiscal impact of a one-off extreme event (% GDP), by country and warming targets (1.5°C and 2°C), applied in 2024**

	1.5°C scenario	2°C scenario
BE	0.4	0.5
BG	2.7	3.2
CZ	4.3	5.2
DK	0.9	1.0
DE	0.9	1.1
EE	1.2	1.7
IE	0.4	0.6
EL	2.0	2.4
ES	4.5	5.3
FR	1.2	1.7
HR	2.4	2.8
IT	1.7	2.0
CY	n.a.	n.a
LV	2.7	3.8
LT	1.2	1.7
LU	2.4	3.4
HU	3.5	4.3
MT	n.a.	n.a
NL	0.5	0.8
AT	1.6	2.0
PL	3.4	4.1
PT	2.1	2.4
RO	2.8	3.4
SI	1.6	1.9
SK	1.6	1.9
FI	0.0	0.0
SE	0.9	1.2

(1) For instance, in Czechia, the fiscal shock in the 1.5°C scenario amounts to 4.3% of GDP. This value is obtained as follows: the maximum value of uninsured losses (% GDP) in Czechia was recorded in 1997 and amounted to 2.5% of GDP. In our stress tests, this value is multiplied by a FI of 1.7 (corresponding to the factor increase identified under the 1.5°C scenario for the country's corresponding regional aggregate (i.e. *Continental* - see Table II.2.2).
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain) and the PESETA IV project (Feyen et al., 2020).

As for *indirect* shocks to GDP (both growth and level), we rely on recent empirical evidence on the macroeconomic impacts of natural disasters (see Section 2.2.1). In particular, given our focus on uninsured economic losses, we first assume an adverse shock to growth in the aftermath of a disaster. To this purpose, we rely on estimates from a recent study of the European Insurance and Occupation Pensions Authority (EIOPA) on OECD countries (Fache Rousová et al., 2021). The study finds that large-scale disasters with low insurance coverage exert, on average, an adverse effect (of around -0.5%) on annual GDP growth rate. In turn, we assume, for each country, a reduction in actual GDP growth (i.e. an impact of -0.5% compared to the baseline) in the same year of the *direct* fiscal shock (i.e. 2024). In addition, we assume that the adverse effect on GDP growth translates into permanently lower levels of GDP, compared to the baseline. ([173]) This is in line with recent empirical evidence on the long-term macroeconomic consequences of uninsured natural catastrophes, pointing to 'no recovery' effects – with post-disaster output continuing to grow in the long term, but on a lower trajectory (Batten, 2018; Von Peter et al., 2012).

Triggering criteria

The stress tests are only triggered for a set of particularly exposed countries. **To this purpose, we rely on specific selection criteria.** In particular, out of the EU countries exhibiting (according to the EM-DAT database) the highest overall share of *uninsured* economic losses (% GDP) and the highest overall number of natural disasters, over the 1980-2020 period, we select those that:

1. Have experienced *at least* 2 peaks ([174]) in the number of reported events, and;
2. Have experienced an increase in the number of reported events over the last 20 years, and;
3. Are at '*medium-to-high*' vulnerability to *acute physical risks* in the long term, according to the SwissRE Climate Economic Index ([175])

On this basis, we trigger the 'extreme event stress tests' for 13 EU countries. These include Spain, Romania, Portugal, Czechia, Hungary, Poland, Greece, Italy, Austria, France, Belgium, Germany and The Netherlands.

([173]) In our stress tests, this translates into an adverse effect on potential GDP growth.

([174]) A peak is identified if the number of natural disasters, for a given country and in a given year, is higher than the corresponding upper end (i.e. 90th percentile) of the country's annual number of observed events over 1980-2020.

([175]) SwissRE developed a 'Climate Economic Index', which ranks countries according to their expected vulnerability to climate change risks. Information is only available for some EU countries. For more details, see https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-economics-of-climate-change.html.

2.2.4. Stress tests results

The stress tests show non-negligible fiscal impacts in some countries. The simulated debt projections for the selected countries are reported in Table II.2.6.

As expected, both the 1.5°C and 2°C scenarios result in progressively higher debt-to-GDP projections, respectively, compared to the baseline.

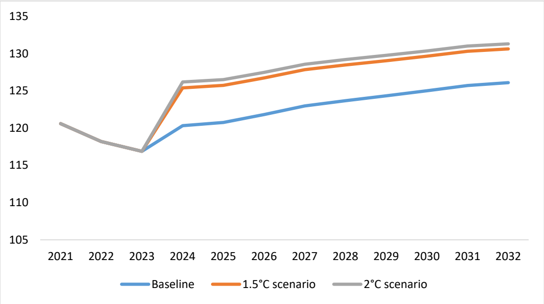
- Among the most exposed countries, we find *Spain* (see Graph II.2.19), with the debt-to-GDP ratio projected to be higher, in 2032, by 4.5 pps of GDP and 5.2 pps of GDP in the 1.5°C and 2°C scenarios respectively, compared with the baseline, also given the high debt level.
- Similar results are found for *Czechia* (see Graph II.2.20), with a difference of 4.0 pps of GDP and 4.7 pps of GDP respectively by 2032 compared with the baseline, as well as for *Hungary* (see Graph II.2.21), where the 1.5°C (2°C) warming scenario is projected to result in 3.1 (3.7) additional percentage points in the debt-to-GDP ratio by the end of the projection horizon.
- *Poland*, *Romania*, and *Greece* follow (with an average of 2.7 pps of GDP and 3.1 pps of GDP difference in 2032 compared with the baseline, in each scenario, respectively).

Table II.2.6: **Debt-to-GDP projections of selected countries, baseline versus 1.5°C and 2°C warming scenarios**

Debt-to-GDP projections					
Spain	**2021**	**2023**	**2024**	**2032**	**2032 change**
Baseline	120.6	116.9	120.3	126.1	
1.5°C scenario	120.6	116.9	125.4	130.6	4.5
2°C scenario	120.6	116.9	126.2	131.3	5.2
Romania	**2021**	**2023**	**2024**	**2032**	
Baseline	49.3	53.2	54.3	76.9	
1.5°C scenario	49.3	53.2	57.4	79.6	2.7
2°C scenario	49.3	53.2	57.9	80.1	3.2
Portugal	**2021**	**2023**	**2024**	**2032**	
Baseline	128.1	122.7	121.8	126.2	
1.5°C scenario	128.1	122.7	124.5	128.6	2.4
2°C scenario	128.1	122.7	124.9	129.0	2.7
Czechia	**2021**	**2023**	**2024**	**2032**	
Baseline	42.4	46.3	48.0	67.1	
1.5°C scenario	42.4	46.3	52.6	71.1	4.0
2°C scenario	42.4	46.3	53.5	71.8	4.7
Hungary	**2021**	**2023**	**2024**	**2032**	
Baseline	79.2	76.4	74.9	68.1	
1.5°C scenario	79.2	76.4	78.8	71.3	3.1
2°C scenario	79.2	76.4	79.5	71.9	3.7
Poland	**2021**	**2023**	**2024**	**2032**	
Baseline	54.7	49.5	48.2	48.3	
1.5°C scenario	54.7	49.5	51.8	51.1	2.8
2°C scenario	54.7	49.5	52.5	51.7	3.4
Greece	**2021**	**2023**	**2024**	**2032**	
Baseline	202.9	192.1	185.9	154.7	
1.5°C scenario	202.9	192.1	188.8	157.3	2.6
2°C scenario	202.9	192.1	189.2	157.5	2.8
Italy	**2021**	**2023**	**2024**	**2032**	
Baseline	154.4	151.0	150.6	161.6	
1.5°C scenario	154.4	151.0	153.0	163.9	2.2
2°C scenario	154.4	151.0	153.3	164.1	2.5
Austria	**2021**	**2023**	**2024**	**2032**	
Baseline	82.9	77.6	76.9	76.3	
1.5°C scenario	82.9	77.6	78.9	77.9	1.6
2°C scenario	82.9	77.6	79.2	78.1	1.9
France	**2021**	**2023**	**2024**	**2032**	
Baseline	114.6	112.9	114.2	122.3	
1.5°C scenario	114.6	112.9	116.0	123.8	1.5
2°C scenario	114.6	112.9	116.5	124.2	1.9
Belgium	**2021**	**2023**	**2024**	**2032**	
Baseline	112.7	114.6	116.5	133.6	
1.5°C scenario	112.7	114.6	117.5	134.4	0.8
2°C scenario	112.7	114.6	117.6	134.5	0.9
Germany	**2021**	**2023**	**2024**	**2032**	
Baseline	71.4	68.1	67.0	61.6	
1.5°C scenario	71.4	68.1	68.3	62.6	1.0
2°C scenario	71.4	68.1	68.4	62.8	1.1
The Netherlands	**2021**	**2023**	**2024**	**2032**	
Baseline	57.5	56.1	56.0	62.8	
1.5°C scenario	57.5	56.1	56.8	63.5	0.7
2°C scenario	57.5	56.1	57.1	63.7	0.9

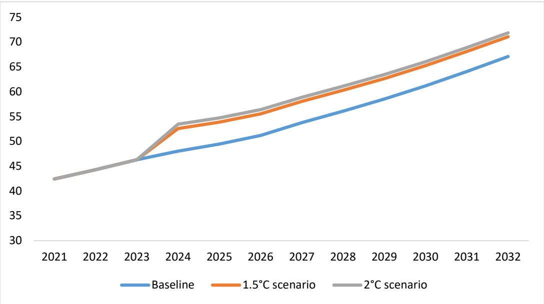
(1) The 2032 change measures the difference, in 2032, between debt-to-GDP in the 1.5°C and 2°C scenarios, respectively, compared to the baseline.
Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain) and the PESETA IV project (Feyen et al., 2020).

Graph II.2.19: **Debt-to-GDP projections, baseline and climate scenarios, 2021-2032, Spain**



Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain) and the PESETA IV project (Feyen et al., 2020).

Graph II.2.20: **Debt-to-GDP projections, baseline and climate scenarios, 2021-2032, Czechia**



Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain) and the PESETA IV project (Feyen et al., 2020).

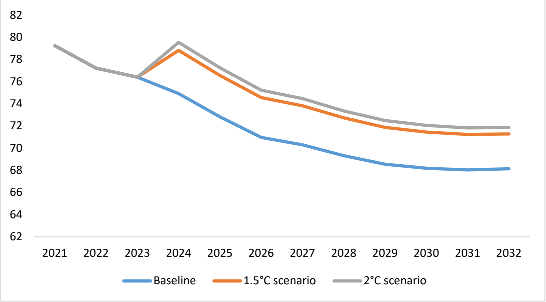
– In *Italy*, both the 1.5°C and 2°C scenarios are expected to lead to a difference of 2.2 pps of GDP to 2.5 pps of GDP by the end of the horizon, compared to the baseline projections.

– The impact will also be quite significant for *Austria* and *France*, with projected difference of 1.5 pps of GDP and 1.9 pps of GDP compared with the baseline.

– *Germany*, *Belgium*, and *The Netherlands* report the lowest difference in debt-to-GDP ratios by the end of the horizon, in each warming scenario.

While pointing to manageable risks so far, our stress tests confirm the macroeconomic relevance of climate-related disasters and the related risks to government finances. Despite the still favourable interest-growth rate differentials assumed in the projections, and the *one-off* nature of the simulated shock, the negative impact on debt projections appears significant and persistent over time. The limited difference between the 1.5°C and the 2°C scenarios relates to the multiplication factor applied (based on the PESETA IV study – see Footnote 153). A more extreme scenario (i.e. an increase of global temperatures by 3°C) would lead to more abrupt (non-linear) impacts. Overall, these results also support calls for increased policy attention to address the 'climate protection gap' as well as the need to strengthen climate-related risk management and financing frameworks, both at national and EU levels.

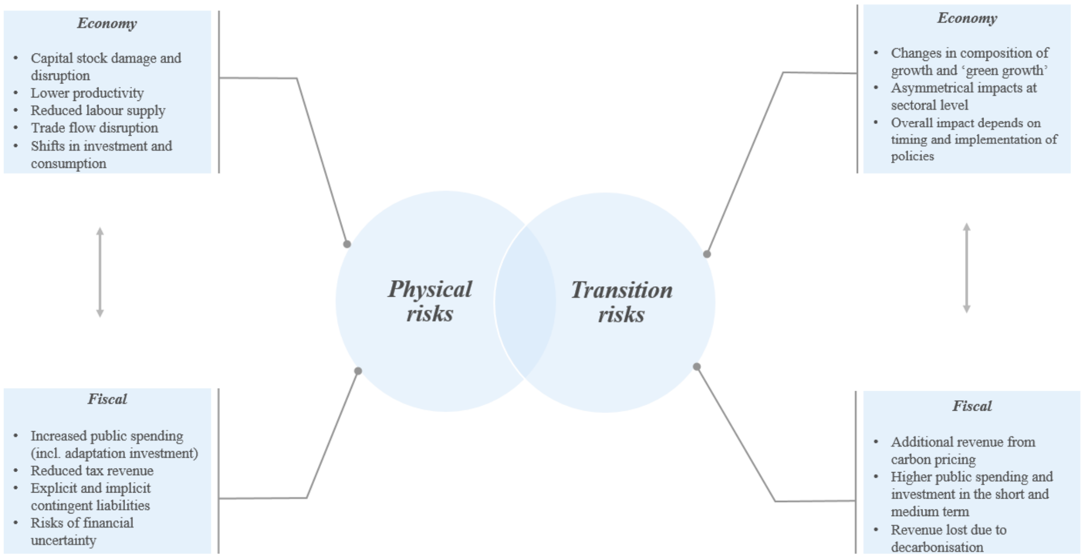
Graph II.2.21: **Debt-to-GDP projections, baseline and climate scenarios, 2021-2032, Hungary**



Source: European Commission, based on The Emergency Events Database (EM-DAT; CRED, UCLouvain) and the PESETA IV project (Feyen et al., 2020).

Moreover, several elements should be considered in the interpretation of our climate scenarios. Due to current data and methodological limitations, the present assessment necessarily builds on several simplifying assumptions. In addition, our assessment only provides a partial perspective of climate-related fiscal (debt) sustainability risks, given our focus on fiscal impact of acute physical risks. Moreover, our results are likely to represent an underestimation of the expected fiscal impact. This may be due to potential underreporting of economic losses in global disaster databases, the use of *lower bound* estimates of the expected adverse economic impact from climate events in the EU, as well as unaccounted risks from non-linearities and tipping points, potential negative feedback effects across sectors, and/or adverse spillover effects across countries, combined with our medium-term perspective.

Graph II.2.22: **Economic and fiscal challenges from climate change**



(1): The list of vulnerabilities is non-exhaustive and only meant as an illustration. For instance, *physical risks* (in the form of a gradual transformation of the environment) could also have positive supply side effects in some regions, which are not presented here. *Transition risks*, related to mitigation policy efforts, refer to the the economic and fiscal consequences stemming from the transition to a low-carbon economy.
Source: European Commission; Batten (2018).

2.3. CONCLUSION

Assessing fiscal risks from climate change is a critical and challenging issue. This chapter illustrates some first stylised stress tests on the fiscal impact of extreme weather and climate-related event for selected EU countries, designed as shocks to public finances and growth, in the context of the European Commission's standard Debt Sustainability Analysis framework. Our purpose is to capture risks associated with *one-off* climate events, over the medium term, in the form of aggravating factors to debt sustainability. This exercise is also in line with the action points reflected in the 2021 EU Climate Adaptation Strategy, as it develops ways to measure the potential impact of climate-related risks on public finances and an assessment of risks to long-term public debt sustainability, with the aim to build macro-fiscal resilience to climate change. ([176])

While our results point to manageable risks so far, compared to other existing fiscal challenges (e.g. linked to population ageing), they highlight that (*acute) physical risks* from climate change may pose some risks to countries' fiscal (debt) sustainability in several countries. **Large-scale, rapid, and immediate mitigation measures have the potential to limit climate change and its related effects.** Our findings also point to the relevance of implementing adequate adaptation policies, including insurance and climate-resilient debt instruments to provide financial resilience to climate change and dampen the fiscal impact of climate-related events, thus reducing potential debt sustainability risks. Robust and effective Disaster Risk Management frameworks and disaster risk financing strategies contribute to reducing the potential fiscal cost of natural disasters and increasing incentives to take action to reduce vulnerability while, at the same time, providing financial support. In addition, increasing insurance penetration can support post-disaster recovery, reduce vulnerability and promote resilience (European Commission, 2021).

The assessment of fiscal risks associated to extreme weather and climate-related events suffers from data limitations. As documented in this chapter, practical caveats remain. Modelling limitations and current data availability constitute important challenges. The existing international

([176]) See COM(2021) 82 final.

datasets recording extreme weather and climate-related events are not (fully) publicly available, and/or often provide a partial reporting of impacts. In addition, the reporting of total economic losses is not done following a common standard, which makes it difficult to disaggregate the total losses between private and public sector, with consequences on the estimation of related fiscal impacts.

Besides risks from direct *physical* impacts, climate change adaptation and mitigation policies are also expected to exert significant effects on the economy and public finances (Graph II.2.22). *Physical* and *transition* risks 'are not independent of each other but tend to interact' (Batten et al., 2020; pp. 3), as inadequate policy actions to fight climate change can aggravate *physical* risks and, in turn, intensify *transition* risks (European Commission, 2021b; NGFS, 2020). The first estimations provided in this chapter cover only one aspect of fiscal challenges raised by climate change, namely related to *acute physical* risk.

Going forward, a broader assessment will therefore need to encompass the fiscal impact of mitigation policies aimed at supporting the transition to climate-neutral economies, as well as of adaptation policies, aimed at anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause. The transition to climate neutral economies will require significant additional investment and major adjustments in productive sectors, labour markets and consumption patterns. The overall macroeconomic and fiscal impact will depend on the timing and design of policies supporting the transition. In addition, the transition to climate neutrality represents major economic opportunities in a range of sectors where the EU can develop a global leadership. Overall, the development of standard harmonised reporting frameworks at EU level remains an essential aspect to build fiscal resilience. This includes the need for better reporting and assessments of the macroeconomic impacts of planned climate mitigation and adaptation policies, and the potential fiscal risks related to these.

Box II.2.1: Overview of natural disaster databases

Comprehensive and comparable data for the monitoring of the macroeconomic impact of climate-related disasters is lacking today. Existing databases generally vary according to their geographical focus (i.e. global, regional, and national), event-reporting framework (i.e., multi-hazard or (single) hazard-based), and related reporting on human/economic implications (JRC, 2020). Here, we focus on a description and comparison of global, multi-hazards databases ([1]). The reason is twofold. Given their extensive coverage, they represent the most adequate source to perform analyses with a European perspective. Moreover, they are the only instances to report extensive information on disaster-related economic losses. In this regard, we look and compare three main international databases: EM-DAT (CRED), NatCat (MUNICH RE), and Sigma (SWISS RE). In addition, we provide an overview of the Risk Data Hub (RDH) loss dataset, recently developed by the European Commission's Joint Research Centre (JRC).

EM-DAT (CRED, UCLouvain)

The Emergency Event Database (EM-DAT) is a global, publicly accessible database held by the Centre for Research on the Epidemiology of Disasters (CRED, UCLouvain, Belgium). It includes data on the occurrence and impact of over 20,000 natural and technological disasters from 1900 to the present day. EM-DAT classifies disasters according to they type of hazard that provokes them. In particular, based on the underlying hazard (e.g. earthquakes, storms, floods, drought, etc.), natural disasters are distinguished into six main groups (i.e. geophysical, meteorological, hydrological, climatological, biological, extra-terrestrial). EM-DAT also collects data on technological disasters, such as industrial and transport accidents. In order for a disaster to be recorded into the database, at least one of the following criteria must be fulfilled: i) 10 or more people deceased; ii) 100 or more people affected; iii) a declaration of a state of emergency; iv) a call for international assistance. Information is obtained from various sources including UN, governmental and non-governmental agencies, insurance companies, research institutes and press agencies. The presence of a threshold for data inclusion naturally implies a reduced number of entries. The chosen data sources may also lead, in some cases, to under-reporting of disasters. Events are entered on a country-level basis, alongside geographical (e.g. location, country), human (e.g. fatalities, people affected) and economic (e.g. economic losses, insured value) information related to the event. Data on economic and insured losses are reported directly from the source. More specifically, information on economic impacts include total estimated damage, reconstruction costs, and insured losses. Total estimated losses (in 000' US$ current value) are defined as the value of all damages to property, crops, and livestock, and other losses related to the disaster. The registered figure corresponds to the damage value at the moment of the event and may also include a breakdown by sector (e.g. social, infrastructure, production, environment, etc.). Reconstruction cost (in 000' US$ current value) represent costs for the replacement of lost assets. Finally, insured losses (in 000' US$ current value) are the part of economic damages covered by insurance companies ([2]).

NatCat (MunichRE)

NatCat is a global, private disaster database maintained by Munich Reinsurance Company (MUNICH RE). It focuses exclusively on natural disasters and currently covers the period 1980-2019. Four categories of events (and their entire duration) are entered on a country basis. In particular, the dataset identifies: i) geophysical (e.g. earthquakes and volcanic activity), ii) meteorological (e.g. severe storms), iii) hydrological (e.g. floods and landslides), and iv) climatological events (e.g. droughts and cold waves). NatCat includes information on the number of fatalities, as well as disaster-related economic and insured losses. No information is provided on losses due to infrastructure damage or malfunction, losses to most publicly owned assets, or indirect losses due to business interruption. In view of its nature, priority on data sources is given to official internal reports on direct insurance claims and reinsurance periodicals. The absence of an inclusion threshold for a given disaster implies a

([1]) For a review of regional and disaster-based databases, see JRC (2020).

([2]) EM-DAT, The international disasters database, Université Catholique de Louvain, www.emdat.be.

(Continued on the next page)

Box (continued)

Table 1: Overview of natural disaster databases	EM-DAT	NatCat	SIGMA
Access	Public	Private	Private
Provider	CRED - UCLouvain	MunichRE	SwissRE
Period covered	1900-present	1980-present	1970-present
Country coverage	Global	Global	Global
Disaster type	Natural (considering epidemics), technological, conflicts	Natural	Natural, man-made
Entry threshold	Present	Not present	Present
Estimation of economic losses	No standard procedure	Own methodology	Own methodology
Data sources	UN, governmental and non-governmental agencies, insurance companies, research institutes and press agencies.	Internal reports, reinsurance periodicals	Newspapers, direct insurance and reinsurance periodicals, specialist publications, insurers and reinsurers reports

greater number of reported entries compared to other datasets. However, NatCat's reporting rationale implies less available data on countries exhibiting lower insurance coverage, as losses from climate-related hazards that MunichRe does not reinsure are not included (JRC 2020; Menoni and Margottini, 2011).

SIGMA (SwissRE)

The SIGMA database is a global, private database maintained by SWISS Reinsurance Company (SwissRE). It includes both natural and 'man-made' disasters from 1970 to present. Disasters are recorded on an event entry basis and recorded information includes dead, missing, injured, and homeless, along with detailed accounting of insured and uninsured damages. Data entry is conditional upon at least one of the following occurrences: i) 20 or more deaths; ii) 50 or more injured; iii) 2000 or more homeless; iv) strict economic criteria (insured losses exceed more than $14m (marine) and $28m (aviation), $35m (all other losses and/or total losses in excess of $70m). This may lead to a limited number of available observations. Information is obtained from newspapers, direct insurance and reinsurance periodicals, specialist publications (in printed or electronic form) and reports from insurers and reinsurers. In SIGMA, total losses are defined as those directly attributable to a major event (e.g. damage to buildings, infrastructure, vehicles, etc.). While losses due to business interruption, following property damage, are somewhat reported, other indirect losses, such as loss of earnings by suppliers due to disabled businesses, estimated shortfalls in GDP and other non-economic losses, are not included. SWISSRe highlights that total included losses are estimated and communicated in very different ways. In turn, this does not allow a direct comparison across events ([3]).

Table 1 summarizes the main differences between the EM-DAT, NatCat, and SIGMA databases.

Risk Data Hub - European Commission, JRC

In an effort to bridge the gaps between the information generated from different sources, especially at the European level, the European Commission's Joint Research Centre (JRC) has developed a Risk Data Hub (RDH) loss dataset, aiming at developing a centralised pan-European platform for collection of loss and damages data. In particular, the RDH Historical Event Catalogue consists in a collection of past events (and related losses and damages) occurred in EU, created from a wide array of data published in several sources and databases ([4]). The data collected is not an aggregation of official national datasets, but rather a collection of sources that become complementary in a collection of existing practises. Given its multi-source nature, the RDH underlies differences in the identification of disaster-related economic losses. Nevertheless, the RDH constitutes a major contribution to the fragmented disaster databases currently available, thus paving the way towards an improvement of past-event loss and damage assessment (JRC, 2020).

([3]) For more information on the SIGMA database, see https://www.sigma-explorer.com/documentation/Methodology_sigma-explorer.com.pdf.

([4]) Sources of the RDH range from internal JRC databases, to online media, existing multi-hazards databases (e.g. Munich Re, Swiss Re, EM-DAT, GLC), single-hazard databasesEU services, EU financed projects (e.g. Share), or academic research (JRC, 2020).

3. 'R-G' DIFFERENTIALS: LATEST DEVELOPMENTS AND IMPLICATIONS FOR PUBLIC DEBT SUSTAINABILITY

Recently, debates sparkled among economists regarding the evidence, persistence, and implications of negative interest-growth rate ('r-g') differentials*. Indeed, the differential between the average interest rate the government pays on its debt and the growth rate of the economy is a key variable for debt sustainability analysis (DSA).*

In this chapter, we take stock of recent evidence, based on the Commission autumn forecast 2021, with a focus on EU and EA countries. *To this purpose, we review recent literature and depict stylised facts about the 'r-g' differential and its contribution to EU and EA countries' change in debt, based on recent data.*

Moreover, using simulations, we illustrate a possible (mild) increase or even reversal of 'r-g' differentials compared to the DSA baseline and its implications for EU countries' debt trajectories. *The results show that more adverse 'r-g' conditions than assumed in the DSA baseline, would lead to higher projected debt ratios by 2032, but would not substantially affect the overall risk assessment in most cases.*

However, even in a negative (favourable) 'r-g' environment, there are strong reasons to retain a focus on debt sustainability. *Even if current favourable financing conditions reflect to some extent structural factors, these conditions could be reversed, especially in high debt countries. Then, factors underlying the debt dynamics are interrelated, and the 'r-g' differential cannot be considered in isolation from other variables. Specifically, favourable 'r-g' differentials have not necessarily been associated with debt reduction, as their favourable effect on the debt dynamic has been offset by a reduced fiscal effort in some countries. Finally, negative 'r-g' differentials are not necessarily associated with reduced fiscal risks, which reflect broader factors.*

3.1. INTRODUCTION

The differential between the average interest rate the government pays on its debt *(r)* and the growth rate of the economy *(g)* is a key variable for debt sustainability analysis. The mechanics through which the *'r-g'* differential affects debt dynamics are summarised in the debt law of motion (see Box II.3.1). Based on this formula, a *negative* differential could appear unambiguously beneficial for debt dynamics. However, the empirical evidence on *'r-g'* differential remains disputed, notably depending on the exact definition and measure of *'r'* and *'g'*, as well as the geographical sample and time period considered. Moreover, an environment of negative differentials may produce complex interactions and implications for debt sustainability.

In recent years, a debate sparkled about the *'r-g'* differential, with some economists calling for revisiting debt sustainability concepts and fiscal policy. Some economists have argued that negative interest-growth rate differentials were the historical norm, and were unlikely to be reversed quickly, notably due to the structural drivers of low interest rates, including population ageing, declining productivity growth and excess saving. In particular, Blanchard (2019) argued that, in such circumstances, "public debt may have no fiscal cost" ([177]), since the economy grows, on average, faster than the interest rate. Therefore, any debt level could be sustained, as public debt would eventually fall gradually relative to GDP (according to a passive debt deleveraging). Such conclusions are instrumental to supportive fiscal policy. Indeed, in a low interest rate environment as currently prevailing, the argument goes, fiscal costs to higher public debt are low, while higher public expenditure, especially investment, would contribute to higher potential growth.

However, other economists challenged this view, putting into evidence the reversibility of the current low interest rate environment and highlighting that debt was not a 'free lunch'. Specific individual levels of *'r'* and *'g'* are likely to matter more for sustainable debt dynamics than the difference between them. Large and positive

([177]) Blanchard, 2019a; Blanchard, 2019b.

GDP growth is especially important: when growth is low or suddenly plunges, this hampers the government's ability to increase the primary balance or to undertake structural reforms to boost long-term growth (e.g. it is politically challenging to fiscally adjust/cut spending when incomes are stagnant) ([178]), ([179]). Moreover, despite favourable financing conditions prevailing, spreads remain in EU countries, reflecting different fundamental characteristics ([180]), and history has shown that financial markets can react quickly and abruptly to changes in economic circumstances ([181]). Then, despite the low or negative *'r-g'* differentials, debt ratios have reached unprecedented levels, as a result of large shocks (global financial crisis, Covid-19 crisis), with limited deleveraging in 'good times'. In fact, several papers highlight that lenient *'r-g'* differentials may have aggravated the deficit bias (see section 3.3.3). Going forward, debt trajectories will be subject to increasing pressures coming from population ageing and climate change, and, neither the growth rate of the economy nor prevailing interest rates are independent from the level of debt. As debt increases, the 'convenience value' of public debt is expected to decrease. Eventually, the rise in the cost of debt will shrink the value of future deficits that the private sector is willing to finance indefinitely and higher debt must be repaid by taxation ([182]).

This debate continues in the aftermath of the Covid-19 crisis, with increased uncertainty on the prospects of several variables relevant for debt sustainability and with debt and its drivers expected to behave in mutually reinforcing ways. In particular, with significant risks of inflation resurgence looming, there are fears of nominal interest rates increasing and of the favourable *'r-g'* differential reversing in the future. Indeed, while long-term real interest rates are still expected to fall in the aftermath of the pandemic ([183]), the effects of monetary policy and inflation in the future are still debated.

([178]) Abbas *et al.*, 2013.
([179]) Abbas *et al.*, 2020.
([180]) Pamies *et al*., 2021.
([181]) Lian *et al.*, 2020.
([182]) Reis, 2021.
([183]) Jordà *et al.*, 2020. Turner and Spinelli, 2012, even point to the possibility of a reversal of the saving glut and thus to an increase of *real* interest rates, though this appear less likely at the current stage.

The remainder of this chapter is organised as follows. A first section provides an overview of the recent literature on the topic and frames the role of *'r-g'* for debt sustainability relative to other relevant factors. A second section depicts stylised facts about the *'r-g'* differential and its contribution to EU and EA countries' debt dynamics, including on the basis of recent data. The third section illustrates the implications of a (mild) increase or possible reversal of *'r-g'* differentials on debt EU countries' trajectories, based on simulations.

3.2. OVERVIEW OF THE LITERATURE

In the literature, *'r'* and *'g'* are defined in slightly different ways, being commonly characterised in nominal terms ([184]). *'r'* may stand for the market *long-term nominal* interest rate (LTI), which often represents the rate of return on 10-year government bonds in local currency ([185]). In other studies, *'r'* refers to the *implicit interest rate (IIR*), which represents the ratio between government interest payments in the current year *t* and the government debt stock in the previous *year t-1* ([186]). In some cases, the *IIR* takes into account the interest receipts earned on government asset holdings ([187]), ([188]). *'g'*, on the other hand, usually stands for the nominal (or real) annual growth rate of the economy, in local currency ([189]) ([190]). Given the focus on long-term

([184]) The real interest rate in the economy may sometimes be quoted (Checherita-Westphal and Domingues Semeano, 2020).
([185]) Turner and Spinelli, 2012; Reis, 2021.
([186]) European Central Bank, 2019; Checherita-Westphal and Domingues Semeano, 2020; European Commission, 2021.
([187]) Turner and Spinelli, 2012.
([188]) In terms of relevance for debt sustainability analysis, the concepts of IIR is more comprehensive, as it reflects several aspects such as the structure of debt (notably in terms of maturity and currency). Though, the simpler concept of market LTI presents advantages, as being available for many countries, in longer, comparable series, all valuable features in cross-country analysis. As LTIs reflect the rate on new issuances of government debt, they may also provide an indicator of future trends in the cost of government financing, which could constitute the preferred angle when analysing a shift about to occur between past/existing and future rates.
([189]) Lian *et al.*, 2020; Mauro and Zhou, 2020; ECB, 2019; Checherita-Westphal and Domingues Semeano, 2020; Reis, 2021.
([190]) Measured as the sum of expected real GDP growth and expected personal consumption expenditure (PCE) inflation rate.

fiscal sustainability, some studies use the nominal *potential* output growth in place of *actual* GDP growth to reduce the volatility associated with the business cycle and measure the trend level of output, which can be sustained without inflationary pressure ([191]).

Many studies note the empirics of a low, declining '*r-g*', which presents itself as a favourable development for debt sustainability. Several papers document a declining, unusually low '*r-g*' since the 1980s and negative since the Global Financial Crisis (GFC) compared to earlier periods. ([192]) In the EU, countries have experienced negative differentials in about half of the years in the past two decades, though the frequency of negative differential episodes appears to differ across Member States, ranging from zero in Italy to almost 90% in Estonia ([193]). Even over longer periods, the negative differentials experienced today are not unprecedented: in both advanced and emerging economies, they would have been often persisting for long historical stretches ([194]). Such conditions look appealing for debt sustainability. They seem to imply that public debt is more sustainable, with 'no fiscal cost' ([195]) and that countercyclical fiscal policy would be less costly and more effective at the zero lower bound (ZLB) ([196]), ([197]). However, economic (or welfare) costs may still exist, as public debt may crowd out private capital, leading to a worse (costlier) capital allocation that lowers growth. In this set-up, the debt path may still be increasing despite favourable snowball effects, likely to entail second-round effects in terms of growth, investor perceptions, and cost of funding, all associated to fiscal sustainability risks.

The fall in '*r-g*' followed mainly from a decline in the real growth rate, '*r*', in turn linked to a variety of factors. Looking at each of the components of the differential since the 1970s in advanced economies, some authors conclude that both have followed a protracted downward trend ([198]). Documenting a longer period since 1800 in selected advanced economies (France, Germany, Italy, Japan, Netherlands, Spain, UK, and US), Schmelzing (2020) ([199]) explains the decline in '*r-g*' mainly as a drop in real interest rates. Importantly, many factors behind the decline of this differential are highly endogenous, with empirical findings mostly constituting correlations, rather then causations (see next section).

However, favourable '*r-g*' are not always guaranteed and higher differentials are often associated with weak fiscal positions, and bad economic times. While countries with higher growth and lower public debt ratios tend to experience negative differentials more often ([200]), this is by far not the rule for all countries. First, more *vulnerable fiscal positions – higher or increasing public debt, larger primary deficits* - are generally associated with higher interest-growth rate differentials, even after controlling for the position in the economic cycle ([201]). For *high-debt* countries, this includes a larger probability of extremely high '*r-g*' in the future, meaning that these countries are more likely to experience a reversal from negative to positive '*r-g*' regimes ([202]); this pattern holds for interest rates and growth separately ([203]). Second, cyclical

([191]) Turner and Spinelli, 2012.
([192]) Turner and Spinelli, 2012; Lian *et al.*, 2020; Mauro and Zhou, 2020.
([193]) European Commission, 2021.
([194]) Mauro and Zhou, 2020.
([195]) Blanchard, 2019a.
([196]) Lian *et al.*, 2020.
([197]) The argument about the ZLB is different than that about '*r-g*'. Presence of the ZLB should ensure absence of crowding out.
([198]) Checherita-Westphal and Domingues Semeano, 2020.
([199]) Schmelzing, 2020.
([200]) European Commission, 2021.
([201]) Escolano *et al.*, 2017; ECB, 2019; Checherita-Westphal and Domingues Semeano, 2020; Turner and Spinelli, 2012.
([202]) This probability is assessed by estimating the distribution of '*r-g*' as a function of public debt, using quantile regressions. The gap between the upper and median quantiles of the average '*r-g*' in the next two or five years is positively associated with the level of public debt. For example, as the current debt-to-GDP ratio increases from 40% to 120%, the 90th percentile of the average '*r-g*' over the following five years increases from around 0 to 2 percent. At the same time, the median '*r-g*' only increases by around 0.8 percentage points. The increase in the downside risk is not compensated by higher upside risk; if anything, higher public debt today is also associated with a smaller decline in '*r-g*' in the very good state (lower quantiles).
([203]) This suggests that both '*r*' and '*g*' components contribute to the positive association between public debt and '*r-g*' at risk. Theoretically, public debt may lead to higher downside risk in '*r-g*' because high public debt affects both '*r*' and '*g*' such that they tend to be significantly more negatively correlated in bad times. On the '*i*' side, many countries with higher public debt experience a larger (and persistent) increase in interest rates in response to adverse global volatility shocks (as measured by VIX); however, in countries typically considered 'safe havens' (the US, the UK, Japan, Switzerland, and Germany) interest rates do not

conditions (*bad economic times*) are also key, and the *'r-g'* differential tends to increase quickly and significantly during *recessions*, especially in high-debt countries ([204]). This happens as *negative shocks*, a slowdown, or domestic growth lower than expected tend to be associated with an increase in risk premia (interest rates), especially in high, foreign currency denominated debt countries. Then, within high-debt countries, a *higher share of foreign currency-denominated public debt* is associated with higher average *'r-g'*, as debts denominated in currencies that appreciate following adverse shocks increase the real value of outstanding liabilities and borrowing costs in bad times ([205]).

3.3. STYLISED FACTS ABOUT 'R-G' DIFFERENTIALS AND DEBT DYNAMICS IN THE EU

3.3.1. Developments in the interest-growth rate differential in the EU

Interest-growth rate overall developments

Over the past two decades, the *'r-g'* differential for the EU as a whole followed an overall downward trend (see Graph II.3.1). It averaged around 0.9 pps. between 2001 and 2020 and recorded three notable spikes ([206]). It was negative during periods of robust output growth, while it reached record highs at the peak of the Great Financial Crisis, the European sovereign debt crisis and the COVID-19 pandemic. Between 2001 and 2020, nominal growth exceeded the cost of debt in eight out of twenty years. The differential was positive and on a declining path between 2000 and 2005 and turned negative in 2006 and 2007. The GFC in 2008-2009 and the outbreak of the European sovereign debt crisis (2009-2012) pushed the interest-rate-growth differential again in positive territory during those years. The differential spiked to a high of 8½ pps. in 2009, driven by the sharp contraction in GDP (see Graph II.3.1). During the subsequent five years (2010-2014), sluggish growth kept the EU average interest-rate-growth differential in positive territory, although with significant heterogeneity across Member States (see below). As the EU economy recovered and market confidence improved, EU GDP growth once again exceeded the implicit interest rate in 2015. In the subsequent years, the interest rate-growth differential remained negative, reaching even -2.0 pps. in 2017, thereby helping to reduce the EU aggregate stock of government debt from 85% of GDP in 2015 to 77½% in 2019. In 2020, the economic crisis triggered by the COVID-19 pandemic once again led to a surge in *'r-g'* to almost 6½ pps. in 2020, due to the sharp contraction in GDP, while the average cost of debt continued to decline (though some temporary tensions on financial markets appeared at the outbreak of the crisis, in March 2020, for some countries) ([207]).

A steady drop in the implicit interest rate drove the underlying downward trend in the interest rate-growth differential for the EU as a whole (see Graph II.3.1)**.** Year-to-year fluctuations in *'r-g'* have been shaped by developments in nominal GDP growth. However, beyond these cyclical fluctuations, GDP growth also followed an underlying downward trend, which has partly offset the favourable impact on debt dynamics from the steady fall in the implicit interest rate from around 5⅓% to 2.0% over the same period. ([208]) The downward trend in the EU interest - growth rate differential is even steeper when, instead of the implicit interest rate, market interest rates are used. The long-term market interest rate ([209]) for the EU as a whole, which describes the cost of the newly issued debt, fell from almost 5.0% in 2021 to 0% in 2021.

The downward trend in nominal output and the interest rate was mirrored by the decline in

react to increases in uncertainty/global volatility, even when their debts are high (Lian *et al.*, 2020).

([204]) ECB, 2019; Checherita-Westphal and Domingues Semeano, 2020.

([205]) Lian *et al.*, 2020.

([206]) The average *'r-g'* differential for the EU as a whole is measured as the GDP-weighted average of the *'r-g'* differential of the 27 EU Member States. The interest rate on government debt for each Member State, *'r'*, refers to the implicit interest rate on debt and is measured by dividing the cost of interest payments in year *t* by the outstanding stock of government debt at the end of year *t-1*.

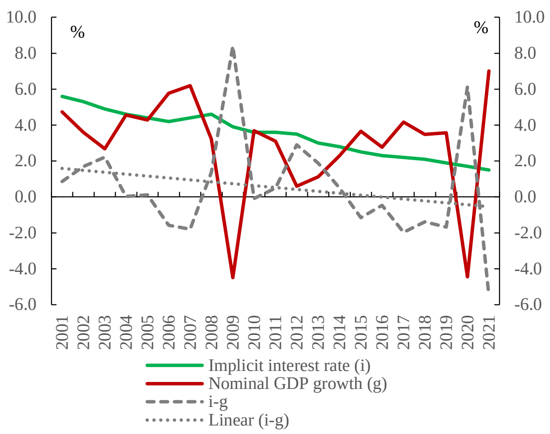
([207]) Data for 2021 in the graphs of this section refer to those projected in the European Commission Autumn 2021 Economic Forecast.

([208]) The euro area nominal long-term interest the rate, as measured by the euro area 10-year government benchmark bond yield provided by the ECB, fell from around 5% in 2001 to 0.2% in 2020.

([209]) This refers to the market yield on government bonds with a 10-year maturity.

their real values. In order to identify the underlying drivers of changes in '*r-g*', it is useful to take into account the effect of inflation and examine changes in the real values of GDP growth and of the interest rate. In real terms, the euro area aggregate long-term interest rate ([210]) fell by almost 6 pps. over the past twenty years, from almost 3.3% in 2001 to -0.7% in 2021. On the output side, according to Commission's estimates, potential (real) GDP growth is also estimated to have declined by around 1 pp. between 2002 and 2019 ([211]), which is significant but substantially less than the drop in the real interest rate.

Graph II.3.1: **EU interest rate-growth differential based on nominal implicit interest rate and nominal GDP growth, 2001-2021**

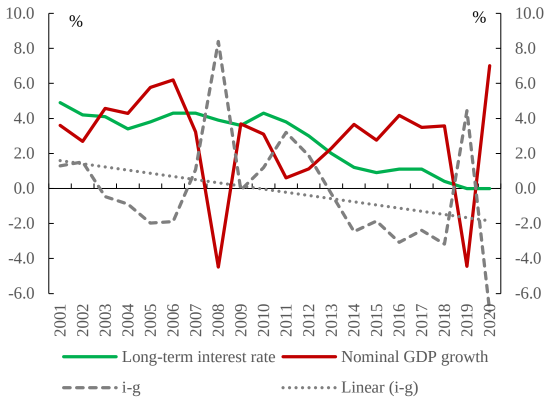


Source: European Commission, Ameco database.

([210]) The long-term interest rate refers to the euro area 10-year government benchmark bond yield as estimated by the ECB. The long-term real rate is calculated using the 12-month average of euro area core inflation.

([211]) Over the two-decade period under review, the drop in HICP core inflation (used to estimate the real interest rate) has been similar to the drop in inflation measured by the GDP deflator (which is used to convert nominal to real GDP).

Graph II.3.2: **EU interest rate-growth differential based on nominal market long-term interest rate and nominal GDP growth, 2001-2021**



Source: European Commission, Ameco database.

Drivers of the trend decrease of market interest rates (and potential growth)

The fall in the nominal long-term market interest rate reflects the downward shifts of both the expected short-term (policy) rates and the term premia ([212]). The impact of the global financial crisis and in particular of the euro area sovereign debt crisis on the euro area economy and muted inflation expectations contributed to the downward shift in the average expected nominal short-term interest rates. The mix of reduced uncertainty about inflation and about the path of future short-term interest rates reflecting inflation expectations and the ECB's forward guidance also exerted a downward pressure on the risk premia. The ECB's expanded asset purchase programme since 2014 contributed to lower interest rate risk at longer maturities and thus further compressed term premia ([213]).

The reduction in the expected policy rate partly reflects a steady drop in the so-called natural rate of interest ([214]). The natural, or neutral, rate of interest (r^*) is the real short-term interest rate that is consistent with an output gap of zero (i.e. full employment) and, therefore, stable inflation. The dynamics of savings and investments stand at

([212]) McCoy, 2019.

([213]) The net asset purchases between March 2015 and end-2018 are estimated to have suppressed 10-year sovereign yields in the euro area by around 100bps. For details, see Eser *et al.*, 2019.

([214]) Brand *et al.*, 2018; Holzmann and Valderrama, 2020; Bean *et al.*, 2015.

the heart of the long-term downward trend in r^*, with the ageing and productivity trends identified as major contributors driving structural changes in savings and investments. The contribution of growing inequality to reducing the natural interest rate has also come under increasing scrutiny, namely through the redistribution of income away from low to high-saving households affecting saving and investment preferences. ([215]) Factors such as post-GFC deleveraging and the global savings glut originating from Asian emerging markets appear to have added a more transitory downward pressure on real interest rates. ([216]) Finally, but importantly, the scarcity of safe assets coupled with their increased demand is likely to have played an increasing role in the post-GFC and European sovereign debt crisis periods, globally and in the euro area ([217]).

Accommodative monetary policy or the quantitative easing measures undertaken since the GFC have been associated with lower interest rates ([218]). Indeed, over the past couple of decades, the adoption of monetary policy regimes credibly targeting low inflation, including the introduction of the euro (European Monetary Union set-up) led to very low (monetary) policy rates and short-term interest rates and even pushed nominal long-term interest rates down.

However, some of the factors that have led to a reduction in r^*, especially ageing and productivity, also affect potential GDP growth. As a result, the favourable impact on the interest rate-growth differential from the reduction in the natural rate of interest is in part offset by lower GDP growth in the longer term. As mentioned above, the Commission's estimates indeed point to a reduction in potential GDP growth over the past two decades. Arena, M. et al. (2020) ([219]) estimate that r^* decreased by 2 percentage points (on average) when comparing the post-GFC with the pre-GFC period, while trend growth fell by around 1 percent. Therefore, their estimates suggest that the trend decline in the *'r-g'* differential was actually half as large as the decrease in r^*.

Country specificities

There has been significant heterogeneity in the development of the interest-growth rate differential across the Member States. As shown in Graph II.3.3, Estonia, Bulgaria, Slovakia and Ireland had a sizeable negative interest-growth rate differential on average over the past two decades. By contrast, in several high debt Member States, including Greece, Italy and Portugal, the implicit interest rate exceeded nominal GDP growth on average. Graph II.3.3 shows that Member States with higher government debt had an unfavourable interest-growth rate differential (i.e. more positive or less negative) compared with those with lower debt. As Graph II.3.4 shows, this was consistently the case during the four main economic periods identified in this section, namely the expansionary period between 2001 and 2007, the GFC and the European sovereign debt crisis (2008-2012), the economic recovery/growth phase between 2013 and 2019, and the COVID-19 crisis (2020-2021). The low debt Member States, defined as those with a debt ratio less than 60% of GDP in 2019 ([220]), had a negative interest-growth rate differential during three of these four economic periods, with their implicit interest rate exceeding nominal GDP growth only during the period of the GFC and the European sovereign debt crisis. On the other hand, the group of Member States with government debt between 60% and 90% of GDP in 2019 ([221]) collectively had a favourable (i.e. negative) *'r-g'* only between 2001 and 2007, while it was practically close to zero during the 2013-2019

([215]) Rachel and Smith, 2015.

([216]) Other studies conjecture that the global savings glut as well as population ageing seem to have depressed not only (natural) interest rates, but also potential GDP growth (ECB, 2019; Checherita-Westphal and Domingues Semeano, 2020). In their work, ageing variables presents some complexities: higher dependency ratio is associated with lower '$r-g$', while slower population growth tends to increase the differential.

([217]) Downgrades by credit rating agencies following the GFC have led to fewer European countries being highly rated (AA and AAA). This effect is also visible at the global level (Caballero *et al.*, 2017). Moreover, during the period preceding the COVID-19 crisis, sovereign net debt issuance by highly rated EU countries had significantly slowed down or even declined. Moreover, the ECB's asset purchase program has withdrawn from the market a significant share of the outstanding amount of highly rated sovereign debt since 2015.

([218]) Lian *et al.*, 2020; Checherita-Westphal and Domingues Semeano, 2020; Turner and Spinelli, 2012.

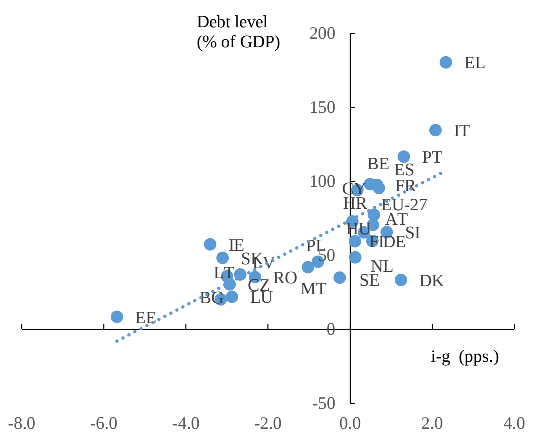
([219]) Arena *et al.* 2020.

([220]) The EU Member States included in this group are Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Romania, Slovakia, Finland, and Sweden.

([221]) This group of Member States consists of Croatia, Austria, Slovenia, and Hungary.

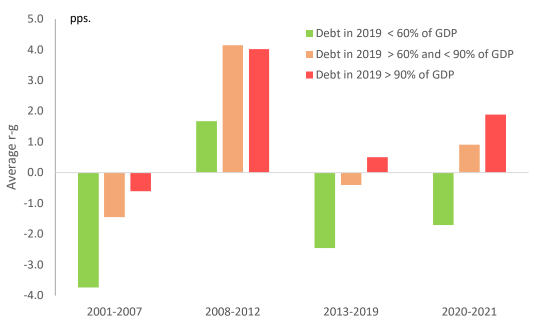
period. The Member States with government debt above 90% of GDP in 2019 ([222]) had a (marginally) negative *'r-g'* only during the strong growth period between 2001 and 2007.

Graph II.3.3: **Interest-growth rate differential and public debt, average 2001-2021 (based on IIR)**



Source: European Commission's Ameco database, Eurostat.

Graph II.3.4: **Interest – growth rate differential across economic periods and debt levels (based on IIR)**



Source: European Commission's Ameco database, Eurostat.

The heterogeneity in *'r-g'* reflects differences in both output growth and in interest rates. Strong output growth contributed to a negative average *'r-g'* in several Member States (see Graph II.3.5, especially in those that acceded the EU in 2004 and 2007 and benefited from a real convergence process. The effect from high growth in these Member States was in part offset by a higher implicit interest rate, due to higher inflation expectations and higher risk premia that are likely to reflect higher inflation risks, less liquid capital markets and currency volatility risks. The implicit interest rate was particularly high in Romania, Hungary, Slovenia and Poland. Among the euro area Member States, low growth in Greece and Italy contributed to a positive differential. At the same time, the implicit interest rate on government debt for Italy, Portugal, Spain and Belgium exceeded the rates for Germany and France by around ¾ pps, including due to a higher credit risk premia ([223]).

Graph II.3.5: **Breakdown of 'r-g' differential across Member States, 2001 – 2021 (based on IIR)**

(1) Positive growth is expressed with a minus sign, reflecting its contribution to the *'r-g'* differential.
Source: European Commission's Ameco database.

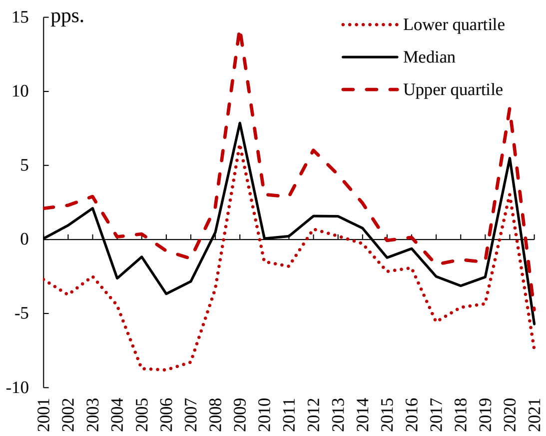
The dispersion of the interest-rate-growth differential across the Member States has been significantly lower during the recent COVID-19 crisis compared with the GFC and the European sovereign debt crisis. The economic crisis between 2008 and 2012 saw an exceptionally sharp increase in the *'r-g'* differential for the quarter of Member States with the highest debt, compared with the median value of the differential and with the quartile of Member States with the lowest debt (see Graph II.3.6), mainly on account of greater concerns about credit risks. By contrast, the COVID-19 crisis was characterised by a reduced dispersion of the *'r-g'* differential and the quarter of Member States with the highest debt had a differential that was close to the median, indicating that the current crisis was accompanied by reduced debt sustainability fears for this group of countries compared to the GFC and the European sovereign debt crisis. This reduced dispersion likely reflects the coordinated fiscal-monetary response in the COVID crisis, which

([222]) This group of Member States consists of Greece, Italy, Portugal, Belgium, France, Spain and Cyprus.

([223]) Corradin *et al.*, 2021.

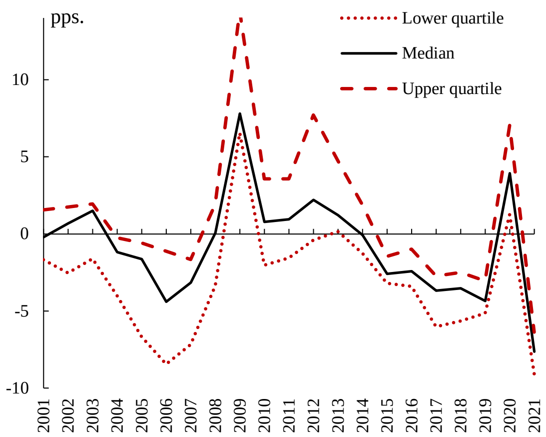
helped to reduce fragmentation in sovereign debt markets in the euro area and the EU.

Graph II.3.6: **Dispersion of the interest-growth rate differential, distribution of EU countries (based on IIR)**



Source: European Commission's Ameco database.

Graph II.3.7: **Dispersion of the interest-growth rate differential, distribution of EU countries (based on market long-term interest rates)**



Source: European Commission's Ameco database.

Looking forward, the COVID-19 crisis, the war in Ukraine and exceptional uncertainty on the economic outlook make it extraordinarily difficult to predict the future development of the interest-growth rate differential. This uncertainty is related to factors such as the need for a substantial increase in investment to meet the green and digital transition and to improve resilience, possible productivity gains from a faster digital transition, the risk of economic scarring effects, the implications of the green transition on sectoral composition of growth, the prospect of higher precautionary savings, possible higher demand for safe bonds, including due to growing demand from emerging market economies ([224]) and their use in collateralised operations, and permanently higher risk premia on less safe assets, and others. Persistently high inflation could also trigger a tightening of monetary policy, possibly resulting in higher nominal interest rates and weaker economic growth.

3.3.2. The main drivers of debt dynamics over time

Several conclusions emerge from an overview of the data for the past couple of decades. To better understand the debt dynamics and the role of *'r-g'* over time, we look at the data available for EU countries in the AMECO database (for most countries since 1995 and until 2021). Several conclusions emerge.

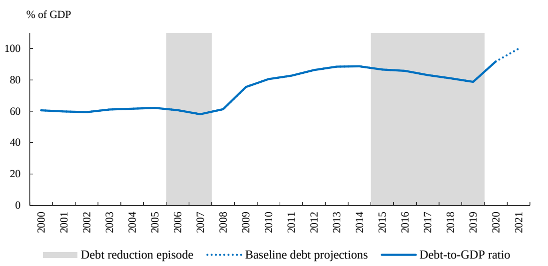
First, in aggregate terms, debt appears 'sticky', with large debt increases having been more customary than large declines and with rises and falls exhibiting different anatomies. Over the available sample, positive and negative changes in debt have indeed occurred with contrasting frequencies and magnitudes ([225]). Largest *debt-increasing episodes* have typically been associated to crises, namely the Global Financial Crisis and the COVID-19 crisis. During the latter, (blue shaded in graph II.3.9 and table II.3.1), government debt increased on average by some 5-6 pps. of GDP per year in the EU/EA, compared to the remaining periods, with some annual peaks larger than 10 pps. of GDP (see Table II.3.1). *Debt declining episodes* have been both less frequent and smaller in magnitude, with debt decreasing on average by a maximum of 1 pp. of GDP per year in the EU/EA (see Graphs II.3.8, II.3.9 and Table II.3.1).

Debt increases and drops also seem to differ in terms of composition, with a varying relative size of debt drivers. During the largest *debt-increasing episodes*, positive (unfavourable) *'r-g'* differentials have featured sizable, matching sign contributions to debt dynamics, comparable and

([224]) Caballero *et al.*, 2017.
([225]) A debt increasing / decreasing episode is defined as a positive / negative y-o-y change.

sometimes larger than those of primary deficits (see Graph II.3.9 and Table II.3.1). During *debt-declining episodes*, all coinciding with good times, the primary surplus has been the clear driver of debt dynamics (see Graph II.3.9 and Table II.3.1.). This partially reflects real growth effects and the use of different policy levers (see Box 2.3 in the Debt Sustainability Monitor 2017).

Graph II.3.8: **Historical developments in the debt ratio, EA**

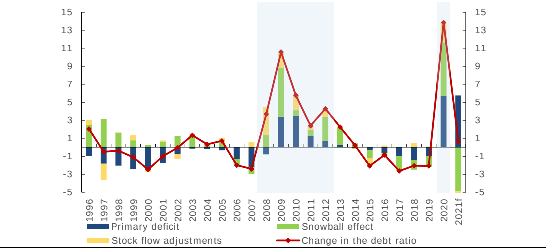


(1) Grey-shaded areas mark periods of debt decline.
Source: Commission services

A more detailed analysis confirms the importance of the snowball effect in the debt dynamic. *Average outcomes* confirm the relevance of the snowball effect (see Table II.3.1.). *Results by year* at aggregate EU level, over the 21 years between 2001-2021, show 9 *debt reduction episodes* (all in good times), 8 of which supported by a favourable/negative *'r-g'* differential, while at EA-19 level, over the period 1996-2021, 7 of the 12 *debt reduction episodes* (all in good times) were backed by a favourable/negative *'r-g'* differential. Conversely, in both EU and the EA, the vast majority of *debt-increasing episodes* in the sample up to 2021 included (i.e. 12 episodes for the EU, 13 for the EA, most of which during crisis periods), coincided with positive *'r-g'* differentials (unfavourable snowball effects).

However, observed debt dynamics do not only depend on *'r-g'*, and debt can sometimes move in the opposite direction compared to the snowball effect. During certain years, debt dropped despite a positive *'r-g'* differential (adverse snowball effects); conversely, debt was found to increase notwithstanding favourable *'r-g'* conditions. At aggregate EU level, debt fell marginally despite an unfavourable (positive) snowball effect in 2002. Similarly, at EA level, before 2003 there were 6 debt-reduction episodes which relied mainly on primary surpluses (and SFA) to prevail over adverse (positive) *'r-g'* differentials. In 2021, both EU and EA aggregate debt ratios are expected to still increase marginally, despite favourable snowball effects (see Graph II.3.9).

Graph II.3.9: **Debt ratio dynamics, breakdown by component, % of GDP, EA**



(1) Blue-shaded areas mark crisis periods. A negative contribution from the deficit constitutes a surplus and reduces debt.
Source: Commission services

A key explanation to this outcome is fiscal policy, which has contributed to EU/EA average debt dynamics more substantially than snowball effects have, over most of the sample. During crises, the deterioration of primary balance is an important driver of debt dynamics, reflecting both the impact of automatic stabilisers (the cyclical component) and of unique events (one-off and temporary items), as well as that of active/discretionary measures adopted by governments to support the economy (as seen in structural primary balance (SPB)). During non-crisis periods, the improvement in the primary balance is the main driver of debt dynamics, with indication of some active consolidation having taken place in 2013-19 (as seen in SPB – see Table II.3.1). However, these aggregate results hide important cross-country differences, with high debt countries known to have consolidated little or not at all before the Covid-19 crisis.

Stock-flow adjustments (SFA) matter too for debt dynamics, especially in crisis times. During crises, (positive) stock-flow adjustments are an important driver of the debt dynamic. Indeed, while in normal times SFA are on average close to zero, crises are associated with more significant SFA (see Table II.3.1.). During the GFC and the European sovereign debt crisis, larger SFA were driven by government support to the financial sector, while during the Covid-19 crisis, SFA rose due to tax deferrals and other liquidity support provided to the corporate sector. In more specific terms, notable SFA occur during crises for different reasons related to their components ([226]).

Not least, in the sample analysed, it is noteworthy that the average *'r-g'* differential has rapidly reversed sign in both of the last two crises even in an environment of low interest rates, essentially as economic activity fell. Both the 2008-12 crisis (GFC, European sovereign debt) and the Covid-19 crisis brought about a reversal of the snowball effect (*'r-g'*) sign compared to the years preceding these crises (see Graph II.3.6). The *'r-g'* differential increased sharply in both crises, essentially as economic activity plummeted. During the GFC and the European sovereign debt crisis, this increase was aggravated by a notable surge in interest rate (spreads) in vulnerable countries ([227]). This reversal materialised even in the environment of low interest rates prevailing before, during, and after the Covid-19 crisis. Indeed, even though at EU aggregate level *'r-g'* had turned negative, inducing snowball effects favourable to debt dynamics since 2015, the outbreak of the Covid-19 crisis briskly interrupted these conditions in 2020 (see Graph II.3.6). Evidence that snowball effects may both revert sign and increase their magnitude in a crisis is therefore a reminder that favourable, negative *'r-g'* differentials cannot be relied upon at all times (see also the next section).

Aggregate EU/EA data hide important cross-country differences. During crisis times, the large average debt increases experienced by (already) high debt countries, associated to strong contributions from unfavourable snowball effects, illustrate their vulnerability to reversals of financing conditions (see Table II.3.1).

Table II.3.1: **Debt ratio dynamics, breakdown by component, different period averages, % of GDP, EA, EU and groups of countries with debt below and above 60%, respectively**

	EA	Non-crisis 1996-07	Crisis 2008-12	Non-crisis 2013-19	Crisis 2020	Non-crisis 2021
	Change in the debt ratio *(1+2+3),* of which:	**-0.5**	**5.3**	**-1.0**	**13.9**	**0.6**
(1)	Primary deficit, of which:	-1.4	1.6	-0.6	5.7	5.7
	• Structural primary deficit	*n.a.*	0.5	-1.2	2.1	4.3
	• Cyclical component	-0.5	0.8	0.5	3.5	1.5
	• One-off and temp items	*n.a.*	0.2	0.1	0.1	0.0
(2)	Snowball effect	0.9	2.2	-0.4	5.9	-4.9
(3)	Stock flow adjustments	0.0	1.6	0.0	2.3	-0.2
	EU	**Non-crisis 2001-07**	**Crisis 2008-12**	**Non-crisis 2013-19**	**Crisis 2020**	**Non-crisis 2021**
	Change in the debt ratio *(1+2+3),* of which:	**-0.6**	**4.8**	**-1.0**	**12.9**	**0.3**
(1)	Primary deficit, of which:	-1.0	1.6	-0.6	5.5	5.3
	• Structural primary deficit	-0.3	0.6	-1.1	2.1	4.0
	• Cyclical component	-0.6	0.8	0.4	3.2	1.4
	• One-off and temp items	*n.a.*	0.2	0.1	0.1	-0.1
(2)	Snowball effect	0.2	1.9	-0.4	5.1	-4.7
(3)	Stock flow adjustments	0.2	1.4	0.0	2.4	-0.2
	EU, debt in 2019 < 60%	**Non-crisis 2001-07**	**Crisis 2008-12**	**Non-crisis 2013-19**	**Crisis 2020**	**Non-crisis 2021**
	Change in the debt ratio *(1+2+3),* of which:	**-0.2**	**3.8**	**-2.5**	**8.5**	**1.4**
(1)	Primary deficit, of which:	-0.8	0.6	-1.4	3.8	4.5
	• Structural primary deficit	-0.7	-0.2	-1.4	1.7	3.6
	• Cyclical component	-0.1	0.5	0.0	2.1	1.0
	• One-off and temp items	*n.a.*	0.4	0.0	0.0	-0.1
(2)	Snowball effect	0.6	0.9	-1.2	1.6	-3.0
(3)	Stock flow adjustments	0.0	2.2	0.1	3.1	-0.1
	EU, debt in 2019 > 60%	**Non-crisis 2001-07**	**Crisis 2008-12**	**Non-crisis 2013-19**	**Crisis 2020**	**Non-crisis 2021**
	Change in the debt ratio *(1+2+3),* of which:	**-0.6**	**6.1**	**0.7**	**19.4**	**-0.8**
(1)	Primary deficit, of which:	-1.1	2.3	0.2	7.2	6.1
	• Structural primary deficit	0.0	1.2	-0.8	2.6	4.4
	• Cyclical component	-1.1	1.1	0.9	4.4	1.8
	• One-off and temp items	*n.a.*	0.0	0.1	0.2	-0.1
(2)	Snowball effect	0.2	3.0	0.5	10.2	-6.4
(3)	Stock flow adjustments	0.3	0.7	0.0	2.0	-0.5

(1) Contributions from the cyclical component and one-off and temporary items are defined as a deficit. A positive contribution from a deficit increases debt. A negative contribution from a deficit constitutes a surplus and reduces debt. *The groups of low and high debt countries ae defined as countries with a debt ratio < 60% and > 60% of GDP in 2019, respectively.*
Source: Commission services.

3.3.3. Final reflections about the importance of a negative (favourable) *'r-g'* differential for debt sustainability relative to other factors

Even in a negative (favourable) *'r-g'* environment, there are further reasons to retain a focus on debt sustainability. First, even if current favourable financing conditions reflect structural factors (see section 3.2.2)**, these conditions could be reversed, especially in high debt countries that already pay higher spreads than others**. Indeed, studies find that sovereign bond spreads respond to fundamental variables, especially government debt, in non-linear fashion, and the sensitivity of spreads to fundamentals,

([226]) First, crises often induce changes in the government's financial assets such as cash deposits use or build-up, potential fire sales to support debt adjustments, privatisations, financial sector recapitalisations or materialisation contingent liabilities from public guarantees, if recorded below the line. Second, *cash-accrual differences* are also larger in a crisis, when governments commonly grant substantial tax deferrals, 'frontload' some social payments, delay settlements on certain goods and services or go for a fast or delayed settlement of tax refunds. Third, large *valuation effects* may also occur in a crisis for countries having issued, for instance, part of their debt in currencies that attract a flight to safety (which quickly appreciate after a global shock) or due to possible *volume effects* associated to sector reclassifications, for instance from the banking sector to the state or general government sector. See Box I.1.2 for more details on the three SFA components.

([227]) Though this is not evident when looking at the implicit interest rate, given the maturity structure of debt.

including government debt also increases with international investors' risk aversion ([228]). Low or negative differentials are not associated with lower frequency of sovereign defaults. Sovereign default histories demonstrate that, after prolonged periods of low differentials, marginal borrowing costs (LTI) (as opposed to average effective interest rates (EIR)) often rise suddenly and sharply just prior to default, shutting countries out of financial markets at short notice ([229]). This evidence shows that favourable *'r-g'* circumstances should not be overstated, as they often escape the direct control of governments ([230]).

Then, all underlying factors driving the debt dynamics are interrelated and the *'r-g'* differential cannot be considered in isolation from other variables. In particular, several papers highlight that negative *'r-g'* differentials may have aggravated the deficit bias ([231]). Indeed, *while negative differentials support debt reduction, this effect is partly offset by a reduced fiscal effort, especially in highly indebted Member States; [hence] a reduction in interest rate-growth differentials does not lead to a one-to-one change in the pace of debt reduction. As [debt] reaches high levels, discretionary fiscal policy tends to react to the negative differential environment by delivering a smaller effort* ([232]). Therefore, low financing costs may pose risks to debt sustainability when they operate as a pull factor towards higher government debt, as the issuance of new debt appears affordable. This perverse effect may cause a protracted (and potentially more sizeable) debt overhang as governments fail to deleverage in good times. The recent literature also provides new insights into the interrelations between the growth rate of the economy, prevailing interest rates, and the level of debt. As debt increases, the convenience value of public debt will decrease. Eventually, the rise in the cost of debt will shrink the value of future deficits that the private sector is willing to finance indefinitely and higher debt must be repaid by taxation ([233]). In this sense, *'r<g'* can finance small deficits, but it does not resolve already exponentially-growing debt *or* large deficits, which still need to be repaid by subsequent surpluses ([234]), also considering that persistent primary surpluses are, nowadays, rare ([235]).

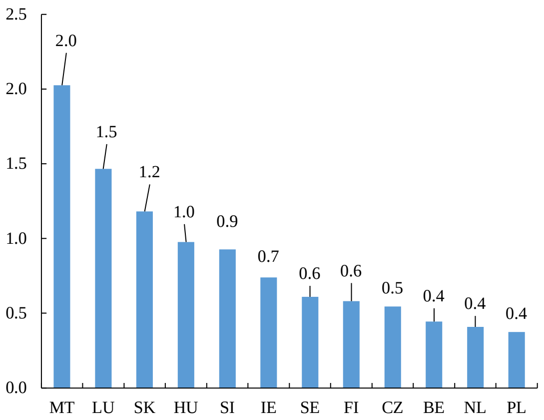
Furthermore, negative *'r-g'* differentials are not necessarily associated with reduced fiscal risks, which encompass broader, future developments in different factors. Despite the low or negative *'r-g'* differentials observed outside of crisis times, debt ratios have reached unprecedented levels, as a result of large shocks (global financial crisis, COVID-19 crisis), increasing in turn the vulnerability of the debt trajectory to future shocks and reversals. In full foresight, a comprehensive analysis should also consider risks to fiscal sustainability from *direct or contingent liabilities* expected in the future. With *population ageing*, *climate change*, *financial stability* risks looming in the banking, insurance and private pension sectors ([236]), and with governments having issued important guarantees to different sectors during the COVID-19 crisis, direct, as well as implicit and explicit contingent liabilities have increased. Thereby, governments may expect higher liabilities to materialise from these areas in the future, also implying new risks to debt sustainability. At the same time, when interest rates are low, governments' future commitments in net present value are larger and likely to widen some countries' sustainability gaps (see Graph II.3.10) ([237]).

For all these reasons, the argument that public debt has no fiscal costs in a negative *'r–g'* environment is only partial and a vigilant focus on debt sustainability is still needed. A holistic approach to government debt sustainability appears desirable, especially after the latest debt surges crises have inflicted over the past decade(s).

([228]) Pamies *et al.*, 2021; Mausch *et al.*, 2017.
([229]) Mauro and Zhou, 2020.
([230]) Lian *et al.*, 2020.
([231]) European Commission, 2021; Schuknecht, 2020.
([232]) European Commission, 2021.
([233]) Reis, 2021.
([234]) Cochrane, 2021.
([235]) Panizza and Eichengrren, 2014 point to Norway after 1999, Belgium after 1995, and Singapore after 1990.
([236]) Risks to financial stability in these sectors may derive from the very phenomenon of climate change and extreme weather events (insurance sector) as well as from the environment of low interest rates, which increases capitalisation needs (in the private pension defined benefit sector) and lowers the rate of return (in the private pension defined contribution sector), as well as it has increased risk taking (in the financial sector as a whole).
([237]) Whether lower interest rates increase or reduce a country's sustainability gap depends on the relative size of two counteracting effects of low rates – reduced future interest payments on debt, on the one hand, and larger future ageing costs in present value, whereby interest rates serve as discount factors, on the other.

Such a view would also need to integrate considerations on the quality of public finances and the strength of institutions.

Graph II.3.10: **Impact of lower interest rates (-1 pp.) on the contribution of costs of ageing to the S2 indicator, selected countries, pps. of GDP**



(1) Interest rates and growth rates serve as discounting factor when calculating the contribution of all future costs of ageing (CoA) to S2, a form of net present value of CoA. The graph shows the difference between such CoA contributions to S2 when interest rates are 1 pp lower compared to baseline assumptions.
Source: Commission services.

3.4. IMPLICATIONS OF A CORRECTION OF 'R-G' DIFFERENTIALS FOR DEBT SUSTAINABILITY RISKS

The baseline debt projections included in this report are anchored to favourable *'r-g'* differentials' assumptions, and warrant stress testing. The baseline interest rate assumptions reflect financial market expectations, which are currently very favourable. Moreover, baseline GDP projections include the expected positive impact of *NextGenerationEU*, and in particular of the investments planned under the Recovery and Resilience Facility. However, given that less favourable macro-financial conditions could materialise, with, in particular, non-trivial risks of reversal of financial conditions (as argued in this chapter), baseline debt trajectories are stress tested against less favourable *'r-g'* differential assumptions.

An adverse *'r-g'* scenario is designed to capture risks of a (moderate) *'r-g'* increase or even reversal. We design an adverse *'r-g'* scenario, whereby the *'r-g'* is assumed to be permanently higher in the future, by 1 pp. compared to the baseline. This higher differential is obtained by applying simultaneous shocks to short and long-term market interest rates and to economic growth assumed under the baseline, similarly to a combined adverse shock to these variables. These combined shocks apply over the period 2022-2032 of the projections.

Table II.3.2: **Interest – growth rate differentials, baseline and adverse scenario (based on the implicit interest rate)**

	avg 2001-21	Baseline 2032	Adverse 'r-g' scenario 2032
BE	0.5	-1.7	-0.8
BG	-2.7	-1.6	-0.8
CZ	-1.0	-1.2	-0.3
DK	1.3	-2.2	-1.5
DE	0.6	-2.5	-1.6
EE	-4.8	-3.9	-3.1
IE	-2.6	-2.9	-2.1
EL	2.6	-1.8	-1.2
ES	0.9	-1.3	-0.5
FR	0.7	-2.0	-1.1
HR	0.4	-1.6	-0.7
IT	2.1	-0.7	0.2
CY	0.3	-2.6	-1.8
LV	-2.5	-2.8	-1.9
LT	-2.0	-2.8	-1.9
LU	-2.7	-3.1	-2.3
HU	-0.9	-1.5	-0.6
MT	-1.1	-3.2	-2.3
NL	0.2	-2.1	-1.2
AT	0.6	-2.2	-1.3
PL	-1.0	-2.6	-1.7
PT	1.4	-1.0	-0.2
RO	-5.6	-0.5	0.5
SI	0.3	-3.1	-2.2
SK	-1.0	-2.7	-1.9
FI	0.2	-2.8	-2.1
SE	-0.9	-2.9	-2.4

(1) cells are highlighted in blue when the projected *'r-g'* differential is lower than its historical average.
Source: Commission services

Under this adverse scenario, *'r-g'* projections would remain negative for most countries in 2032, but would have higher values than assumed in the baseline. Indeed, while this scenario is not designed to capture magnitudes of the reversal that *'r-g'* experienced during crises, it does lead to an increase of the differential in all cases. In 2032, the baseline assumptions lead to lower *'r-g'* values than the countries' historical averages (2001-21) in all cases except Bulgaria, Estonia and Romania. Alternatively, the adverse *'r-g'* scenario pushes this differential up to values exceeding historical averages also in Czechia, Ireland, Latvia, Lithuania, Luxembourg, and Hungary the same year, although the differential would remain negative in all but two cases, Italy and Romania (see Table II.3.2).

Consequently, the adverse *'r-g'* scenario would lead to higher projected debt levels by 2032 compared with the baseline, but the risk category would remain unchanged in all but two countries. As expected, this adverse *'r-g'* scenario would lead to higher projected debt levels by 2032 compared to the baseline. Higher impacts are seen in high debt countries (Greece, Italy, Spain, Portugal, Belgium and France) and / or in countries with a shorter average (residual) maturity of debt (Hungary, Portugal, Germany, Italy, Spain and Romania), meaning a faster pass-through of the less favourable assumption. However, in the vast majority of countries, these results do not lead to a different risk category, compared with the baseline ([238]). Only in Portugal and Croatia the risk category of the adverse *'r-g'* scenario is 'high', compared to a 'medium' risk category in the baseline. This worsening occurs in these countries as their debt paths under the adverse *'r-g'* scenario would bounce back more quickly and to higher a level by 2032, compared to the baseline. In all countries where risks were already high under the baseline (Italy, Greece, Belgium, Spain, France, Slovenia and Slovakia), a higher or adverse *'r-g'* would further aggravate risks (see Table II.3.3).

Table II.3.3: **Projected debt levels in 2032, baseline and adverse 'r-g' scenario, % of GDP**

	Baseline	Adverse 'r-g' scenario (+1 pp)	Impact adverse 'r-g' scenario
BE	133.6	143.0	9.4
BG	36.4	38.6	2.2
CZ	67.1	71.6	4.5
DK	15.6	17.5	1.9
DE	61.6	66.8	5.1
EE	25.7	27.2	1.5
IE	45.7	48.8	3.2
EL	154.7	165.6	10.9
ES	126.1	136.1	10.0
FR	122.3	131.4	9.1
HR	76.7	82.6	5.8
IT	161.6	174.8	13.2
CY	77.8	83.6	5.7
LV	48.8	52.5	3.8
LT	39.4	42.4	2.9
LU	18.2	19.5	1.4
HU	68.1	73.7	5.6
MT	73.2	78.4	5.2
NL	62.8	67.5	4.7
AT	76.3	81.8	5.5
PL	48.3	51.7	3.4
PT	126.2	136.3	10.0
RO	76.9	82.0	5.1
SI	95.2	101.6	6.4
SK	72.2	76.4	4.2
FI	63.9	68.2	4.3
SE	11.2	12.4	1.2

Source: Commission services

([238]) For the definition of risk categories, in general and in the specific case of the new *'r-g'* scenario, see Annex A1. Fiscal sustainability analysis: the Commission's framework.

Box II.3.1: The 'r-g' differential and its importance for debt sustainability, relative to other factors: a snapshot of key concepts

A glance at the debt law of motion. In the simplified version of a closed economy with all debt issued in domestic currency (i.e. ignoring exchange rate valuation effects[1]), the government debt stock to GDP ratio evolves between two periods as follows:

$$d_t = d_{t-1}.\frac{(1+r_t)}{(1+g_t)} - pb_t + sfa_t \qquad (1)$$

$$\Delta d_t = \underbrace{d_{t-1}.\frac{(r_t - g_t)}{(1+g_t)}}_{\text{automatic debt dynamics}} - pb_t + sfa_t \qquad (2)$$

where

d_t represents the total government debt stock to GDP ratio in year t

r_t represents the nominal implicit interest rate on government debt

g_t represents the nominal growth rate of GDP (in national currency)

pb_t represents the primary balance over GDP

sfa_t represents the stock-flow adjustments over GDP.

Alongside other relevant factors, the *'r-g'* differential influences the debt ratio change between two periods. Together with the *existing debt stock* d_{t-1}, *'r-g' captures* the flow of interest payments due on this outstanding debt stock, eroded by nominal effects (% of GDP); then, two other flows - the *primary fiscal deficit* (pb_t) and *stock-flow adjustments* (sfa_t) – influence overall debt dynamics alongside (see the debt law of motion in (2))**.** Because *'r-g'* applies to the initial debt ratio, the *'r-g'* differential is intrinsically compounded by the latter and produces on debt what is called the *'snowball effect'* or *'automatic debt dynamics'*. This first component of the debt law of motion indicates what happens to the debt ratio automatically, as a result of the *'r'* and *'g'* prevailing in the economy, all else being equal (when the other flows - *pb* and *sfa* - are zero). As such, the snowball effect essentially reflects the macroeconomic *environment's* conditions.

A negative *'r-g'* differential supports debt sustainability (favourable snowball effect), while a positive differential hampers it (unfavourable snowball effect). When $r > g$ (positive differential), automatic debt dynamics are unfavourable and the initial debt stock snowballs into larger debt, with expectedly adverse implications for overall debt dynamics, unless the two other flows, *pb* and *sfa*, offset the $r > g$ impact. When $r < g$ (negative differential), automatic debt dynamics are favourable, supporting a passive debt deleveraging. If the automatic reduction in debt from growth exceeding the interest rate is larger than or equal to the effect of the two other flows, *pb* and *sfa*, a persistently favourable snowball effect could lead to an overall reduction or stabilisation of the government debt ratio, even in the presence of primary deficits.

The influence on debt dynamics of other factors such as the primary balance is especially powerful, reason why a favourable *'r-g'* environment cannot (be expected to) stabilise or cut debt in isolation. The primary balance, which essentially reflects fiscal policy, gives the relative importance of government action versus macroeconomic conditions (*'r-g'*). In this manner, a sufficiently large primary fiscal surplus or deficit can, respectively, improve or hamper debt dynamics regardless of the macroeconomic environment. All factors accounted for, the final size of the debt globe d_t is eventually given by the sum of macroeconomic conditions (the rolling snowball or *automatic* debt dynamics), the effect of fiscal policy (the primary fiscal balance), as well as that of other factors affecting debt but not the budget balance (the sfa).

(1) In the EU, most of government debt is held in domestic currency. Few exceptions are found among non-EA countries (e.g. BG, HR, RO), though in these cases, the bulk of debt held in foreign currency is issued in euro (and BG and HR have their currencies pegged to the latter).

Annexes

ANNEX A1

Fiscal sustainability analysis: the Commission's framework

This annex presents the approach followed to assess fiscal sustainability risks over the short, medium and long term. Graph A1.1 provides an overview of the main building blocks. The general approach is similar to that of the 2020 Debt Sustainability Monitor, although with some changes to the decision trees used for the medium-term assessment. The aim of these changes is to simplify the approach and give more prominence to the debt trajectory and the plausibility of fiscal assumptions, as explained in Box I.2.2.

The remainder of this annex is organised as follows. Sections A1.1, A1.2 and A1.3 describe the approach to assess short-, medium- and long-term fiscal sustainability risks. Section A1.4 then provides an overview of the thresholds used for the risk classification throughout the report.

A1.1. THE APPROACH USED TO ASSESS SHORT-TERM RISKS

The analysis of short-term fiscal sustainability risks relies on the composite S0 indicator. This early-detection indicator of fiscal stress follows a signalling approach: it flashes red when certain variables (among a set of 25) exceed critical thresholds beyond which they tended to be associated with episodes of fiscal stress in the past. S0 includes two sub-indices that cover the fiscal side and the financial-competitiveness side. The main benefit of this approach is therefore that it does not only consider purely fiscal factors, but also the risks that may arise from non-fiscal factors, thus recognising the role of structural weaknesses in triggering fiscal stress. Further details on S0 are available in Chapter 1 of Part I (in particular in Box I.1.1) and Annex A2.

A1.2. THE APPROACH USED TO ASSESS MEDIUM-TERM RISKS

This section explains how the overall medium-term risk classification is established. It starts from the final assessment and gradually moves back to the initial stages of the analysis, as described in Graph A1.1.

The overall assessment of medium-term risks is based on the debt sustainability analysis (DSA) and the S1 indicator. A country is deemed at high risk if S1 or the DSA identifies high risk; otherwise, if at least one of the two points to medium risk, the country is classified at medium risk (see Graph A1.2). It is considered at low risk only if both the DSA and S1 lead to this conclusion.

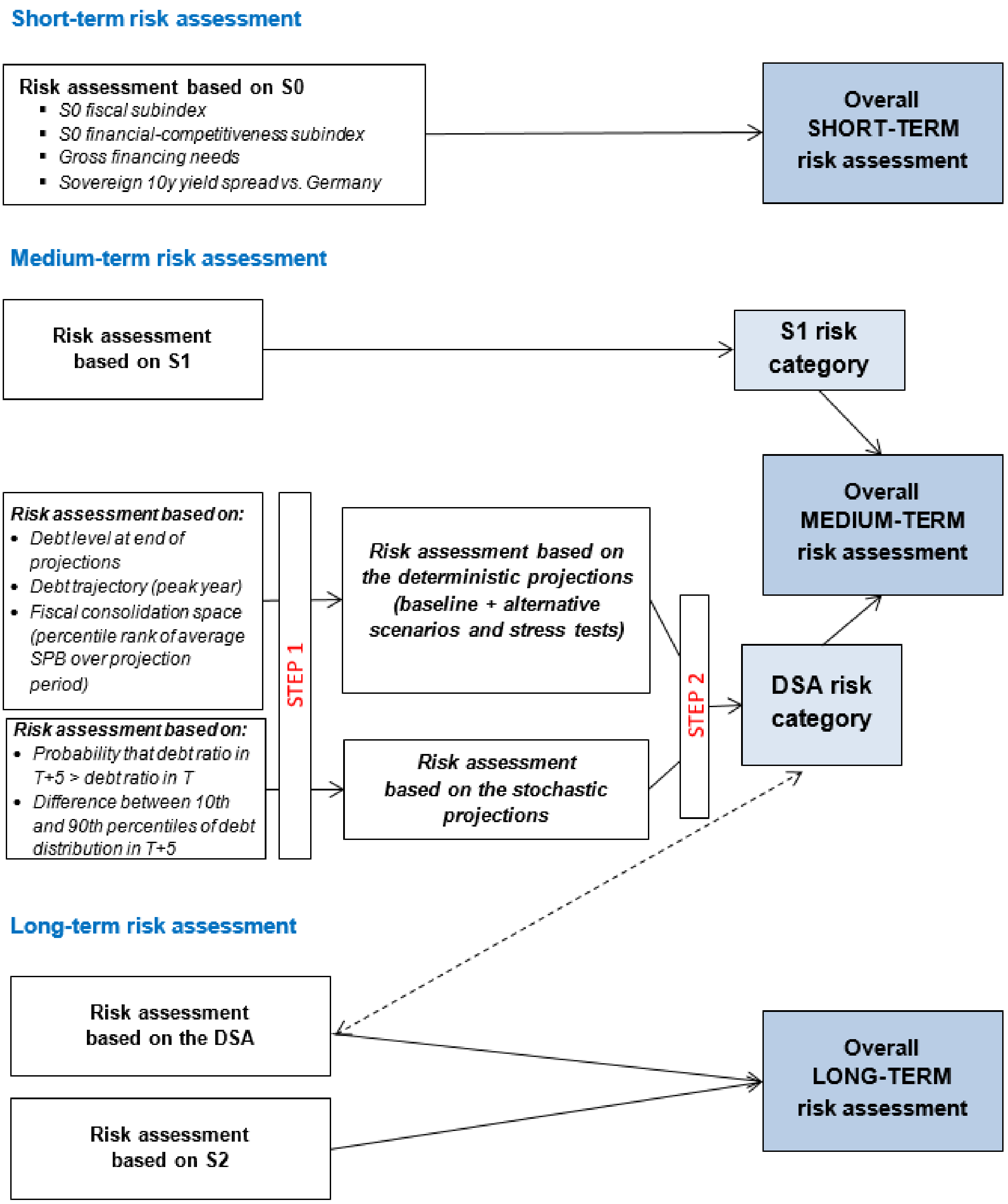
***The risk classification derived from S1* depends on the amount of fiscal consolidation needed to reduce debt to 60% of GDP over the medium term.** When this requires a large effort of more than 2.5% of GDP on top of the baseline assumptions, this identifies a high risk. When no additional effort is needed as debt is already projected to stand below 60% of GDP, corresponding to a negative S1, the risk is low. For intermediate values of S1, the risk is medium. Technical details on S1 can be found in Annex A5.

***The DSA risk category* is established in two steps.** The first step assigns a risk category to the country under consideration for each of the deterministic projections (including the baseline) and for the stochastic projections. The second step combines the risk categories derived from the various deterministic scenarios and from the stochastic projections to conclude on the overall DSA risk category.

In the first step, *the risk category based on the deterministic scenarios* depends on three criteria. These are (1) the projected debt level in 10 years' time, (2) the projected debt trajectory (as summarised by the year in which debt is projected to peak), and (3) the 'fiscal consolidation space' (as measured by the percentile rank of the projected structural primary balance (SPB) in the past distribution of SPBs). The fiscal consolidation space gives an indication of whether the projected SPB is plausible in view of the country's track record, and whether the country has fiscal room for manoeuvre to take corrective measures if necessary.

The decision tree for deterministic projections describes how the three criteria interplay. First, the value of each criterion is associated with a risk category (low, medium or high, according to the thresholds reported in Table A1.2 below), then the risk categories derived from the three criteria are combined along the decision tree presented in Graph A1.3. While the risk classification starts from the risk signal associated with the projected

Graph A1.1: **The multi-dimensional approach to assess fiscal sustainability risks**

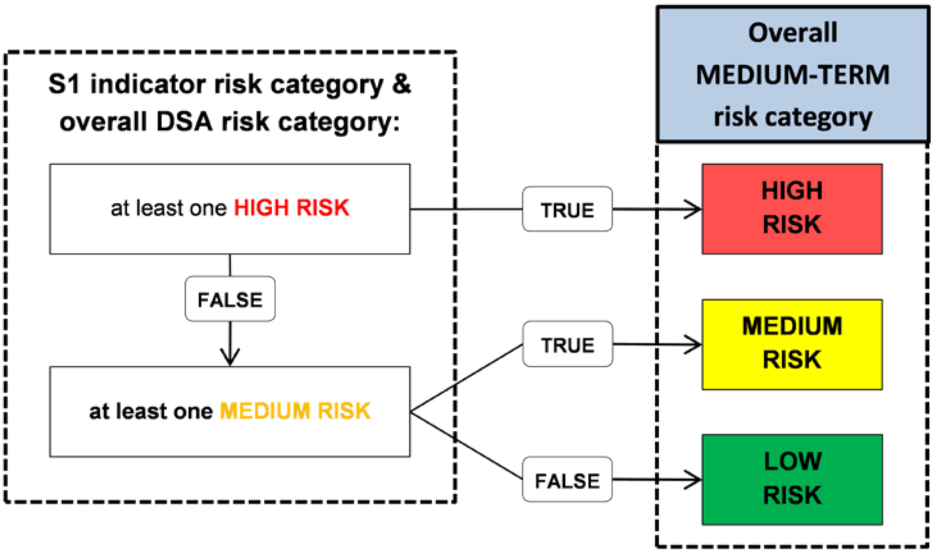


Source: European Commission.

debt level, this signal may be notched up or down by one category depending on the projected debt trajectory and the 'fiscal consolidation space'.

***The risk category based on the stochastic projections* depends on two criteria.** The first one is the probability that the debt level in 5 years' time will not exceed its current level. The second one is the amount of uncertainty, as measured by the difference between the 10th and 90th percentiles of the distribution of debt paths resulting from the stochastic projections (i.e. the difference between the worst and the best possible outcomes, leaving aside tail events). The

Graph A1.2: **Decision tree for the assessment of overall medium-term fiscal sustainability risks**



Source: Commission services.

Graph A1.3: **DSA, step 1: decision tree for the deterministic projections (including the baseline)**

	DSA scenarios (all deterministic scenarios)			
Case	Debt level	Debt path	Consolidation space	Overall
1	HIGH	HIGH/MEDIUM	**ANY**	HIGH
2	HIGH	LOW	HIGH/MEDIUM	HIGH
3	HIGH	LOW	LOW	MEDIUM
4	MEDIUM	HIGH	HIGH/MEDIUM	HIGH
5	MEDIUM	HIGH	LOW	MEDIUM
6	MEDIUM	MEDIUM	ANY	MEDIUM
7	MEDIUM	LOW	HIGH/MEDIUM	MEDIUM
8	MEDIUM	LOW	LOW	LOW
9	LOW	HIGH	HIGH/MEDIUM	MEDIUM
10	LOW	HIGH	LOW	LOW
11	LOW	MEDIUM/LOW	ANY	LOW

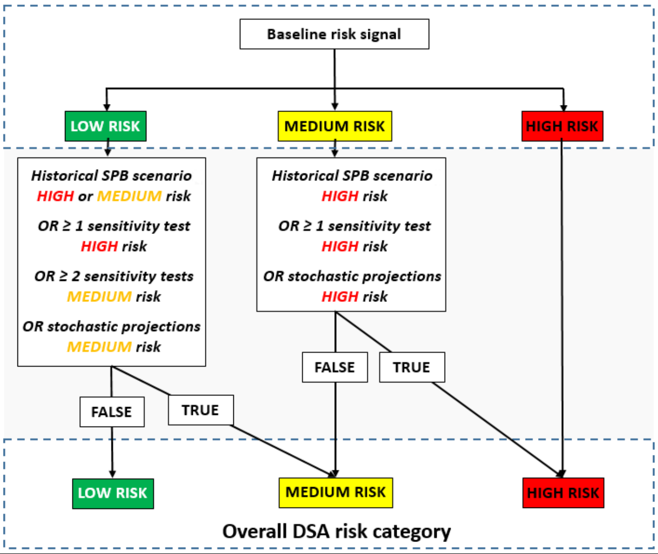
Note: the table is to be read as a decision tree, starting from the debt level then moving on to the debt path and the fiscal consolidation space. The risk category derived from the debt level in T+10 is notched up if the debt path points to high risk and the consolidation space points to medium or high risk (cases 4 and 9). Indeed, in these cases, countries have an increasing debt and limited consolidation space, meaning that there is a chance that there is no feasible adjustment path to curb the debt path. Conversely, the risk is notched down if both the debt path and the consolidation space indicator point to low risk (cases 3 and 8). In these cases, even if the projected debt level is high/medium, the debt path is decreasing, and the country has enough space to take measures in case of adverse shocks.
Source: European Commission.

Graph A1.4: **DSA, step 1: decision tree for the stochastic projections**

Probability debt not to stabilise	Size of uncertainty	Overall
HIGH	ANY	HIGH
MEDIUM	HIGH	MEDIUM
MEDIUM	MEDIUM	MEDIUM
MEDIUM	LOW	LOW
LOW	HIGH	MEDIUM
LOW	MEDIUM	LOW
LOW	LOW	LOW

Note: The table is to be read from left to right as a decision tree, starting from the probability of debt not to stabilise then moving on to the size of uncertainty. It gives a strong weight to the probability of debt not to stabilise over the next 5 years. Only in cases where the signal associated to this probability is medium and uncertainty is low, is the overall risk category notched down to low risk. Conversely, in cases where this probability is deemed low, but uncertainty is high, the overall risk category is notched up to medium risk.
Source: European Commission.

Graph A1.5: **DSA, step 2: decision tree for the overall DSA risk classification**



Source: European Commission.

thresholds associated with these criteria are reported in Table A1.3. and the decision tree combining the two criteria is presented in Graph A1.4.

The second step combines signals from the deterministic and stochastic projections. Each country is first attributed a preliminary risk classification based on the baseline. This preliminary category may then be notched up but not down. It may be adjusted from low to medium or from medium to high based on the outcome of other scenarios and stochastic projections (see Graph A1.5). On the other hand, if a country is considered at high risk under the baseline, the overall DSA risk category is automatically high.

A1.3. THE APPROACH USED TO ASSESS LONG-TERM RISKS

The assessment of long-term fiscal sustainability risks is based on the conclusions of both the S2 sustainability gap indicator and the DSA. The S2 indicator measures the fiscal effort needed to stabilise debt in the long term (regardless of the level), based on the infinite version of the government budget constraint (see Box I.3.1). The DSA may notch up the risk category derived from S2 when it signals a higher risk than S2. As a result, a country is assessed to be at high risk if (i) the S2 indicator flags high risk, irrespective of the risk category derived from the DSA, or (ii) S2 signals medium risk but the DSA points to high risk (see Table A1.1). Similarly, a country is assessed at medium risk if S2 points to low risk but the DSA flags medium or high risk. The aim of these adjustments is to capture risks linked to higher debt levels, as explained in Box 4.1 of the 2018 FSR.

Table A1.1: **Decision tree for the long-term risk classification**

Risk derived from S2	Risk derived from the DSA	Overall long-term risk category
High	Any	High
Medium	High	High
	Medium	Medium
	Low	
Low	High	Medium
	Medium	
	Low	Low

Source: European Commission.

A1.4. OVERVIEW OF THE THRESHOLDS USED TO ASSESS FISCAL SUSTAINABILITY RISKS

The tables in this section provide a quick reference on all the thresholds underpinning the various heat maps presented in the report.

Table A1.2: **DSA: thresholds for the deterministic projections**

Criteria	*Thresholds*
Debt level (2032)	*High:* above 90% of GDP *Medium:* between 60% of GDP and 90% of GDP *Low:* below 60% of GDP
Debt trajectory (debt peak year)	*High:* peak year between T+7 and end projections (2028-32), or still increasing at end projections *Medium:* peak year between end of forecasts (T+3) and T+6 (2024-27) *Low:* peak year within forecast horizon (2021-23)
Fiscal consolidation space (percentile rank avg SPB 2023-32)	*High:* if smaller than (or equal to) 25% *Medium:* between 25% and 50% *Low:* greater than 50%

Source: European Commission.

– **The thresholds for the DSA risk classification** are in Table A1.2 for the deterministic projections and Table A1.3 for the stochastic projections.

– **For the short term,** Table A1.4 reports the thresholds used for the S0 indicator, its sub-indices, and each of the variables that they include. The overall S0 index and its sub-indices use only one threshold, beyond which they identify vulnerabilities. For the individual variables, the upper thresholds derived from the signalling approach are complemented by lower thresholds (set at around 80% of the upper thresholds), implying that variables may flash red, yellow or not flash at all.

– **Finally, for the S1 and S2 indicators,** Table A1.4 reports both upper and lower thresholds, to distinguish between low, medium and high risk. The ageing sub-components – namely the cost of ageing for S1, and pensions, healthcare and long-term care for S2– use one threshold each, corresponding to the EU average, above which they flash red. As for the percentile rank of the SPBs required by S1 and S2, they are subject to the same upper and lower thresholds as the average SPB in DSA scenarios (see Table A1.2).

Table A1.3: **DSA: thresholds for the stochastic projections**

Criteria	*Thresholds*	
Probability of debt not to stabilise over the next 5 years	Initial (2021) debt ratio at or above 90% of GDP:	*High:* if probability above 30% *Medium:* if probability strictly positive and at or below 30% *Low:* if zero probability
	Initial (2021) debt ratio at or above 60% of GDP and below 90% of GDP:	*High:* if probability above 60% *Medium:* if probability between 30% and 60% *Low:* if probability below 30%
	Initial (2021) debt ratio below 60% of GDP:	*Medium:* if probability above 70% *Low:* if probability at or below 70%
Size of macroeconomic uncertainty (difference between the 10th and 90th percentiles of the distribution of debt paths)	*High:* the third of the countries with highest dispersion *Medium:* the third of the countries with intermediate dispersion *Low:* the third of the countries with lowest dispersion	

Source: European Commission.

Table A1.4: **Overview of thresholds used for the fiscal sustainability risk classification**

	Safety	*Upper threshold*	*Lower threshold*
SHORT-TERM RISKS			
S0 overall index	<	0.46	:
S0 fiscal sub-index	<	0.36	:
S0 financial-competitiveness sub-index	<	0.49	:
Fiscal risks from the fiscal context			
Balance (% of GDP)	>	-9.6	-7.7
Primary balance (% of GDP)	>	0.2	0.3
Cyclically-adjusted balance (% of GDP)	>	-2.5	-2.0
Stabilising primary balance (% of GDP)	<	2.3	1.9
Gross debt (% of GDP)	<	68.4	54.8
Change in gross debt (% of GDP)	<	8.1	6.4
Short-term public debt (% of GDP)	<	13.2	10.6
Net debt (% of GDP)	<	59.5	47.6
Gross financing needs (% of GDP)	<	15.9	12.8
Interest-growth rate differential (%)	<	4.8	3.8
Change in governement expenditure (% of GDP)	<	1.9	1.5
Change in governement consumption (% of GDP)	<	0.6	0.5
Fiscal risks from the macro-financial context			
Yield curve (%)	>	0.6	0.7
Real GDP growth (%)	>	-0.7	-0.5
GDP per capita in PPP (% US level)	>	72.7	87.2
Net international investment position (% of GDP)	>	-19.8	-15.8
Net savings households (% of GDP)	>	2.6	3.1
Private debt (% of GDP)	<	164.7	131.8
Private credit flow (% of GDP)	<	11.7	9.4
Short-term debt non-financial corporations (% of GDP)	<	15.4	12.3
Short-term debt households (% of GDP)	<	2.9	2.3
Construction (% of value added)	<	7.5	6.0
Current account balance (% of GDP)	>	-2.5	-2.0
Change in REER (%)	<	9.7	7.7
Change in nominal ULC (%)	<	7.0	5.6
Fiscal risks from financial market developments			
Sovereign yield spreads (bp) - 10 year	<	231.0	184.8
MEDIUM-TERM RISKS			
S1 indicator	<	2.5	0
Percentile rank of the SPB implied by S1	>	25%	50%
DSA variables	see Tables A1.2 and A1.3		
LONG-TERM RISKS			
S2 indicator	<	6	2
Percentile rank of the SPB implied by S2	>	25%	50%
ADDITIONAL VARIABLES			
Structure of public debt			
Share of short-term public debt (% of debt)	<	6.6	5.3
Share of public debt in foreign currency (% of debt)	<	31.6	25.0
Share of public debt held by non-residents (% of debt)	<	49.0	40.0
Contingent liabilites linked to the banking sector			
Bank loans-to-deposits ratio (%)	<	133.4	107.0
Share of non-performing loans (% of loans)	<	2.3	1.8
Change in share of non-performing loans (p.p.)	<	0.3	0.2
NPL coverage ratio (% loans)	>	66.0	33.0
Change in nominal house prix index (%)	<	13.2	11.0

Note: Variables common to the scoreboard used in the macroeconomic imbalances procedure (MIP) have different thresholds here than under the MIP, because the methodologies used to calculate them thresholds are different.
Source: European Commission.

ANNEX A2

The early-detection indicator of fiscal stress risk (S0)

A2.1. THE METHODOLOGY FOR THE CALCULATION OF THE THRESHOLDS

For each variable used in the composite indicator S0 the optimal threshold is chosen in a way to minimise, based on historical data, the sum of the number of fiscal stress signals sent ahead of no-fiscal-stress episodes (false positive signals – type-I error) and the number of no-fiscal-stress signals sent ahead of fiscal stress episodes (false negative signals – type-II error), with different weights attached to the two components**.** The table below reports the four possible combinations of events.

Table A2.1: **Possible cases based on type of signal sent by the variable at t-1 and state of the world at t**

	Fiscal stress episode	No-fiscal stress episode
Fiscal stress signal	True Positive signal	False Positive signal (Type I error)
No-fiscal stress signal	False Negative signal (Type II error)	True Negative signal

Source: Commission services

Formally, for each variable *i* the optimal threshold (t_i^*) is such as to minimise the sum of type I and type II errors for variable *i* (respectively fiscal stress signals followed by no-fiscal stress episodes - False Positive signals - and no-fiscal-stress signals followed by fiscal stress episodes – False Negative signals) as from the following total misclassification error for variable *i* (TME_i): ([239])

$$t_i^* = \arg\min_{t_i \in T_i} \left(TME_i(t_i)\right) =$$

$$= \arg\min_{t_i \in T_i} \left(\frac{FN_i(t_i)}{Fs} + \frac{FP_i(t_i)}{Nfs} \right) \qquad (1)$$

$i = 1,.., n$

where T_i = set of all values taken by variable *i* over all countries and years in the panel; $FN_i(t_i)$ = total number of false negative signals sent by variable *i* (over all countries and years) based on threshold t_i; $FP_i(t_i)$ = total number of false positive signals sent by variable *i* (over all countries and years) based on threshold t_i; *Fs* = total number of fiscal stress episodes recorded in the data; *Nfs* = total number of no-fiscal-stress episodes recorded in the data; ([240]) *n* = total number of variables used.

It is straightforward to see from (1) that in the minimisation problem False Negative signals are weighted more than False Positive signals as:

$$\frac{1}{Fs} > \frac{1}{Nfs}$$

This is due to the fact that the total number of fiscal stress episodes recorded over a (large enough) panel of countries will be typically much smaller than the total number of non-fiscal-stress episodes. This is a positive feature of the model as we might reasonably want to weigh the type II error more than the type I given the more serious consequences deriving from failing to correctly predict a fiscal stress episode relative to predicting a fiscal stress episode when there will be none.

The threshold for variable *i* (with *i* = 1,…, *n*) obtained from (1) is common to all countries in the panel. We define it as a common *absolute* threshold (a critical value for the level of public debt to GDP, or general government balance over GDP, for instance) but it could also be defined as a common *relative* threshold (a common percentage tail of the country-specific distributions). ([241]) In the latter case, while the optimal percentage tail obtained from (1) is the same for all countries, the associated absolute threshold will differ across countries reflecting differences in distributions (country *j*'s absolute threshold for variable *i* will reflect the country-specific history with regard to that variable). Both the aforementioned methods were applied and a decision was made to focus exclusively on the first, given that the second one tends to produce sensitive country-specific absolute thresholds for variable *i* only for those countries having a history of medium to high values for the variable concerned (or medium to

([239]) Following this methodological approach the optimal threshold will be such as to balance between type I and type II errors. For variables for which values above the threshold would signal fiscal stress, a relatively low threshold would produce relatively more false positive signals and fewer false negative signals, meaning higher type I error and lower type II error; the opposite would be true if a relatively high threshold was chosen.

([240]) Here we simplify on the total number of fiscal stress and non-fiscal-stress episodes as in fact also these numbers vary across variables. This is due to the fact that data availability constraints do not allow us to use the whole series of episodes for all variables.

([241]) See, for instance, Reinhart, Goldstein and Kaminsky (2000); Hemming, Kell and Schimmelpfennig (2003).

low, depending on what the fiscal-stress-prone side of the distribution is), while country-specific thresholds would not be meaningful for the rest of the sample.

The TME function in equation (1) is the criterion we used to calculate the thresholds but it is not the only possible criterion used in the literature. The minimisation of the noise-to-signal ratio (*NSR*) is another possible option. ([242]) In this case the optimal threshold for variable i (t_i^*) is obtained as:

$$t_i^* = \arg\min_{t_i \in T_i} \left(NSR_i(t_i) \right) = \arg\min_{t_i \in T_i} \left(\frac{FP_i(t_i)/Nfs}{TP_i(t_i)/Fs} \right) \qquad (2)$$

$i = 1,\ldots,n$

where $TP_i(t_i)$ = total number of true positive signals sent by variable i (over all countries and years) based on threshold t_i. The TME minimisation was preferred to this alternative criterion based on the size of the total errors produced.

A2.2. THE CALCULATION OF THE COMPOSITE INDICATOR S0

The early-detection indicator of fiscal stress (S0) is constructed in a similar way to what done in Baldacci et al. (2011) and Reinhart et al. (2000). ([243]) To a certain country j and year t, a 1 is assigned for every variable i that signals fiscal stress for the following year (a dummy d^i is created for each variable i such that $d_{jt}^i = 1$ if a fiscal stress signal is sent by the variable and $d_{jt}^i = 0$ otherwise, i.e. if a no-fiscal-stress signal is sent or the variable is missing). The value of the composite indicator S0 for country j and year t ($S0_{jt}$) is then calculated as the weighted number of variables having reached their optimal thresholds with the weights given by the "signalling power" of the individual variables:

$$S0_{jt} = \sum_{i=1}^{n} w_i d_{jt}^i = \sum_{i=1}^{n} \frac{z_i}{\sum_{k=1}^{n} h_{jt}^k \cdot z_k} d_{jt}^i \qquad (3)$$

where n = total number of variables; z_i = 1 – (type I error + type II error) = signalling power of variable i; and $h_{jt}^k \in \{0,1\}$ is an indicator variable taking value 1 if variable k is observed for country j at time t and 0 otherwise. ([244]) The variables are therefore assigned higher weight in the composite indicator, the higher their past forecasting accuracy. ([245])

([242]) See, for instance, Reinhart, Goldstein and Kaminsky (2000); Hemming, Kell and Schimmelpfennig (2003).

([243]) See Berti et al. (2012). The difference with Baldacci et al. (2011) is that Berti et al. do not use a system of "double weighting" of each variable incorporated in the composite indicator based on the weight of the subgroup of variables it belongs to (fiscal and financial-competitiveness variables here) and the weight of the individual variable within the group. The difference with Reinhart et al. (2000) is in the way the individual variables' weights are computed (Reinhart et al. use as weights the inverse of the noise-to-signal ratios of the individual variables as they apply the NSR criterion, rather than the TME minimisation).

([244]) This ensures that the sum of the weights is equal to 1 regardless of data availability (which is of course necessary to be able to analyse the evolution of the composite indicator).

([245]) Moreover, as evident from (3), the weight attached to each variable is decreasing in the signalling power attached to the other variables, as well as in the number of variables available for a given country and year.

ANNEX A3

Decomposing the debt dynamic, projecting the interest rate on government debt and property incomes

A3.1. DECOMPOSING THE DEBT DYNAMICS

Deterministic government debt projections are based on a general identity characterizing the evolution of the stock of debt. In a simplified version, the evolution of the government debt to GDP ratio can be described in the following way:

$$d_t = \alpha^n . d_{t-1} . \frac{(1+i_t)}{(1+g_t)} + \alpha^f . d_{t-1} . \frac{(1+i_t)}{(1+g_t)} . \frac{e_t}{e_{t-1}} - pb_t + f_t \quad (1)$$

where d_t represents the total government debt to GDP ratio in year t

α^n represents the share of total government debt denominated in national currency

α^f represents the share of total government debt denominated in foreign currency

i_t represents the implicit interest rate on government debt ([246])

g_t represents the *nominal* growth rate of GDP (in national currency)

e_t represents the nominal exchange rate (expressed as national currency per unit of foreign currency)

pb_t represents the primary balance over GDP

f_t represents the stock-flow adjustments over GDP.

In order to obtain the debt dynamics, d_{t-1} is subtracted from both sides of equation (1). This gives the following expression:

$$\Delta d_t = \alpha^n . d_{t-1} . \frac{(i_t - g_t)}{(1+g_t)} + \alpha^f . d_{t-1} . \frac{(i_t - g_t) + \varepsilon_t . (1+i_t)}{(1+g_t)} - pb_t + f_t \quad (2)$$

where $\varepsilon_t = \frac{e_t}{e_{t-1}} - 1$ represents the rate of depreciation of the national currency.

([246]) By simplicity, it is assumed that this interest rate is the same for government debt denominated in national currency and in foreign currency.

Decomposing further the nominal GDP growth rate, and rearranging the different terms, we obtain:

$$\Delta d_t = d_{t-1} . \frac{i_t}{(1+g_t)} - d_{t-1} . \frac{gr_t}{(1+g_t)} - d_{t-1} . \frac{\pi_t (1+gr_t)}{(1+g_t)} + \alpha^f . d_{t-1} . \varepsilon_t . \frac{(1+i_t)}{(1+g_t)} - pb_t + f_t \quad (2)'$$

where gr_t represents the *real* growth rate of GDP

π_t represents the inflation rate (in terms of GDP deflator, in national currency)

This expression allows us identifying the key drivers of the debt ratio dynamics, in particular the snow-ball effect, which can be further decomposed into four terms:

- (+) the interest rate effect: $d_{t-1} . \frac{i_t}{(1+g_t)}$
- (-) the real GDP growth effect: $-d_{t-1} . \frac{gr_t}{(1+g_t)}$
- (-) the inflation effect: $-d_{t-1} . \frac{\pi_t (1+gr_t)}{(1+g_t)}$
- (+) the exchange rate effect: $\alpha^f . d_{t-1} . \varepsilon_t . \frac{(1+i_t)}{(1+g_t)}$

As can be easily seen from this expression, both the interest rate and the foreign exchange depreciation rate contribute to the increase of the debt ratio. On the other hand, higher real GDP growth and higher inflation erode the debt to GDP ratio. ([247])

Other key contributors to the debt motion are the primary balance (pb_t) (that is further decomposed in our tables between the structural primary balance before cost of ageing, the cost of ageing, the cyclical component and one-offs and other temporary measures) and stock and flow adjustments (f_t).

([247]) This presentation, based on the government debt ratio identity equation, allows grasping the impact of real GDP growth and inflation on the debt motion coming from direct valuation effects (as government debt is expressed as a share of GDP). However, the primary balance is also influenced by economic activity and inflation. Such behavioural effects are explicitly taken into account in the fiscal reaction function scenario presented in chapter 2 of the report.

As can be seen from the exchange rate effect expression, both valuation effects affecting the *stock* of foreign currency denominated debt and *interest rate* payments (on this share of government debt) contribute to the debt dynamic. ([248]) Looking at historical series, Eurostat includes the exchange rate effect on the *stock* of foreign currency denominated debt in stock and flow adjustments, while the impact due to the cost of servicing debt in foreign currency is included in interest payments. In our tables, we follow this convention.

In practice, the equation used in our model is slightly more complex than equation (1), as we consider three currencies: the national currency, the EUR (foreign currency for non-euro area countries) and the USD (foreign currency for all countries). Hence, equation (1) becomes:

$$d_t = \alpha^n . d_{t-1} . \frac{(1+i_t)}{(1+g_t)} + \alpha^{eur} . d_{t-1} . \frac{(1+i_t)}{(1+g_t)} . \frac{e_t}{e_{t-1}} + \alpha^{usd} . d_{t-1} . \frac{(1+i_t)}{(1+g_t)} . \frac{\tilde{e}_{t-1}}{\tilde{e}_t} . \frac{e_t}{e_{t-1}} - pb_t + f_t \qquad (1)'$$

where α^{eur} represents the share of total government debt denominated in euros

α^{usd} represents the share of total government debt denominated in USD

e_t represents the nominal exchange rate between the national currency and the euro (expressed as national currency per EUR)

$\tilde{e}_t$ represents the nominal exchange rate between the USD and the euro (expressed as USD per EUR).

Such a specification allows taking into account the effect of exchange rate movements on government debt not only in non-euro area countries, but also in euro area countries (among which government debt issued in USD can be significant).

([248]) An indirect effect, due to the fact that exchange rate movements affect the value of GDP in domestic currency through changes in prices in the tradable sector, could also be shown. However, in practice, in line with other institutions practices (e.g. IMF), these effects are not isolated (data limitation would require to impose further assumptions; effect likely to be of second-order).

A3.2. PROJECTING THE IMPLICIT INTEREST RATE ON GOVERNMENT DEBT

As seen from equation (1), a key driver of the debt motion is the implicit interest rate on government debt. Projecting the implicit interest rate on government debt requires not only assumptions on *market* interest rates (for newly issued debt), but also taking into account explicitly the current and future maturity structure of government debt (between short-term and long-term government debt, and between maturing, rolled-over or not, and non-maturing government debt). This allows a differential treatment in terms of interest rates applied to successive "debt vintages", and interestingly captures different levels of exposure of sovereigns to immediate financial markets' pressures.

Formally, in our model, the implicit interest rate is expressed in the following way:

$$iir_t = \alpha_{t-1} . i_t^{ST} + (1 - \alpha_{t-1}) . iir_t^{LT} \qquad (3)$$

where iii_t is the implicit interest rate in year t ([249])

i_t^{ST} is the *market* short-term interest rate in year t

iir_t^{LT} is the implicit long-term interest rate in year t

α_{t-1} is the share of short-term debt in total government debt (and $(1 - \alpha_{t-1})$ is the share of long-term debt in total government debt). ([250])

Our model considers two types of government debt in terms of maturity: short-term debt (debt issued with an *original* maturity of less than one year) and long-term debt (debt issued with an *original* maturity of more than one year). Furthermore, government debt can be decomposed between new debt (debt issued to cover new financing requirements), ([251]) maturing debt (i.e. existing debt that is maturing within the year ([252]) and that

([249]) This corresponds to i_t in the previous section.
([250]) Hence, as indicated by the t index, these shares may vary through time depending on the debt dynamic.
([251]) This amount also corresponds to the yearly budgetary deficit.
([252]) Another way to describe it is that this existing debt has a *residual* maturity of less than one year.

needs to be repaid), rolled-over (i.e. whose repayment is covered by newly issued debt) or not, and outstanding debt (i.e. existing debt that has not reached maturity). Combining these different aspects, α_{t-1} (and $(1-\alpha_{t-1})$) used in (3) can be described as follows:

$$\alpha_{t-1} = \frac{D_{t-1}^{STN}+D_{t-1}^{STR}}{D_{t-1}} \quad (4)$$

$$1-\alpha_{t-1} = \frac{D_{t-1}^{o}+D_{t-1}^{LTN}+D_{t-1}^{LTR}}{D_{t-1}} \quad (5)$$

where D_{t-1}^{STN} is the new short-term government debt in year $t-1$

D_{t-1}^{STR} is the maturing and rolled-over short-term government debt (i.e. the existing short-term debt that has reached maturity, and whose repayment is covered by newly issued short-term debt)

D_{t-1}^{LTN} is the new long-term government debt

D_{t-1}^{LTR} is the maturing and rolled-over long-term government debt (i.e. the existing long-term debt that has reached maturity, and whose repayment is covered by newly issued long-term debt)

D_{t-1}^{o} is the outstanding (non-maturing) long-term government debt.

Moreover, the implicit long-term interest rate used in (3) can be further decomposed:

$$iir_t^{LT} = \beta_{t-1}.i_t^{LT} + (1-\beta_{t-1}).iir_{t-1}^{LT} \quad (6)$$

where β_{t-1} is the share of newly issued long-term debt (corresponding to both new debt and maturing and rolled-over debt) in total long-term government debt in year $t-1$ (and $(1-\beta_{t-1})$ is the share of outstanding long-term debt in total long-term government debt)

i_t^{LT} is the *market* long-term interest rate in year t.

The share of newly issued long-term debt (respectively outstanding debt) in total long-term government debt, used in expression (6), is described as follows:

$$\beta_{t-1} = \frac{D_{t-1}^{LTN}+D_{t-1}^{LTR}}{D_{t-1}^{o}+D_{t-1}^{LTN}+D_{t-1}^{LTR}} \quad (7)$$

$$(1-\beta_{t-1}) = \frac{D_{t-1}^{o}}{D_{t-1}^{o}+D_{t-1}^{LTN}+D_{t-1}^{LTR}} \quad (8)$$

Hence, replacing iir_t^{LT} in (3) by its expression in (6) gives:

$$iir_t = a_{t-1}.i_t^{ST} + b_{t-1}.i_t^{LT} + (1-a_{t-1}-b_{t-1}).iir_{t-1}^{LT} \quad (3)'$$

From equation (3)', we can see that the implicit interest rate on government debt at year t is a weighted average of market short-term and long-term interest rates and of the implicit interest rate on outstanding (i.e. non-maturing) long-term debt in year $t-1$. Hence, depending on the weight of outstanding debt in total government debt, an increase of market interest rates will transmit more or less quickly to the implicit interest rate on government debt.

In the projections, the following assumptions are made:

- i_t^{LT} and i_t^{ST} are supposed to converge linearly by T+10 to the short term and 10 year long term forward rates.

- After T+10, i_t^{LT} is supposed to converge linearly to 4% in nominal terms ([253]) (2% in real terms) for all countries by the T+30 horizon;

- i_t^{ST} is supposed to converge linearly to i_t^{LT} time a coefficient corresponding to the historical (pre-crisis) EA yield curve (currently 0.5) for all countries by the T+30 horizon;

- new debt (D_{t-1}^{STN} and D_{t-1}^{LTN}) is assumed to be issued in the projections, as a proportion of the variation of government debt, based on the shares given by Estat (of short-term and long-term government debt), ([254]) whenever government debt is projected to increase; ([255])

([253]) For some non-euro countries, the convergence value is higher: PL, RO: 4.5%; HU: 5%, reflecting higher inflation targets by the national central banks.
([254]) More precisely, we use the average shares over the last 3 years available.
([255]) Otherwise, in the cases where government debt is projected to decrease, for instance, in case of a budgetary surplus, no new debt needs to be issued.

- short-term debt issued in year $t-1$ is assumed to entirely mature within the year, and to be rolled-over (D_{t-1}^{STR}) as a proportion of past government debt, based on the share of short-term government debt given by Estat, whenever government debt is projected to increase; (256)

- a fraction of long-term debt issued in the past is assumed to mature every year, and to be rolled-over (D_{t-1}^{LTR}), whenever government debt is projected to increase. (257) This fraction is estimated based on Estat data on the share of long-term government debt and on ECB data on the share of existing long-term debt maturing within the year. (258)

Finally, the values of the different variables *over the forecast horizon* (especially i_t^{LT}, i_t^{ST} and iir_{t-1}^{LT}) are set consistently with the available forecast values of the implicit interest rate (iir_t) and information on the maturity structure of debt.

A3.3. TECHNICAL OVERVIEW OF THE T+10 METHODOLOGY

The following model is solved from T+3 up to T+10 (note that as of T+6, for the EU-15 without Germany, the model for the capital and investment module deviates from the general framework below and is governed by the rules described further down in the text):

$$YPOT_{it} = LS_{it}^{\alpha} K_{it}^{(1-\alpha)} TFPS_{it}$$

$$TFP_{it} = \frac{Y_{it}}{H_{it}^{\alpha} K_{it}^{(1-\alpha)}}$$

(256) Otherwise, in the cases where government debt is projected to decrease, for instance, in case of a budgetary surplus, only part of this maturing debt needs to be rolled-over (none when government debt is assumed to strongly decrease, for example, when a large budgetary surplus allows repaying past maturing debt).

(257) See previous footnote.

(258) More precisely, the starting point (currently 2021) is calculated based on the 2020 ECB data on the share of long-term debt that is maturing within the year. Beyond this year, it is assumed that the share of maturing long-term debt linearly converges from the value taken in the last available year (2021) to the country-specific historical average by the end of the T+10 projection horizon. Additionally, for post-program countries, IE, CY and PT, the redemption profile of official loans has been taken into account for the calculation of the long-term debt maturing within the year.

$$K_{it} = I_{it} + (1-\delta)K_{it-1}$$

$$I_{it} = \frac{I_{it}}{YPOT_{it}} YPOT_{it}$$

$$Y_{it} = YPOT_{it}(1 + YGAP_{it}) * 100$$

1. TFP trend: Kalman-filter extension. T+10 TFP is capped (i.e. a ceiling is imposed) on the basis of US TFP growth.

2. Capital:

a) Investment to potential GDP ratio: ARIMA process to produce extended series (extension to avoid end-point bias for HP filter)

b) Depreciation rate: fixed T+2 rate which is calculated on the basis of the capital law of motion

c) Investment rule: (K_{it} and I_{it} as defined in the equation system above) up to T+5; after T+5: a mix between a capital rule (K_{it} defined as $K_{it-1}\frac{YPOT_{it}}{YPOT_{it-1}}$) and I_{it} defined by capital law of motion) and the investment rule for EU-15 (except DE); investment rule for all other member states. The weight of the capital-rule based investment is gradually decreasing.

3. Trend labour: $LS_{it} = \left(POPW_{it}PARTS_{it}(1 - NAWRU_{it})\right)HPERES_{it}$

a) Working age population: use Eurostat projections on population growth (“proj_np”)

b) Participation rate: up to T+5: HP-smoothed ARIMA process to produce extended series (extension beyond T+5 to avoid end-point bias for HP filter); for projection up to T+10 we use Ageing Working Group (AWG’s) Cohort Simulation Model with a technical transition rule smoothing the break in T+6.

c) Average hours worked: ARIMA process to produce extended series up to T+5 (extension to avoid end-point bias for HP filter) and HP smoothed. From t+6 to t+10 we forecast hours using a stabilisation rule: hours(t) = hours(t-1)*1.5 – hours(t-2)*.5. Results are comparable with those from the AWG.

d) NAWRU (T+2 = last year of the ECFIN forecast):

Between T+2 and T+5:

$$NAWRU_{iT+1} = NAWRU_{iT} + \frac{NAWRU_{iT} - NAWRU_{iT-1}}{2}$$

$$NAWRU_{iT+2} = NAWRU_{iT+1}$$

$$NAWRU_{iT+3} = NAWRU_{iT+2}$$

Between T+6 and T+10: convergence rule and prudent rule

T+10 anchor based on panel regression (union density, tax wedge, almp, unemployment benefits replacement rate, demographics/education and a set of macro control variables i.e. TFP, real interest rate, construction)

4. Output gap: closure of the output gap by T+5; each year as of T+3, YGAP decreases by 1/3 of the T+2 YGAP. The gap closure rule states that if the gaps are not closed before the end of the medium term (T+5), they should be mechanically closed by that time.

A3.4. PROPERTY INCOME

In the context of this report, property income received by Member States is considered to be the sum of returns from three categories of general government financial and non-financial assets: i) interest from debt securities – bonds, ii) dividends from equity securities – shares and iii) rents from tangible non-produced non-financial assets such as land and subsoil assets (i.e. natural resources water, mineral and fossil fuels). (259)

Property income is projected up to 2070, affecting both the medium and long term fiscal sustainability assessment in the form of S1 and S2 indicators. (260) Property income projections are separate from and additional to present property income accounted for in the actual balances reported every year by Member States under the SCP scenario, as well as to property income reflected in the two-year forecast horizon.

In calculating the sustainability gaps, property income received by governments is explicitly modelled in a way that is different from government revenues in general. Government revenues in general are a function of the tax bases and the rates chosen by the government. Property income differs from this generalised assumption in that it is determined by market conditions rather than policy settings.

However, since the future stocks of assets and the expected rate of return on these assets that generate income for Member States' governments in the future are not always known, to render projections manageable, a number of simplifying assumptions are made.

In order to model the evolution of property income, the key assumption is that there is no stock-flow adjustment, meaning that government debt is only driven by the general government balance and there is no net sale or purchase of assets in the future. As such, projections for the three categories of property income rely on the general assumption that the stock of financial and non-financial assets generating this income remains constant over time (261) at the level of latest available data, i.e. at the values posted in T-1. This assumption implies that there is no future sale or redemption of government assets, that when short-term assets (such as bonds) mature, they are implicitly assumed to be replaced with other bonds of the same nominal value, and that property income flows received by a government from the current stock of assets are used to reimburse debt through its contribution to the general government balance, rather than to purchase other assets.

(259) This definition is somewhat narrower than the one used in national accounts, where property income (D.4) is as well the income from financial assets and non-produced non-financial assets, but sub-categories considered for these assets are more comprehensive. In national accounts the financial instruments giving rise to interest are, in addition to debt securities, monetary gold / SDRs, deposits, loans and other accounts. The use of produced non-financial assets such as buildings is a fee (P.11 / P.131).

(260) In the calculation of sustainability indicators (S1 and S2), the projected path of property income is conventionally included in the sub-indicator "initial budgetary position" (IBP).

(261) Exception are natural resources for Denmark and the Netherlands, see below.

Consequently, future property income is assumed to be generated only from the upcoming returns on the assets stock and property income projections are modelled by just using further assumptions on the future evolution of the rate of return on assets.

In this sense, returns for equity and non-financial assets (rents) are generally considered to occur in line with GDP projections, whereas returns on bonds are underpinned by the additional assumptions described below.

All data for property income projections comes from Eurostat (general government property income subcategories bonds D41, equity D42 and rents D45).

A3.4.1. Bond returns projection

These projections are based on an agreement reached in 2009 by the Economic Policy Committee's Working Group on Ageing Populations and Sustainability (AWG) and later supported in 2012 and 2015, as well as on some ad-hoc assumptions.

Returns on bonds (D.41) have been considered to be as follows:

- In the short run (between T and T+30): country-specific yields on 10y government bonds apply as starting point in present year T to gradually converge to a 4% yield applied in T+30.
- In the medium to long run (as of T+30): a constant 4% yield applies; this horizon and value are in line with the horizon used for government debt projections.

Due to the current low level of government bond yields, an additional assumption was made that the starting point of convergence to a 4% yield in T+30 should not be the current (T) *level* of the 10-y government bond yield that year, but an *average* of the last 10-y government bond yields.

The assumptions regarding the starting yield value and the duration of convergence to a 4% yield intend to compress the yield gap to be bridged and to stretch the timespan available for convergence, thus limiting distortionary impacts on S1 and S2 for countries with high property income.

A3.4.2. Equity returns projection

These projections are based on a method agreed by the AWG in 2007.

Using income from equity - D.42 which reports distributed returns - country-specific shares of paid dividends in GDP are calculated for the last year of available data, T-1; for each country it is considered this share remains constant over the projection horizon, thereby implicitly assuming continuing valuation effects in line with nominal GDP growth.

A3.4.3. Rents projection

These projections are based on a method agreed by the AWG in 2007.

The share of rents (D45) to GDP is calculated for the last year of available data for each country, T-1. ([262]) This share is assumed to remain constant over the projection horizon for all countries except Denmark and the Netherlands. For these two countries rich in fossil fuels the stock of subsoil assets is assumed to deplete by 2050, so that the share of rents to GDP in these countries would decline linearly to reach the EU average ([263]) by 2050.

Returns on real estate (rentals on buildings etc.) are not included in property income in the National Accounts since they are produced and often consumed by the general government.

In sum, considering these hypotheses, the projected path of property income ultimately depends on the stock of bonds held at the start of the projection period (the higher the bonds stock, the steeper the decline in property income over time) given that the return on these bonds is assumed to converge to a 4% yield in the medium-long term.

Since both elements can affect property income projections markedly, mitigating assumptions on the starting point and length of bond returns

([262]) This is a simplification. Rents projections should combine the size of reserves, the timing of exploitation and the eur value of the commodity (assumption).

([263]) This average excludes excluding Denmark and the Netherlands.

convergence aim to avoid unrealistic boosts to property income projections (and thereby too large of a required SPB adjustment)), in particular in countries with significant property income shares.

ANNEX A4

Stochastic debt projections based on a historical variance-covariance matrix

This Annex provides a description of the methodology used for stochastic debt projections based on the historical variance-covariance matrix approach and the data used to implement it. ([264])

A4.1. THE METHOD TO OBTAIN (ANNUAL) STOCHASTIC SHOCKS TO MACROECONOMIC VARIABLES

Stochastic shocks are simulated for five macroeconomic variables entering the debt evolution equation: the government primary balance, nominal short-term interest rate, nominal long-term interest rate, nominal GDP growth rate and exchange rate (for non-EA countries). First, the methodology requires transforming the time series of quarterly data for each macroeconomic variable x into series of historical quarterly shocks δ_q^x as follows:

$$\delta_q^x = x_q - x_{q-1}$$

A Monte Carlo simulation is then run by extracting random vectors of quarterly shocks over the projection period (2022-26) from a joint normal distribution with zero mean and variance-covariance matrix identical to that of historical (quarterly) shocks. The quarterly shocks (ε_q) obtained in this way are aggregated into annual shocks to primary balance, nominal short-term interest rate, nominal long-term interest rate, nominal GDP growth, and exchange rate (for non-EA countries), as follows:

– the shock to the primary balance b in year t is given by the sum of the quarterly shocks to the primary balance:

$$\varepsilon_t^b = \sum_{q=1}^{4} \varepsilon_q^b$$

– the shock to nominal GDP growth g in year t is given by the sum of the quarterly shocks to growth:

$$\varepsilon_t^g = \sum_{q=1}^{4} \varepsilon_q^g$$

– the shock in year t to the nominal exchange rate e is given by the sum of the quarterly shocks to the exchange rate:

$$\varepsilon_t^e = \sum_{q=1}^{4} \varepsilon_q^e$$

– the shock in year t to the nominal *short-term* interest rate i^S is given by the sum of the quarterly shocks to the short-term interest rate:

$$\varepsilon_t^{i^S} = \sum_{q=1}^{4} \varepsilon_q^{i^S}$$

The calculation of the shock to the nominal short-term interest rate in annual terms is justified based on the fact that the short-term interest rate is defined here as the interest rate on government bonds with maturity below the year. With the equation above, we rule out persistence of short-term interest rate shocks over time, exactly as done in standard deterministic projections. In other words, unlike the case of the long-term interest rate (see below), a shock to the short-term interest rate occurring in any of the quarters of year t is not carried over beyond year t.

– the aggregation of the quarterly shocks to the nominal *long-term* interest rate i^L into annual shocks takes account of the persistence of these shocks over time. This is due to the fact that long-term debt issued/rolled over at the moment where the shock takes place will remain in the debt stock, for all years to maturity, at the interest rate conditions holding in the market at the time of issuance ([265]). A shock to the long-term interest rate in year t is therefore carried over to the following years in proportion to the share of maturing debt that is progressively rolled over (ECB data on weighted average maturity is used to implement this). For countries where average weighted maturity of debt T is equal or greater than the number of projection years (5 years, from 2022 to 2026), the annual shock to long-term interest rate in year t is defined as:

([264]) For more details see Berti (2013).

([265]) The implicit assumption is made here that long-term government bonds are issued at fixed interest rates only.

$$\varepsilon_t^{i^L} = \frac{1}{T}\sum_{q=1}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2022$$

$$\varepsilon_t^{i^L} = \frac{2}{T}\sum_{q=-4}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2023$$

$$\varepsilon_t^{i^L} = \frac{3}{T}\sum_{q=-8}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2024$$

$$\varepsilon_t^{i^L} = \frac{4}{T}\sum_{q=-12}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2025$$

$$\varepsilon_t^{i^L} = \frac{5}{T}\sum_{q=-16}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2026$$

where q = -4, -8, -12, -16 respectively indicate the first quarter of years t-1, t-2, t-3 and t-4. The set of equations above clearly allows for shocks to the long-term interest rate in a certain year to carry over to the following years, till when, on average, debt issued at those interest rate conditions will remain part of the stock.

For countries where the average weighted maturity of debt is smaller than the number of projection years, the equations above are adjusted accordingly to reflect a shorter carryover of past shocks. For instance, countries with average weighted maturity T = 3 years will have the annual shock to the long-term interest rate defined as follows ([266]):

$$\varepsilon_t^{i^L} = \frac{1}{3}\sum_{q=1}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2022$$

$$\varepsilon_t^{i^L} = \frac{2}{3}\sum_{q=-4}^{4} \varepsilon_q^{i^L} \ \ if\ t = 2023$$

$$\varepsilon_t^{i^L} = \sum_{q=-8}^{4} \varepsilon_q^{i^L} \ \ if\ t \geq 2024$$

([266]) Annual shocks to the long-term interest rate for countries with weighted average maturities of 2 and 4 years will be defined in a fully analogous way.

Finally, the weighted average of annual shocks to short-term and long-term interest rates (with weights given by the shares of short-term debt, α^S, and long-term debt, α^L, over total) gives us the annual shock to the implicit interest rate i:

$$\varepsilon_t^i = \alpha^S \varepsilon^{i^S} + \alpha^L \varepsilon^{i^L}$$

A4.2. APPLYING STOCHASTIC SHOCKS TO THE CENTRAL SCENARIO

All results from stochastic projections presented in this report refer to a scenario in which shocks are assumed to be temporary. In this case, annual shocks ε are applied to the baseline value of the variables (primary balance b, implicit interest rate i, nominal growth rate g and exchange rate e) each year as follows:

$b_t = \bar{b}_t + \varepsilon_t^b$ with $\bar{b}_t$ = baseline (from standard deterministic projections) primary balance at year t

$g_t = \bar{g}_t + \varepsilon_t^g$ with $\bar{g}_t$ = baseline (from standard deterministic projections) nominal GDP growth at year t

$i_t = \bar{\imath}_t + \varepsilon_t^i$ with $\bar{\imath}_t$ = baseline (from standard deterministic projections) implicit interest rate at year t

$e_t = \bar{e}_t + \varepsilon_t^e$ with $\bar{e}_t$ = nominal exchange rate as in DG ECFIN forecasts if t within forecast horizon; nominal exchange rate identical to last forecasted value if t beyond forecast horizon.

In other words, if the shock in year t were equal to zero, the value of the variable would be the same as in the standard deterministic baseline projections.

A4.3. THE DEBT EVOLUTION EQUATION

Through the steps described above we obtain series, over the whole projection period, of simulated government primary balance, nominal growth rate, implicit interest rate and nominal exchange rate that can be used in the debt evolution equation to calculate debt ratios over a 5-year horizon, starting from the last historical value.

The debt evolution equation takes the following form:

$$d_t = \alpha^n d_{t-1} \frac{1+i_t}{1+g_t} + \alpha^f d_{t-1} \frac{1+i_t}{1+g_t} \frac{e_t}{e_{t-1}} - b_t + c_t + f_t$$

where: d_t = debt-to-GDP ratio in year t

α^n = share of total debt denominated in national currency ([267])

α^f = share of total debt denominated in foreign currency

b_t = primary balance over GDP in year t

c_t = change in age-related costs over GDP in year t relative to starting year ([268])

f_t = stock-flow adjustment over GDP in year t

All the steps above (extraction of random vectors of quarterly shocks over the projection horizon; aggregation of quarterly shocks into annual shocks; calculation of the corresponding simulated series of primary balance, implicit interest rate, nominal growth rate and exchange rate; calculation of the corresponding path for the debt ratio) are repeated 2000 times. This allows us to obtain yearly distributions of the debt-to-GDP ratio over 2022-26, from which we extract the percentiles to construct the fan charts.

In the construction of the asymmetric fan charts, a restriction is placed on the upside primary balance shocks. This allows to exclude the primary balance shocks that are higher than a one half standard deviation of the primary balance sample.

A4.4. THE DATA USED

For the calculation of the historical variance-covariance matrix, quarterly data on government primary balance are taken from ESTAT; nominal short-term and long-term interest rates are taken from IMF-IFS and OECD; quarterly data on nominal growth rate come from ESTAT and IMF-IFS; quarterly data on nominal exchange rate for non-EA countries come from ESTAT.

Results using the methodology described above were derived for all EU countries by using both short-term and long-term interest rates, whenever possible based on data availability, to keep in line with standard deterministic projections. This was indeed possible for the vast majority of EU countries, the only exceptions being Bulgaria, Croatia and Estonia. ([269]) Shocks to the primary balance were simulated for all countries but two (Croatia and Estonia), based on availability of sufficiently long time series of quarterly primary balances.

In general, data starting from the late 90s - early 2000s until the second quarter of 2021 were used to calculate the historical variance-covariance matrix.

([267]) Shares of public debt denominated in national and foreign currency are kept constant over the projection period at the latest ESTAT data (ECB data are used for those countries, for which ESTAT data were not available).

([268]) Figures on age-related costs from the European Commission's 2021 Ageing Report were used.

([269]) For Estonia and Croatia we only used the short-term interest rate as quarterly data on the long-term rate were not available; for Bulgaria we used the long-term interest rate only as data on the short-term rate were not available for most recent years.

ANNEX A5
The fiscal sustainability indicators (S1 and S2)

A5.1. NOTATION

t: time index. Each period is one year

t_F: last year before the long-term projection (i.e. last year forecasted in the European Commission Autumn Forecast 2021, 2023).

t_0: last year before the start of the fiscal adjustment (country-specific).

t_0+1: first year of the long-term projection period (i.e. start of the fiscal adjustment).

t_1: end of the fiscal adjustment (relevant for S1)

t_2: target year for the debt ratio (country-specific, relevant for S1).

t_3: final year of the long-term projection period (e.g. 2070).

Notice that $t_0 < t_1 < t_2 < t_3$.

D_t: debt-to-GDP ratio (at the end of year t).

PB_t: ratio of structural primary balance to GDP

$\Delta\mathrm{PB}_t \equiv \mathrm{PB}_t - \mathrm{PB}_{t_0}$: change in the structural primary balance relative to the base year t_0. In the absence of fiscal adjustment, it equals the change in age related expenditure (ΔA_t) for $t > t_0$.

$\Delta A_t \equiv A_t - A_{t_0}$: change in age-related costs relative to the base year t_0.

c: the annual increase in the primary structural balance during fiscal adjustment (i.e. between t_0+1 and t_1) (relevant for S1).

$S_1 \equiv c(t_1 - t_0)$: the value of the S1 indicator, i.e. the total fiscal adjustment.

r: differential between the nominal interest rate and the nominal GDP growth rate i.e.

$1 + r \equiv \frac{1+R}{1+G}$: where R and G are, respectively, the nominal interest rate and the nominal growth rate.

If the interest-growth rate differential is time-varying, we define:

$$\alpha_{s;v} \equiv (1+r_{s+1})(1+r_{s+2})\dots(1+r_v)$$

$$\alpha_{v;v} \equiv 1$$

as the accumulation factor that transforms 1 nominal unit in period s to its period v value.

A5.2. DEBT DYNAMICS

By definition, the debt-to-GDP ratio evolves according to:

$$D_t = (1+r_t)D_{t-1} - \mathrm{PB}_t. \qquad (1)$$

That is, the debt ratio at the end of year t, D_t, is a sum of three components: the debt ratio at the end of the previous year (D_{t-1}), interest accrued on existing debt during year t (rD_{t-1}), and the negative of the primary balance ($-\mathrm{PB}_t$).

Repeatedly substituting for D_t, the debt ratio at the end of some future year $T > t$ can be expressed similarly, as:

$$D_T = D_{t-1}\alpha_{t-1;T} - \sum_{i=t}^{T}(\mathrm{PB}_i\alpha_{i;T}). \qquad (2)$$

The path of the debt ratio is thus determined by the initial debt ratio, accrued interest (net of growth), and the path of primary balances from t through T.

Important warning

It should be noted that the actual calculation of the S1 and S2 indicators also accounts for property income and tax revenue on pensions, although they are not explicitly included in the derivations in order to simplify them and to facilitate the interpretation of results. Their inclusion would be trivial, implying "adding" terms to the formulas similar to that for "ageing costs" ΔA_t.

A5.3. DERIVATION OF THE S1 INDICATOR

The S1 indicator is defined as the constant annual improvement in the ratio of structural primary balance to GDP, from year t_0+1 up to year t_1, that is required to bring the debt ratio to a given level by year t_2. ([270]) In addition to accounting for the need to adjust the initial intertemporal budgetary position and the debt level, it incorporates financing for any additional expenditure until the target date arising from an ageing population.

During the S1 adjustment, the primary balance (as a percentage of GDP) increases by a constant annual amount $c > 0$ each year starting from $t_0 + 1$ through t_1. The adjustment is assumed to be permanent. Under the assumed consolidation schedule, the change in the primary balance is thus given by

$$\mathrm{PB}_i = \mathrm{SPB}_{t_0} + c(i - t_0) - \Delta A_i + \Delta PI_i + CC_i \quad \text{for } t_0 < i \leq t_1 \qquad (3i)$$

$$\mathrm{PB}_i = \mathrm{SPB}_{t_0} + \underbrace{c(t_1 - t_0)}_{=S_1} - \Delta A_i + \Delta PI_i + CC_i \quad \text{for } t_2 \geq i > t_1 \qquad (3ii)$$

Using (2), the debt ratio target D_{t_2} can then be written as:

$$D_{t_2} = D_{t_0}\alpha_{t_0;t_2} - \sum_{i=t_0+1}^{t_2} \left(\mathrm{PB}_i \alpha_{i;t_2}\right) \qquad (4)$$

Replacing (3i)-(3ii) into (4) yields:

$$\begin{aligned} D_{t_2} = D_{t_0}\alpha_{t_0;t_2} &- \sum_{i=t_0+1}^{t_1} \left(\mathrm{SPB}_{t_0} + c(i - t_0)\right) \alpha_{i;t_2} \\ &- \sum_{i=t_1+1}^{t_2} \left(\mathrm{SPB}_{t_0} + \underbrace{c(t_1 - t_0)}_{=S_1}\right) \alpha_{i;t_2} \\ &+ \sum_{i=t_0+1}^{t_2} \left((\Delta A_i - \Delta PI_i - CC_i)\, \alpha_{i;t_2}\right) \end{aligned} \qquad (5)$$

After some straightforward manipulations, ([271]) we can decompose the S1 into the following main components:

$$\begin{aligned} S_1 \equiv \underbrace{c(t_1 - t_0)}_{T} = \\ = \underbrace{\frac{D_{t_0}(\alpha_{t_0;t_2} - 1)}{\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})} - \mathrm{SPB}_{t_0} - \frac{\sum_{i=t_0+1}^{t_2}(\Delta PI_i \alpha_{i;t_2})}{\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})} - \frac{\sum_{i=t_0+1}^{t_2}(CC_i \alpha_{i;t_2})}{\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})}}_{A} \\ + \underbrace{c\frac{\sum_{i=t_0+1}^{t_1}\left((t_1 - i)\alpha_{i;t_2}\right)}{\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})}}_{B} + \underbrace{\frac{D_{t_0} - D_{t_2}}{\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})}}_{C} \\ + \underbrace{\frac{\sum_{i=t_0+1}^{t_2}(\Delta A_i \alpha_{i;t_2})}{\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})}}_{D} \end{aligned} \qquad (6)$$

where (T) is the total adjustment (the S1 indicator by definition); (A) the strict initial budgetary position (i.e. the gap to the debt-stabilising primary balance); (B) the cost of delaying the adjustment; (C) the required additional adjustment due to the debt target (DR); and (D) the additional required adjustment due to the costs of ageing (LTC). The total initial budgetary position (IBP) is the sum of A and B i.e. includes the cost of delaying the adjustment.

A5.4. DERIVATION OF THE S2 INDICATOR

The intertemporal budget constraint and the S2 indicator

According to a generally invoked definition, fiscal policy is sustainable in the long term if the present value of future primary balances is equal to the current level of debt, that is, if the intertemporal government budget constraint (IBC) is met. Let us define the S2 as the immediate and permanent one-off fiscal adjustment that would ensure that the IBC is met. This indicator is appropriate for assessing long-term fiscal sustainability in the face of ageing costs. ([272])

Since the S2 indicator is defined with reference to the intertemporal government budget constraint (IBC), we first discuss which conditions are required for the IBC to hold in a standard model of debt dynamics. From (2), the debt to GDP ratio at the end of any year $t > t_0$ is given by:

([270]) This is in contrast to the S2 indicator, which is defined as an immediate, one-off adjustment.

([271]) Add and subtract D_{t_0} on the LHS of (5). In the second term on the LHS, rewrite $c(i - t_0) = S_1 - c(t_1 - i)$, then exchange $-S_1 \cdot \sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})$ on the LHS for D_{t_2} on the RHS. Finally, divide by $\sum_{i=t_0+1}^{t_2}(\alpha_{i;t_2})$, simplify, and group the terms as in (6).

([272]) Note that the derivation of S2 does not assume that either the initial sequence of primary balances or the fixed annual increase (S2) are optimal according to some criterion. S2 should be considered as a benchmark and not as a policy recommendation or as a measure of the actual adjustment needed in any particular year.

$$D_t = D_{t_0}\alpha_{t_0;t} - \sum_{i=t_0+1}^{t} (\mathrm{PB}_i \alpha_{i;t}). \quad (7)$$

Rearranging the above and discounting both sides to their time t_0 values, we obtain the debt ratio on the initial period:

$$D_{t_0} = \left(\frac{D_t}{\alpha_{t_0;t}}\right) + \sum_{i=t_0+1}^{t} \left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right). \quad (8i)$$

Assuming an infinite time horizon ($t \to \infty$) we get:

$$D_{t_0} = \lim_{t\to\infty}\left(\frac{D_t}{\alpha_{t_0;t}}\right) + \lim_{t\to\infty}\sum_{i=t_0+1}^{t} \left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right) = \lim_{t\to\infty}\left(\frac{D_t}{\alpha_{t_0;t}}\right) + \sum_{i=t_0+1}^{\infty} \left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right) \quad (8ii)$$

Either both of the limits on right-hand side of equation (8ii) fail to exist, or if one of them exists, so does the other.

Let us define the *no-Ponzi game condition* (also called the *transversality condition*) for debt sustainability, namely that the discounted present value of debt (in the very long term or in the infinite horizon) will tend to zero:

$$\lim_{t\to\infty}\left(\frac{D_t}{\alpha_{t_0;t}}\right) = 0 \quad (9i)$$

Condition (9i) means that asymptotically, the debt ratio cannot grow at a rate equal or higher than the (growth-adjusted) interest rate, which is what would happen if debt and interest were systematically paid by issuing new debt (i.e. a Ponzi game).

Combining the no-Ponzi game condition (9i) with (8ii), one obtains the intertemporal budget constraint, stating that a fiscal policy is sustainable if the present discounted value of future primary balances is equal to the initial value of the debt ratio.

$$D_{t_0} = \sum_{i=t_0+1}^{\infty} \left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right) \quad (9ii)$$

On the other hand, substituting the intertemporal budget constraint (9ii) into (8ii) implies the no-Ponzi game condition. This shows that the no-Ponzi game condition (9i) and the IBC (9ii) are, in fact, equivalent.

Assuming that the intertemporal budget constraint is satisfied through a permanent, one-off fiscal adjustment whose size is given by the S2, from $t_0 + 1$ onwards we can write:

$$\mathrm{PB}_i = \mathrm{SPB}_{t_0} + S_2 - \Delta A_i + \Delta PI_i + CC_i \quad \text{for} \quad i > t_0. \quad (10)$$

Then the intertemporal budget constraint (9ii) becomes

$$D_{t_0} = \sum_{i=t_0+1}^{\infty} \left(\frac{\mathrm{PB}_{t_0} + S_2 - \Delta A_i + \Delta PI_i + CC_i}{\alpha_{t_0;i}}\right). \quad (9iii)$$

Here the ratio of structural primary balance to GDP, PB_t is re-expressed in terms of the required annual additional effort, S2, and the change in age-related costs relative to the base year t_0, combining the equation (10) with equation (9ii).

According to the theory on the convergence of series, necessary conditions for the series in equation (9ii)-(9iii) to converge are for the initial path of primary balances to be bounded and the interest rate differential in the infinite horizon to be positive ([273]). The latter is equivalent to the modified golden rule, stating that the nominal interest rate exceeds the real growth rate (i.e. $\lim_{t\to\infty} r_t > 0$). ([274])

After some rearranging, ([275]) we can decompose the S2 into the following two components:

$$S_2 = \underbrace{\frac{D_{t_0}}{\sum_{i=t_0+1}^{\infty}\left(\frac{1}{\alpha_{t_0;i}}\right)} - \mathrm{SPB}_{t_0} - \frac{\sum_{i=t_0+1}^{\infty}\left(\frac{\Delta PI_i + CC_i}{\alpha_{t_0;i}}\right)}{\sum_{i=t_0+1}^{\infty}\left(\frac{1}{\alpha_{t_0;i}}\right)}}_{A} + \underbrace{\frac{\sum_{i=t_0+1}^{\infty}\left(\frac{\Delta A_i}{\alpha_{t_0;i}}\right)}{\sum_{i=t_0+1}^{\infty}\left(\frac{1}{\alpha_{t_0;i}}\right)}}_{B} \quad (11)$$

where (A) is the initial budgetary position i.e. the gap to the debt stabilising primary balance ([276]);

([273]) The latter is an application of the ratio test for convergence.
([274]) See Escolano (2010) for further details on the relationships among the stability of the debt ratio, the IBC and the no-Ponzi game condition.
([275]) In addition, constant multiplicative terms are systematically taken out of summation signs.
([276]) In practical calculations, the present value of property income is also accounted for in the initial budgetary

and (B) the additional required adjustment due to the costs of ageing.

If the interest-growth rate differential r is constant, the accumulation factor simplifies to $\alpha_{s;v} = (1+r_{s+1})(1+r_{s+2})\dots(1+r_v) = (1+r)^{v-s}$. Then equation (10) can be simplified further by noting that:

$$\sum_{i=t_0+1}^{\infty}\left(\frac{1}{\alpha_{t_0;i}}\right) = \sum_{i=t_0+1}^{\infty}\left(\frac{1}{(1+r)^{i-t_0}}\right) = \frac{1}{r} \qquad (12)$$

Thus, for a constant discounting factor, (11) can be rewritten as:

$$S_2 = \underbrace{rD_{t_0} - \mathrm{SPB}_{t_0} - r\sum_{i=t_0+1}^{\infty}\left(\frac{\Delta PI_i + CC_i}{\alpha_{t_0;i}}\right)}_{A} + \underbrace{r\sum_{i=t_0+1}^{\infty}\left(\frac{\Delta A_i}{\alpha_{t_0;i}}\right)}_{B} \qquad (13i)$$

If the interest-growth rate differential and the structural primary balance are constant after a certain date (here $t_3 = 2070$), equation (11) can be rewritten as:

$$S_2 = \frac{D_{t_0}}{\sum_{i=t_0+1}^{2069}\left(\frac{1}{\alpha_{t_0;i}}\right) + \frac{1}{r\alpha_{t_0;2069}}} - \mathrm{SPB}_{t_0} - \frac{\sum_{i=t_0+1}^{2069}\left(\frac{\Delta PI_i + CC_i}{\alpha_{t_0;i}}\right) + \frac{\Delta PI_{2070} + CC_{2070}}{r\,\alpha_{t_0;2069}}}{\sum_{i=t_0+1}^{2069}\left(\frac{1}{\alpha_{t_0;i}}\right) + \frac{1}{r\,\alpha_{t_0;2069}}} + \frac{\sum_{i=t_0+1}^{2069}\left(\frac{\Delta A_i}{\alpha_{t_0;i}}\right) + \frac{\Delta A_{2070}}{r\,\alpha_{t_0;2069}}}{\sum_{i=t_0+1}^{2069}\left(\frac{1}{\alpha_{t_0;i}}\right) + \frac{1}{r\,\alpha_{t_0;2069}}} \qquad (13ii)$$

where $r_t = r$ and $\Delta A_t = \Delta A_{2070}$ for $t \geq t_3 = 2070$.

Derivation of the steady state debt level (at the end of the projection period) corresponding to the S2

Assuming that the intertemporal budget constraint is satisfied and that the primary balance and the interest-growth rate differential are constant at their long-run levels after the end of the projection period, then the debt ratio remains constant at the value attained at the end point of the projection period (i.e. at $t_3 = 2070$).

To see this, rewrite (9ii) as:

$$D_{t_0} = \sum_{i=t_0+1}^{\infty}\left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right) = \sum_{i=t_0+1}^{t_3}\left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right) + \sum_{i=t_3+1}^{\infty}\left(\frac{\mathrm{PB}_i}{\alpha_{t_0;i}}\right) \qquad (14i)$$

Using (7) and the fact that for $t \geq t_3$ the primary balance and interest-growth rate differential stay constant at $\mathrm{PB}_t = \mathrm{PB}_{t_3}$ we can rearrange (14i) to obtain the debt ratio at t_3:

$$D_{t_3} = D_{t_0}\alpha_{t_0;t_3} - \sum_{i=t_0+1}^{t_3}(\mathrm{PB}_i\alpha_{i;t_3}) = \sum_{i=t_3+1}^{\infty}\left(\frac{\mathrm{PB}_i}{\alpha_{t_3;i}}\right) = \sum_{i=1}^{\infty}\left(\frac{\mathrm{PB}_{t_3}}{(1+r_{t_3})^i}\right) = \frac{\mathrm{PB}_{t_3}}{r_{t_3}} \qquad (14ii)$$

We can generalising the above to each $t \geq t_3$ by using (7) with the initial year changed to t_3 instead of t_0, we see that for each year after t_3, the debt ratio remains unchanged at this value:

$$\begin{aligned} D_t &= D_{t_3}\alpha_{t_3;t} - \sum_{i=t_3+1}^{t}(\mathrm{PB}_i\alpha_{i;t}) \\ &= \frac{\mathrm{PB}_{t_3}}{r_{t_3}}(1+r_{t_3})^{t-t_3} - \mathrm{PB}_{t_3}\sum_{i=t_3+1}^{t}(1+r_{t_3})^{t-i} \\ &= \underbrace{\left[(1+r_{t_3})^{t-t_3} - r_{t_3}\left(\frac{1-(1+r_{t_3})^{t-t_3}}{1-(1+r_{t_3})}\right)\right]}_{=1}\frac{\mathrm{PB}_{t_3}}{r_{t_3}} \\ &= \frac{\mathrm{PB}_{t_3}}{r_{t_3}} \equiv \bar{\bar{D}} \quad \text{for} \quad t \geq t_3 \end{aligned} \qquad (15)$$

where $\bar{\bar{D}}$ is the constant debt ratio reached after the end of the projection period.

Using (4), the primary balance at the end of the projection period can be calculated as:

$$\mathrm{PB}_{t_3} = \mathrm{SPB}_{t_0} + \Delta PI_{t_3} + CC_{t_3} + S_2 - \Delta A_{t_3} \qquad (16)$$

Replacing (16) into (15), the constant (steady-state) debt ratio ($\bar{\bar{D}}$) is given by:

$$\bar{\bar{D}} = \frac{\mathrm{PB}_{t_3}}{r_{t_3}} = \frac{\mathrm{SPB}_{t_0} + \Delta PI_{t_3} + CC_{t_3} + S_2 - \Delta A_{t_3}}{r_{t_3}} \quad \text{for} \quad t \geq t_3 \qquad (17)$$

position. Property income enters the equation in an identical manner as age-related costs ΔA_t (i.e. term (B)), but with an opposite sign.

The S2 adjustment implies that the sum of debt and the discounted present value of future changes in aged-related expenditure is (approximately) constant over time

Replacing equations (16) and (13i) into (15), and assuming a constant interest rate differential, the following equation is obtained:

$$D_t + \sum_{i=t+1}^{\infty}\left(\frac{\Delta A_i}{(1+r)^{i-t}}\right) - \sum_{i=t+1}^{\infty}\left(\frac{\Delta PI_i + CC_i}{(1+r)^{i-t}}\right) = D_{t_0} + \sum_{i=t_0+1}^{\infty}\left(\frac{\Delta A_i}{(1+r)^{i-t_0}}\right) - \sum_{i=t_0+1}^{\infty}\left(\frac{\Delta PI_i + CC_i}{(1+r)^{i-t_0}}\right) \quad (18)$$

Equation (18) can be interpreted as follows. Implementing a permanent annual improvement in the primary balance amounting to S2 (equation 5), which is both necessary and sufficient to secure intertemporal solvency, implies that the sum of explicit debt (the first term in both sides) and the variation in age-related expenditure or implicit debt (the second terms in both sides) is (approximately) constant over time. Equation (17) is exact in the steady state (e.g. after 2070), holding only as an approximation during transitory phases (i.e. for time-varying interest rate differentials). ([277])

([277]) Moreover, equations (17) and (18) imply that both the debt and the variation in age-related expenditure are constant over time in the steady state.

ANNEX A6

Estimating the potential impact of simulated bank losses on public finances based on the SYMBOL model

SYMBOL approximates the probability distributions of individual bank's losses using publicly available information from banks' financial statements. In particular, the model estimates an average implied default probability of the individual banks' asset/loan portfolios by inverting the Basel FIRB formula for capital requirements ([278]).

The main data source on banks' financial statements is Orbis Bank Focus, a commercial database of the private company Bureau van Dijk. For the reference year 2020, unconsolidated data for commercial, saving and cooperatives banks are included. The database as provided by Orbis Bank Focus lacks information on specific variables for some banks in the sample (e.g. capital, risk weighted assets, provisions, gross non-performing loans). In those cases, capital is imputed via a robust regression by common equity, while risk weighted assets are approximated using the total regulatory capital ratio (at bank or country level) ([279]). While gross loans are available for all banks, values for provisions and non-performing loans are available only for two thirds of the sample. Missing values for provisions have thus been estimated by country aggregates coming from EBA dashboard ([280]), while missing values for non-performing loans have been imputed by applying a robust regression with provisions as explanatory variable. Information on the sample is presented in Table A11.1, and Table A11.2 reports statistics at aggregated Member State level for non-performing loans (NPLs) and loans provisions, taken from the EBA dashboard or the Orbis Bankfocus database, while recovery rates (country aggregates) are taken from the World Bank (2020). Given the rapid evolution of some of the magnitudes during the last year, following the implementation of NPL reduction plans, data for NPL and Capital have been updated to reflect the most recent statistics.

Similarly, to past exercises, the sample covers roughly 75% of all EU banking assets. ([281]) When the sample, as illustrated in Table A11.1, includes either a small number of banks or the share of total assets covered is low, results should be interpreted with caution, since a minor change to any bank's data or the addition of a new bank could have large effects on results.

Table A6.1: **Descriptive statistics of samples used for SYMBOL simulations**

	Sample ratio *(Sample TA/ Population TA)*	Nbr.of banks	Total assets (TA)	Capital	Risk weighted assets (RWA)	RWA/TA	Capital/RWA
	%		EUR bn	EUR bn	EUR bn	%	%
AT	76.1%	423	717.1	62.3	320.5	44.7%	19.4%
BE	96.7%	24	939.5	70.7	345.4	36.8%	20.5%
BG	83.6%	13	54.3	6.5	28.8	53.0%	22.7%
CY	83.8%	23	52.6	4.4	21.6	41.1%	20.2%
CZ	68.4%	17	191.1	17.7	74.7	39.1%	23.7%
DE	58.1%	1068	4951.8	386.1	2127.6	43.0%	18.1%
DK	45.2%	54	518.9	45.4	178.1	34.3%	25.5%
EE	111.9%	3	37.3	4.2	14.5	38.7%	29.0%
ES	80.5%	82	2212.2	192.4	1093.4	49.4%	17.6%
FI	94.2%	139	578.1	42.6	182.7	31.6%	23.3%
FR	74.9%	147	7667.8	434.8	2233.9	29.1%	19.5%
EL	85.0%	7	282.7	26.5	164.4	58.2%	16.1%
HR	91.5%	20	58.7	7.7	30.8	52.4%	25.1%
HU	53.4%	10	76.1	9.4	40.6	53.4%	23.2%
IE	24.1%	20	311.3	33.8	147.5	47.4%	22.9%
IT	71.3%	301	2565.2	215.3	1064.2	41.5%	20.2%
LT	69.7%	4	27.6	2.1	9.4	34.1%	22.4%
LU	43.8%	43	419.2	38.6	163.5	39.0%	23.6%
LV	100.9%	13	20.1	2.2	8.6	42.7%	26.1%
MT	61.9%	9	25.0	2.2	9.6	38.3%	22.4%
NL	75.3%	17	1837.3	134.1	580.6	31.6%	23.1%
PL	70.1%	68	365.1	39.7	200.0	54.8%	19.9%
PT	71.7%	91	277.0	25.3	130.1	47.0%	19.4%
RO	76.1%	15	92.5	10.1	45.0	48.7%	22.5%
SE	57.0%	78	727.6	54.3	190.0	26.1%	28.6%
SI	80.5%	9	37.1	4.0	20.2	54.3%	20.1%
SK	79.2%	6	64.6	5.6	29.3	45.4%	19.0%

(1) 2020 unconsolidated data. Capital has been updated using aggregated data from EBA Risk Dashboard as of Q3 2021.
Source: Commission services.

([278]) European Commission (2016) Section 5.2.2 and Annex A7 for more detail on the SYMBOL model.
([279]) The procedure for the imputation of missing values of capital and RWA is described in Benczur et al. (2013).
([280]) EBA Risk Dashboard - data as of Q4 2020.
([281]) The sample ratio changes per each MS ranging from 24% in Ireland to higher than 100% in EE and LV. This variability calls for caution when reading the results in particular for country with a low coverage ratio and small number of banks.

Table A6.2: **Descriptive statistics for Non-Performing Loans (NPL)**

	Gross loans	**NPL Ratio** Gross NPL/Gross loans	**NPL/TA** Gross NPL/TA	**NPL/Capital** Gross NPL/Capital	**Provisions**	**Recovery rate** Baseline Scenario	**NPL losses** Baseline Scenario
	EUR bn	**%**	**%**	**%**	**EUR bn**	**%**	**EUR bn**
AT	403.2	2.5%	1.4%	15.9%	5.5	79.9%	2.1
BE	472.9	1.0%	0.5%	6.4%	3.8	89.4%	0.1
BG	30.6	7.3%	4.1%	34.3%	1.6	37.7%	0.4
CY	25.9	8.3%	4.1%	49.5%	1.7	73.8%	0.0
CZ	111.8	2.0%	1.2%	12.6%	2.2	67.5%	0.1
DE	2607.1	1.0%	0.5%	6.5%	15.5	79.8%	3.5
DK	165.9	3.9%	1.2%	14.3%	5.2	88.5%	0.0
EE	24.1	1.6%	1.0%	9.1%	0.2	36.1%	0.1
ES	1178.3	3.5%	1.9%	21.4%	29.4	77.5%	3.4
FI	234.0	1.8%	0.7%	9.8%	2.7	88.0%	0.2
FR	2489.7	2.0%	0.7%	11.7%	29.6	74.8%	10.2
EL	165.7	13.3%	7.8%	82.9%	24.7	32.0%	0.0
HR	35.6	6.2%	3.7%	28.5%	2.2	35.2%	0.0
HU	32.2	2.3%	1.0%	7.7%	1.0	44.2%	0.0
IE	117.0	4.8%	1.8%	16.5%	5.0	86.1%	0.0
IT	1606.2	4.4%	2.7%	32.5%	54.9	65.6%	4.0
LT	13.7	1.4%	0.7%	9.3%	0.1	41.4%	0.0
LU	162.7	1.2%	0.5%	5.0%	1.3	43.9%	0.3
LV	9.6	4.1%	2.0%	17.7%	0.2	41.4%	0.2
MT	12.0	4.5%	2.1%	25.0%	0.4	39.2%	0.1
NL	938.5	0.6%	0.3%	4.3%	5.1	90.1%	0.0
PL	222.0	6.3%	3.8%	35.0%	10.5	60.9%	0.2
PT	146.1	3.4%	1.8%	19.8%	6.3	64.8%	0.0
RO	49.4	5.1%	2.7%	24.9%	2.7	34.4%	0.0
SE	308.4	1.1%	0.5%	6.5%	3.1	78.1%	0.0
SI	20.1	2.2%	1.2%	11.1%	0.5	90.0%	0.0
SK	49.0	2.0%	1.5%	17.8%	1.3	46.1%	0.0

(1) 2020 unconsolidated data. The NPL ratio has been updated using Orbis Bankfocus data as of Q3 2021.
Source: Commission services.

Computation of aggregate banking losses and estimated impact on public finances

Starting from the estimated average probability of default of the asset portfolio of each bank, SYMBOL generates realisations for each individual bank's credit losses via Monte Carlo simulation using the Basel FIRB loss distribution function and assuming a correlation between simulated shocks hitting different banks in the system ([282]). In the short-term scenario, losses from SYMBOL are added on top of losses due to current stocks of non-performing loans, adjusted for moratoria.

Individual bank losses are then transformed into excess losses and recapitalisation needs to be covered and finally aggregated at country and EU27 system level. Based on the bank-level balance sheet data and losses simulation, the model can then implement the loss allocation cascade (e.g. own funds, bail-in of eligible liabilities, Resolution Fund interventions…), distinguishing between excess losses and recapitalisation needs. Excess losses are losses in excess of available total capital of a bank, while recapitalisation needs are the funds necessary to restore the bank's minimum level of capitalisation given by the regulatory scenario under consideration ([283]).

Throughout the cascade of safety net intervention, it can then be traced how much of these two types of financing needs are picked up by the different tools. If a bank is failing or if it is left undercapitalised with respect to the minimum level established in the scenarios, the bail-in tool is applied at individual bank level up to 8% of its total liabilities and own funds (TLOF) (or total assets, TA). ([284]) Where a Resolution Fund (RF) is available, it is then assumed to intervene up to 5% of the total assets of each bank. ([285]) Given that the sample coverage in terms of the number and total assets of banks in the sample is not complete, the RF is assumed to have ex-ante funding equal to the appropriate percentage of covered deposits of the banks in the sample. Any leftover losses or recapitalisation needs not covered after all available tools have intervened are finally assumed to be covered by the government, taking into account the ratio between the sample and the population TA of all banks.

In the baseline scenario, for the purposes of determining the course of action in case of failure, banks are split into two groups. Those that are not designated as significant institutions for SSM purposes, which are assumed to be always liquidated (i.e. resolution probability equal to 0%),

([282]) The correlation is assumed to be 0.5 for all banks in the current simulation. All EU banks are simulated together.

([283]) European Commission (2016) Annex A7.

([284]) The BRRD does not establish a harmonised level of liabilities eligible for bail-in, but Art. 44 sets out that the RF can kick in only after shareholders and holders of other eligible instruments have made a contribution to loss absorption and recapitalisation of at least 8% of total liabilities and own funds (TLOF). Since bank-level data on bail-inable liabilities is unavailable, the bail-in tool is modelled in both the short- and long-term by imposing that individual banks hold a LAC of at least 8% of their TLOF. In practice banks with total capital under this threshold are assumed to meet the 8% minimum threshold via bail-inable liabilities. In the simulation, bail-in stops once the 8% of TA limit has been reached. If a bank holds capital above 8% of TA, there would be no bail-in, but capital might be bearing losses above 8% of TLOF.

([285]) Art. 44 of the BRRD sets out that the contribution of the resolution financing arrangement cannot exceed 5% of the total liabilities. In case of excess demand for SRF funds, funds are rationed in proportion to demand (i.e., proportionally to excess losses and recapitalization needs after the minimum bail-in, capped at 5% of TA at bank level).

and those that are designated as significant institutions, which in case of distress might go into resolution or liquidation. In the category of significant institutions, for global systemically important institutions (G-SIIs) and their subsidiaries the probability of going to resolution is set to 100% (i.e. we assume that G-SIIs will be always resolved), while for the other entities we assume an 80% resolution probability ([286]).

The results give an estimate of the implicit contingent liabilities - banking losses and recapitalisation needs after the safety net.). We here apply the latest methodological development of the model as explained by Bellia et al. (forthcoming 2022). Notably, we apply a sub-additive measure, the Expected Shortfall, to calculate the losses in the tail of the distribution. In practical terms, we select all the simulations where the factor is above a threshold (fixed for values of the common factor above 3 standard deviations) and we calculate the average value in this selected tail of the distribution. This represents the expected value of the portfolio losses under a stressed economic situation

Table A11.3 visualises the role of the various safety-net tools in absorbing unexpected losses.

([286]) Up until last year, for DSA exercises, the standard assumptions were either that only significant institutions go into resolution, or that all banks go into resolution. The current set up is thus more favorable to resolution funds, because a share of the significant banks (20%) is now assumed to go into liquidation.

Table A6.3: **Leftover financial needs after each safety net tool (% of GDP 2020), under the short and long term scenarios**

	Initial (2022) short term scenarios			Final (2032) long term scenarios		
	Excess losses plus recap	Excess losses plus recap after bail in	Excess losses plus recap after RFs	Excess losses plus recap	Excess losses plus recap after bail in	Excess losses plus recap after RFs
AT	0.8%	0.5%	0.2%	0.4%	0.3%	0.1%
BE	0.5%	0.4%	0.2%	0.4%	0.3%	0.1%
BG	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%
CY	1.9%	1.6%	0.6%	0.5%	0.4%	0.1%
CZ	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
DE	0.5%	0.2%	0.1%	0.4%	0.1%	0.0%
DK	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%
EE	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%
ES	1.6%	1.4%	0.8%	1.0%	0.9%	0.3%
FI	0.3%	0.2%	0.1%	0.2%	0.2%	0.0%
FR	1.8%	0.8%	0.4%	1.0%	0.4%	0.1%
EL	1.4%	1.3%	0.6%	1.0%	0.9%	0.2%
HR	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
HU	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
IE	0.5%	0.5%	0.3%	0.4%	0.4%	0.1%
IT	1.2%	0.9%	0.5%	0.7%	0.5%	0.1%
LT	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%
LU	3.2%	2.0%	0.9%	2.2%	1.4%	0.4%
LV	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
MT	0.3%	0.3%	0.2%	0.2%	0.1%	0.0%
NL	0.5%	0.4%	0.2%	0.3%	0.2%	0.1%
PL	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%
PT	1.0%	0.6%	0.3%	0.9%	0.5%	0.1%
RO	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%
SE	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%
SI	0.4%	0.4%	0.2%	0.2%	0.2%	0.0%
SK	0.2%	0.2%	0.1%	0.2%	0.1%	0.0%

Source: Commission services.

Scenarios settings

SYMBOL estimates how the regulatory framework set up by the Commission in recent years would, under certain assumptions, limit the impact of a systemic banking crisis on public finances.

Three pieces of legislation are considered: the Capital Requirement Regulation and Directive IV (CRR, CRDIV) ([287]), which improved the definitions of regulatory capital and risk-weighted assets, increased the level of regulatory capital by introducing the capital buffers, including extra capital buffers for European Global Systematically Important Institutions (G-SIIs) and Other Systemically Important Institutions (O-SII) ([288]); the Bank Recovery and Resolution Directive (BRRD) ([289]), which introduced bail-in ([290]) and national resolution funds ([291]), and the Single Resolution Mechanism Regulation (SRMR), ([292])

([287]) See European Parliament and Council (2013).
([288]) Very few banks which are OSII are affected by extra buffer (not considered).
([289]) See European Parliament and Council (2014a).
([290]) A legal framework ensuring that part of the distressed banks' losses are absorbed by unsecured creditors. The bail-in tool entered into force on 01/01/2016.
([291]) Funds financed by banks to orderly resolve failing banks, avoiding contagion and other spill-overs.
([292]) See European Parliament and Council (2014b).

which established the Single Resolution Board and the Single Resolution Fund (SRF). To reflect the phasing-in ([293]) of the safety-net tools foreseen by this body of legislation, two regulatory scenarios are modelled.

An initial (2022) short-term baseline scenario with safety net in progress, comprising:

- Asset correlation is fixed to 50% (traditional SYMBOL assumption, compatible with default regulatory parameter);
- Bank total capital and initial risk-weighted assets (RWAs) taken directly from the banks' balance sheets. RWA are then updated to reflect the stress condition as detailed in Box I.4.1. Capital has been updated using aggregated values at MS level from the EBA Risk Dashboard as of Q3-2021.
- Current stocks of non-performing loans contribute to losses in the banking system of each country and their magnitude has been estimated as explained in the main text, including the potential effects of the moratoria. NPLs losses updated with data as of Q3 2021 are added to all banks.
- Extra capital buffers for G-SIIs prescribed by the Financial Stability Board (FSB) are considered.
- Bail-in: modelled as a scenario whereby a Loss Absorbing Capacity (LAC) is built to represent, together with regulatory capital, 8% of TA ([284]).
- Resolution Funds - national (NRFs, for Member States not part of the Banking Union) and single (SRF, for Banking Union members) – phased-in in proportion of 7/10 of their target or long-run level and contributing to resolution absorbing losses up to 5% of the TA of the insolvent bank, provided that at least 8% LAC has already been called in ([285]). No backstop (other than public finances) nor ex-post contributions ([294]) are considered.
- No DGS contribution or intervention is modelled.
- Extra losses generated by loans granted by the State are directly transferred to debt or deficit without passing through the safety net cascade.

A final (long-term) 2030 baseline scenario as of when a completely phased-in safety net comprises:

- Asset correlation is fixed to 50% (traditional SYMBOL assumption, compatible with default regulatory parameter).
- Bank total capital taken directly from the banks' balance sheets and reflecting an increased minimum requirement topped-up to 10.5% RWA ([295]). RWA as reported, without Stress Test adjustments.
- Losses on current NPL stocks are not considered, and moratoria is assumed to be expired ([296]).
- Extra capital buffers for G-SIIs prescribed by the Financial Stability Board (FSB) are considered.
- Bail-in: modelled as a scenario whereby a Loss Absorbing Capacity (LAC) is built to represent, together with regulatory capital, 8% of TA ([297]).
- Resolution Funds ([298]) - national (NRFs, for Member States not part of the Banking Union)

([293]) CRR/CRDIV increased capital requirements are being phased-in from 2014 to 2019 and banks are progressively introducing the capital conservation buffer; according to BRRD and SRMR, national RFs and the SRF have a target of 1% of covered deposits to be collected over 10 years from 2015 onwards and 8 years from 2016 onwards, respectively.

([294]) Given the aim to portray worst-case fiscal consequences, ex-post contributions to the NRFs/SRF are not modelled, but these can actually go up to 3 times the ex-ante contributions, further reducing the impact on public finances.

([295]) Only mandatory requirements, i.e. the 8% total capital requirement and the 2.5% capital conservation buffer, are included. The discretionary counter-cyclical capital buffer (at the regulator's choice) is not.

([296]) The impact of non-performing loans (NPLs) is considered only in the current situation and the effect is assumed to become negligible in the long-term.

([297]) Same assumptions regarding 8% TA hold under BRRD2 once it will become applicable in December 2020. See footnote 16.

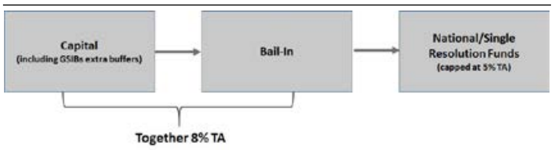
([298]) In practice, under the Agreement on the mutualisation and transfer of contributions to the SRF (IGA), in the short-term only a part of current SRF contributions would be and single (SRF, for Banking Union members) – fully phased-in and contributing to resolution absorbing losses up to 5% of the TA of the insolvent bank, provided that at least 8% TA has already been called in ([299]). No backstop (other than public finances) nor ex-post contributions ([300]) are considered.

- No DGS contribution or intervention is modelled.

- Graph A11.1 illustrates the order of intervention of different tools. The first cushion assumed to absorb simulated losses is capital, the second tool is bail-in, and the last are RFs, as legally foreseen ([301]).

- Moreover, alternative scenario settings are considered, as summarised in Table A11.5 and Graph A11.2.

Graph A6.1: **Implemented order of intervention of the safety net tools**



Source: Commission services.

Calibrating the heat map

The model allows estimating the probability distribution of the amount of public funds needed to cover losses after exhausting the protection provided by the financial safety net. To obtain the input for the heat map on government's implicit contingent liability risks, a minimum size of government's contingent liabilities is fixed, and the theoretical probability of the materialisation of the event is assessed.

Table A11.4 shows the heat map, which illustrates the relative riskiness of countries in terms of public finances being hit by at least a fixed share (3%, 5%, and 10%) of GDP, conditional on having (a) the banking sector in distress, (2) at least three countries with government's contingent liabilities. The colour coding reflects the relative magnitude of the theoretical probabilities of such an event.

Table A6.4: **Theoretical probability of public finances being hit by more than 3%, 5% or 10% of GDP, in the event of a severe crisis (i.e. involving excess loses and recapitalisation needs in at least three different EU countries)**

	Initial (2022) short term scenarios						Final (2032) long term scenarios					
	Baseline (a)			Stress (b)			Baseline (a)			Stress (b)		
	3% GDP	5% GDP	10% GDP	3% GDP	5% GDP	10% GDP	3% GDP	5% GDP	10% GDP	3% GDP	5% GDP	10% GDP
AT	0.02%	0.00%	0.00%	0.38%	0.15%	0.02%	0.00%	0.00%	0.00%	0.20%	0.08%	0.01%
BE	0.05%	0.02%	0.00%	0.54%	0.25%	0.04%	0.03%	0.01%	0.00%	0.38%	0.17%	0.04%
BG	0.00%	0.00%	0.00%	0.17%	0.05%	0.00%	0.00%	0.00%	0.00%	0.07%	0.02%	0.00%
CY	0.19%	0.09%	0.03%	4.49%	2.53%	0.78%	0.03%	0.02%	0.00%	0.45%	0.24%	0.08%
CZ	0.01%	0.00%	0.00%	0.17%	0.05%	0.00%	0.00%	0.00%	0.00%	0.10%	0.03%	0.00%
DE	0.01%	0.00%	0.00%	0.13%	0.04%	0.00%	0.00%	0.00%	0.00%	0.08%	0.03%	0.00%
DK	0.07%	0.04%	0.01%	0.25%	0.16%	0.05%	0.03%	0.03%	0.01%	0.16%	0.10%	0.04%
EE	0.02%	0.00%	0.00%	0.13%	0.04%	0.00%	0.00%	0.00%	0.00%	0.06%	0.02%	0.00%
ES	0.30%	0.10%	0.01%	2.26%	1.05%	0.26%	0.10%	0.05%	0.01%	1.01%	0.55%	0.15%
FI	0.04%	0.02%	0.01%	0.32%	0.17%	0.04%	0.02%	0.01%	0.00%	0.25%	0.14%	0.04%
FR	0.10%	0.03%	0.01%	0.84%	0.43%	0.12%	0.04%	0.01%	0.00%	0.45%	0.23%	0.06%
EL	0.21%	0.07%	0.00%	2.62%	1.28%	0.29%	0.07%	0.02%	0.00%	0.95%	0.52%	0.12%
HR	0.00%	0.00%	0.00%	0.04%	0.01%	0.00%	0.00%	0.00%	0.00%	0.04%	0.01%	0.00%
HU	0.01%	0.00%	0.00%	0.06%	0.02%	0.00%	0.01%	0.00%	0.00%	0.04%	0.01%	0.00%
IE	0.08%	0.04%	0.01%	0.94%	0.54%	0.18%	0.04%	0.02%	0.00%	0.49%	0.28%	0.09%
IT	0.07%	0.01%	0.00%	0.85%	0.34%	0.05%	0.03%	0.01%	0.00%	0.43%	0.19%	0.03%
LT	0.01%	0.00%	0.00%	0.10%	0.02%	0.00%	0.00%	0.00%	0.00%	0.03%	0.01%	0.00%
LU	0.39%	0.19%	0.05%	2.53%	1.58%	0.68%	0.14%	0.07%	0.03%	1.30%	0.90%	0.44%
LV	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%
MT	0.04%	0.02%	0.00%	0.39%	0.20%	0.06%	0.02%	0.01%	0.00%	0.22%	0.12%	0.04%
NL	0.08%	0.02%	0.01%	0.64%	0.32%	0.08%	0.02%	0.01%	0.00%	0.28%	0.14%	0.04%
PL	0.00%	0.00%	0.00%	0.14%	0.03%	0.01%	0.00%	0.00%	0.00%	0.12%	0.04%	0.00%
PT	0.04%	0.01%	0.00%	0.59%	0.24%	0.03%	0.02%	0.01%	0.00%	0.46%	0.18%	0.03%
RO	0.00%	0.00%	0.00%	0.05%	0.01%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%
SE	0.04%	0.02%	0.00%	0.17%	0.07%	0.01%	0.02%	0.01%	0.00%	0.06%	0.02%	0.01%
SI	0.01%	0.00%	0.00%	0.33%	0.07%	0.01%	0.00%	0.00%	0.00%	0.12%	0.03%	0.00%
SK	0.01%	0.00%	0.00%	0.14%	0.03%	0.00%	0.00%	0.00%	0.00%	0.10%	0.02%	0.00%

(1) Green: low risk (probability lower than 0.50%); Yellow: medium risk (probability between 0.50% and 1%); Red: high risk (probability higher than 1%).
Source: Commission services.

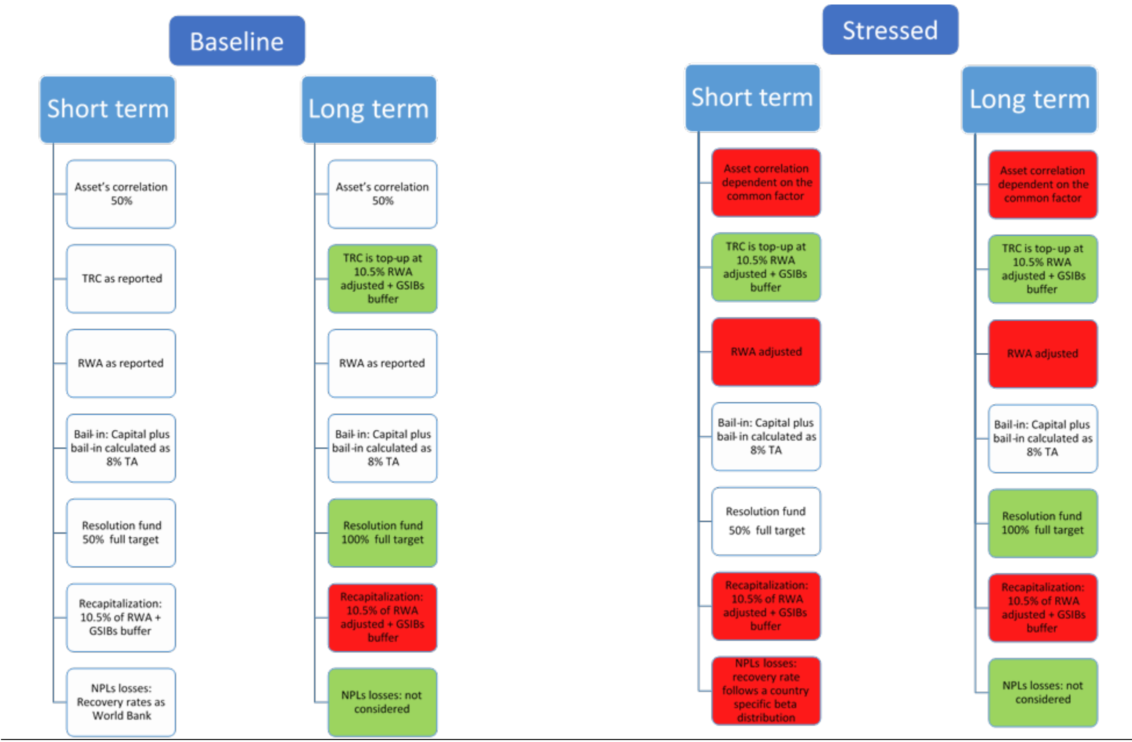
mutualised (i.e. available to all banks irrespective of their location), while the rest of the fund is only available to banks from their country of origin. Since a system-wide waterfall under IGA with sequential intervention of national and mutualised SRF is complex to model and since in the short-term only 10% of the SRF would be in place, the model assumes that the entire SRF is already mutualised.

([299]) In case of excess demand for SRF funds, funds are rationed in proportion to demand (i.e., proportionally to excess losses and recapitalization needs after the minimum bail-in, capped at 5% of TA at bank level).

([300]) Given the aim to portray worst-case fiscal consequences, ex-post contributions to the NRFs/SRF are not modelled, but these can actually go up to 3 times the ex-ante contributions, further reducing the impact on public finances.

([301]) Additional tools are available to absorb residual losses and recapitalisation needs, including additional bail-in liabilities, leftover resolution funds and the deposit guarantee scheme. See Benczur et al. (2015) for a discussion. In addition, by 2024 at the latest a common backstop to the SRF will be introduced.

Graph A6.2: **Schematic representation of the scenarios**



Source: Commission services.

Table A6.5: **Detailed scenarios description**

Scenario: / Components:	Asset correlation	TRC	RWAs	Bail-in	National/ Single RF	Recapitalization	Extra losses due to NPLs	Deposit Guarantee Scheme	Banks in resolution
Initial Baseline (2022) Short term	50%	K	RWA Adjusted	Yes Capital plus bail-in 8% TA	Yes, 5% TA cap, after LAC of 8% has been called in 7/10 of full target No ex-post contributions	10.5% RWA Adjusted + Buffers	- Yes to all banks - NPL including loans under moratoria - RR as reported by World Bank	No	Random significant banks
Initial Stressed (2022) Short term	Depending on common factor	K	RWA Adjusted	Yes Capital plus bail-in 8% TA	Yes, 5% TA cap, after LAC of 8% has been called in 7/10 of full target No ex-post contributions	10.5% RWA Adjusted + Buffers	- Yes to all banks - NPL including loans under moratoria - RR follows a country specific beta distribution depending on the size of the shock	No	Random significant banks
Final Baseline (2032) Long term	50%	K	RWA	Yes Capital plus bail-in 8% TA	Yes, 5% TA cap, after LAC of 8% has been called in No ex-post contributions	10.5% RWA + Buffers	No	No	Random significant banks
Final Stressed (2032) Long term	Depending on common factor	K	RWA	Yes Capital plus bail-in 8% TA	Yes, 5% TA cap, after LAC of 8% has been called in No ex-post contributions	10.5% RWA + Buffers	No	No	Random significant banks

(1) The size of the Single Resolution Fund was on Q2 2020 €42 billion (https://www.srb.europa.eu/en/content/srf-grows-eu42-billion-after-latest-round-transfers) which is around 60% of its target size (i.e. 1% of deposits).
Source: Commission services.

ANNEX A7

Statistical annex: cross-country tables

A7.1. SHORT-TERM FISCAL SUSTAINABILITY CHALLENGES

Table A7.1: **S0 and sub-indexes heat map**

	S0 overall index	Fiscal sub-index	Financial-competitiveness sub-index	Overall SHORT-TERM risk category
BE	0.31	0.57	0.18	LOW
BG	0.32	0.22	0.38	LOW
CZ	0.24	0.22	0.25	LOW
DK	0.18	0.08	0.24	LOW
DE	0.31	0.45	0.24	LOW
EE	0.22	0.22	0.22	LOW
IE	0.36	0.22	0.43	LOW
EL	0.48	0.56	0.45	HIGH
ES	0.34	0.57	0.22	LOW
FR	0.45	0.69	0.33	LOW
HR	0.38	0.33	0.41	LOW
IT	0.28	0.69	0.07	LOW
CY	0.47	0.41	0.51	HIGH
LV	0.26	0.32	0.22	LOW
LT	0.17	0.26	0.13	LOW
LU	0.30	0.08	0.41	LOW
HU	0.34	0.57	0.22	LOW
MT	0.31	0.45	0.22	LOW
NL	0.32	0.37	0.30	LOW
AT	0.18	0.41	0.06	LOW
PL	0.22	0.22	0.22	LOW
PT	0.40	0.53	0.33	LOW
RO	0.31	0.22	0.37	LOW
SI	0.18	0.29	0.13	LOW
SK	0.24	0.28	0.22	LOW
FI	0.26	0.29	0.24	LOW
SE	0.27	0.08	0.37	LOW

The following thresholds are used to identify countries at risk of fiscal stress: 0.46 for the S0; 0.36 for the fiscal sub-index and 0.49 for the financial-competitiveness sub-index. They have been derived using a signalling approach (see Part I, Chapter 1).
Source: European Commission.

Table A7.2: **Fiscal variables used in the S0 indicator, 2021**

	Budget balance (%GDP)	Primary balance (%GDP)	Cyclically-adjusted balance (%GDP)	Stabilising primary balance (%GDP)	Gross debt (%GDP)	Change in gross debt (%GDP)	Short-term debt (%GDP)	Net debt (%GDP)	Gross financing needs (%GDP)	Interest-growth rate differential	Change in general government expenditure (%GDP)	Change in general government final consumption (%GDP)
BE	-7.8	-6.1	-7.0	-6.7	112.7	0.0	9.1	99.6	21.9	-6.5	-2.5	-0.5
BG	-3.6	-3.0	-3.0	-1.2	26.7	2.0	0.0	15.1	4.5	-5.2	0.4	-0.1
CZ	-7.0	-6.2	-5.5	-1.7	42.4	4.7	0.6	31.1	11.2	-4.9	0.1	-0.2
DK	-0.9	-0.2	0.4	-1.4	41.0	-1.1	9.0	15.8	8.6	-3.5	-1.2	0.5
DE	-6.5	-5.9	-4.9	-3.0	71.4	2.7	8.1	54.4	18.3	-4.6	1.4	0.0
EE	-3.1	-3.1	-2.6	-2.0	18.4	-0.6	1.7	5.8	2.5	-11.9	-2.4	-0.5
IE	-3.2	-2.4	-4.9	-6.5	55.6	-2.8	9.0	50.2	6.3	-12.8	-2.4	-0.9
EL	-9.9	-7.3	-7.1	-10.9	202.9	-3.4	12.1	:	22.4	-5.6	-1.9	-0.2
ES	-8.1	-5.9	-4.5	-4.8	120.6	0.6	8.9	104.5	24.7	-4.2	-1.6	-0.2
FR	-8.1	-6.9	-6.6	-6.8	114.6	-0.4	13.9	103.3	23.1	-6.3	-1.6	-0.6
HR	-4.1	-2.4	-3.4	-6.7	82.3	-5.0	5.4	:	13.0	-8.5	-3.3	-0.7
IT	-9.4	-5.9	-7.4	-7.3	154.4	-1.3	22.2	142.2	30.0	-5.0	-0.9	-0.8
CY	-4.9	-3.0	-4.7	-6.5	104.1	-11.3	7.5	63.2	3.8	-6.1	-0.2	0.4
LV	-9.5	-8.9	-8.4	-2.7	48.2	4.9	1.4	39.3	12.8	-6.8	4.5	1.7
LT	-4.1	-3.7	-4.0	-3.6	45.3	-1.3	0.2	42.3	6.3	-8.6	-1.7	0.6
LU	-0.2	0.0	0.6	-1.7	25.9	1.2	0.7	-1.3	3.3	-7.6	-2.6	-0.3
HU	-7.5	-5.1	-6.7	-6.5	79.2	-0.8	6.6	69.6	20.3	-9.2	-3.1	-0.5
MT	-11.1	-10.0	-8.8	-2.3	61.4	8.0	8.4	50.5	18.4	-4.6	1.2	1.1
NL	-5.3	-4.8	-4.4	-2.9	57.5	3.2	8.0	47.1	16.2	-5.6	0.1	0.5
AT	-5.9	-4.7	-4.1	-3.8	82.9	-0.3	7.5	61.9	13.5	-4.9	-2.1	-0.1
PL	-3.3	-2.2	-2.6	-4.0	54.7	-2.8	1.1	43.4	7.3	-7.7	-3.5	-0.3
PT	-4.5	-1.9	-2.6	-4.6	128.1	-7.0	22.5	121.8	15.0	-3.6	-0.3	0.0
RO	-8.0	-6.4	-6.9	-3.1	49.3	1.9	1.7	41.8	10.3	-7.2	-1.0	-0.8
SI	-7.2	-5.8	-7.7	-4.5	77.7	-2.1	2.0	50.2	15.3	-6.2	-0.4	0.1
SK	-7.3	-6.1	-6.3	-1.8	61.8	2.1	2.1	55.5	7.2	-3.1	2.0	0.3
FI	-3.8	-3.3	-2.7	-3.0	71.2	1.7	10.8	36.6	11.6	-4.5	-0.4	0.0
SE	-0.9	-0.8	0.2	-2.2	37.3	-2.3	12.2	9.7	7.0	-5.9	-1.6	-0.3

Note: The upper thresholds used for each variable have been derived using a signalling approach (see Part I, Chapter 1). The lower thresholds have been set at 80% of the original signalling approach thresholds, for prudential reasons.
Source: European Commission.

Table A7.3: **Financial-competitiveness variables used in the S0 indicator, 2021**

	Yield curve	Real GDP growth	GDP per capita in PPP (%US level)	L. Net international investment position (%GDP)	L. Net savings households (%GDP)	L. Private debt (%GDP)	L. Private credit flow (%GDP)	L. Short-term debt non-fin. corp. (%GDP)	L. Short-term debt households (%GDP)	L. Construc-tion (%value added)	L. Current account (%GDP)	L. Change real eff. exch. rate	L. Change nom. unit labour costs
BE	0.7	6.0	83.6	44.4	8.0	194.4	1.1	35.2	1.4	5.5	0.1	1.2	7.5
BG	0.2	3.8	38.6	-26.3	:	94.3	4.2	12.7	1.6	4.9	0.8	3.6	20.4
CZ	0.3	3.0	64.9	-12.5	9.3	81.9	2.4	12.7	1.0	5.7	1.5	1.0	19.2
DK	0.4	4.3	94.4	68.8	2.8	220.9	4.8	34.3	2.6	6.1	8.1	5.6	6.2
DE	0.3	2.7	83.7	61.7	9.7	120.1	6.0	15.5	1.6	5.8	7.4	0.7	11.1
EE	0.7	9.0	62.1	-21.5	6.7	104.4	3.6	6.4	1.0	6.7	1.0	1.3	17.1
IE	0.8	14.6	162.5	-174.0	2.4	188.9	-1.8	20.5	0.5	2.2	-5.8	0.3	-6.3
EL	1.5	7.1	45.7	-175.0	-3.2	125.3	5.4	10.7	4.9	1.9	-3.7	-5.3	6.4
ES	1.0	4.6	59.8	-85.5	6.8	146.4	4.4	7.4	2.8	6.2	1.6	0.5	11.0
FR	0.8	6.5	74.0	-30.2	5.5	173.7	13.0	28.2	1.8	5.2	-1.0	0.4	4.6
HR	0.3	8.1	47.5	-47.8	4.8	98.0	1.3	4.8	3.0	6.1	1.6	-0.3	13.7
IT	1.5	6.2	66.9	2.4	6.5	118.9	4.1	12.7	2.5	4.4	3.2	1.6	5.5
CY	0.9	5.4	62.3	-136.7	1.2	260.5	-2.6	14.9	4.9	6.1	-6.6	1.0	5.8
LV	0.7	4.7	50.9	-34.7	5.6	66.5	-1.8	5.7	1.0	7.0	0.7	2.7	18.4
LT	0.7	5.0	61.9	-15.8	5.8	54.7	0.3	3.7	0.6	7.3	3.7	-0.9	18.3
LU	0.4	5.8	184.9	39.9	6.8	316.8	44.1	59.9	2.1	5.9	4.5	4.9	11.1
HU	1.7	7.4	53.7	-48.1	5.9	76.4	7.7	12.2	2.2	5.5	-0.7	-5.2	13.2
MT	1.2	5.0	67.9	60.3	:	139.1	9.0	11.7	2.9	4.6	3.0	4.0	19.7
NL	0.4	4.0	92.2	113.9	9.1	233.7	-1.3	35.7	1.9	5.4	9.1	-0.7	14.0
AT	0.6	4.4	86.8	9.3	8.5	131.2	4.7	9.6	2.1	7.0	1.6	0.0	12.2
PL	2.0	4.9	53.6	-44.5	4.2	75.9	1.5	6.6	1.9	7.2	0.7	2.7	12.3
PT	0.9	4.5	53.5	-106.4	2.3	163.7	4.4	13.5	2.4	4.8	0.0	-0.3	16.2
RO	2.7	7.0	51.7	-48.3	:	48.5	1.3	8.3	0.7	7.3	-4.9	2.2	26.1
SI	0.7	6.4	63.9	-15.2	9.7	69.7	-0.9	7.3	1.8	6.0	6.4	0.1	14.9
SK	0.7	3.8	49.8	-65.7	3.2	95.3	3.7	11.9	1.4	6.5	-1.8	-1.4	16.4
FI	0.6	3.4	78.8	-5.3	2.6	155.2	6.5	13.9	3.8	7.5	-0.4	-0.3	6.1
SE	0.5	3.9	85.4	16.4	9.1	215.7	11.6	37.6	16.0	6.7	4.6	-3.2	9.4

Notes: (1) Variable names preceded by 'L.' are in lagged value. (2) The upper thresholds used for each variable have been derived using a signalling approach (see Part I, Chapter 1). (3) The lower thresholds have been set at 80% of the original signalling approach thresholds, for prudential reasons.
Source: European Commission.

Additional indicators

Table A7.4: **Risks related to the structure of public debt financing, by country (2020)**

	Short-term public debt (original maturity)	Public debt in foreign currency	Public debt held by non-residents
	Shares of total debt (%):		
BE	8.0	0.0	55.9
BG	0.1	82.5	48.8
CZ	1.7	8.6	32.7
DK	21.6	8.4	33.0
DE	11.8	4.3	45.4
EE	9.3	0.0	70.0
IE	10.1	0.0	55.5
EL	5.8	1.2	82.6
ES	7.5	0.0	43.9
FR	12.8	4.3	48.6
HR	6.0	71.0	32.1
IT	14.2	0.1	29.8
CY	6.6	0.0	81.9
LV	3.0	0.0	66.8
LT	0.0	0.0	69.5
LU	2.6	0.0	50.0
HU	8.2	22.0	33.2
MT	10.2	0.0	18.2
NL	14.7	0.0	37.8
AT	8.9	0.4	63.7
PL	1.8	23.4	34.5
PT	16.7	0.0	49.0
RO	3.5	52.3	50.9
SI	2.5	0.1	58.9
SK	3.5	0.0	53.6
FI	15.6	2.7	60.8
SE	29.9	17.9	20.0

(1) The upper thresholds used for each variable have been derived using a signalling approach; the lower thresholds have been set at 80% of the original signalling approach thresholds, for prudential reasons (see Annex A2).
(2) Foreign-held debt figures are shown against a double shading that blends the colour coding of volatility risks from non-resident tenure (left side of the shaded cells) with that of sovereign risk given by the average spread on 10-year government bonds vs. Germany (right side of the shaded cells).
Source: Eurostat, ECB.

Table A7.5: **Potential triggers for governments' contingent liabilities from the banking sector, by country**

	Private sector credit flow (% GDP)	House price nominal index change (%)	Bank loan-to-deposit ratio (%)	NPL ratio (% of total gross loans)	NPL ratio change (pps)	NPL coverage ratio (%)
BE	1.1	4.2	97.5	1.7	-0.3	40.5
BG	4.2	4.6	66.9	**6.4**	-1.2	51.2
CZ	2.4	8.5	74.7	1.4	0.1	53.8
DK	4.8	5.1	**288.9**	2.0	0.2	**27.2**
DE	6.0	7.8	119.3	1.1	-0.1	35.4
EE	3.6	6.0	101.8	1.1	-0.4	**27.2**
IE	-1.8	0.3	77.7	**3.4**	-0.7	**28.3**
EL	5.4	4.4	67.1	**14.8**	-15.5	46.6
ES	4.4	2.2	103.2	**3.1**	0.1	40.8
FR	**13.0**	5.2	105.0	2.1	-0.3	49.4
HR	1.3	7.7	65.5	**3.9**	-0.4	62.0
IT	4.1	1.9	94.0	**3.7**	-2.3	53.5
CY	-2.6	-0.2	54.8	**9.1**	-6.4	44.4
LV	-1.8	3.5	68.0	1.7	-0.1	**30.9**
LT	0.3	7.3	63.1	0.9	-0.4	**26.8**
LU	**44.1**	**14.5**	**156.2**	1.5	**0.4**	36.7
HU	7.7	5.0	77.8	**3.6**	-0.8	63.8
MT	9.0	3.4	54.0	**3.2**	-0.3	**30.0**
NL	-1.3	7.6	112.6	1.7	-0.3	**26.4**
AT	4.7	7.7	94.9	1.9	-0.1	50.9
PL	1.5	10.5	83.7	**5.2**	**0.3**	59.8
PT	4.4	8.4	77.1	**4.2**	-1.5	58.4
RO	1.3	4.7	58.0	**3.8**	-0.4	66.9
SI	-0.9	4.6	60.8	**2.6**	-0.6	54.5
SK	3.7	9.6	105.2	1.8	-0.6	62.9
FI	6.5	1.8	**165.3**	1.4	-0.2	**30.7**
SE	11.6	4.2	**172.5**	0.4	-0.1	42.3

The upper thresholds used for each variable were derived using a signalling approach, except for the NPL coverage ratio; the lower thresholds have been set at 80% of the upper thresholds, for prudential reasons (see Annex A2 and Chapter 1).
Source: Eurostat (2020), EBA (June 2021).

Table A7.6: **Financial market information**

	Sovereign yield spreads (bp.) - 10 year - Oct 2021
BE	37
BG	46
CZ	255
DK	31
DE	0
EE	39
IE	43
EL	117
ES	68
FR	41
HR	53
IT	116
CY	60
LV	38
LT	37
LU	1
HU	390
MT	88
NL	3
AT	29
PL	284
PT	60
RO	496
SI	38
SK	34
FI	29
SE	59

(1) The upper thresholds used for each variable were derived using a signalling approach; the lower thresholds have been set at 80% of the original signalling approach thresholds, for prudential reasons (see Annex A2).
Source: ECB.

A7.2. MEDIUM-TERM FISCAL SUSTAINABILITY CHALLENGES

Table A7.7: DSA heat map, by country

	Debt sustainability analysis: Sovereign-debt sustainability risks in EU countries																										
	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE
Baseline ('no-policy change' scenario)	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	133.6	36.4	67.1	15.6	61.6	25.7	45.7	154.7	126.1	122.3	76.7	161.6	77.8	48.8	39.4	18.2	68.1	73.2	62.8	76.3	48.3	126.2	76.9	95.2	72.2	63.9	11.2
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2021	2032	2021	2022	2023	2021	2021	2032	2032	2021	2021	2021	2032	2032	2032	2021	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	98%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	81%	97%	48%	94%	60%
Stochastic projections	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	HIGH	HIGH	LOW	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	MEDIUM	LOW	LOW	LOW	LOW
Probability of debt in 2026 greater than in 2021 (%)	66%	54%	79%	7%	27%	98%	22.2%	18%	57%	59%	21%	41%	16%	52%	38%	31%	31%	76%	44%	26%	14%	36%	71%	60%	41%	35.0%	0%
Difference of the 10th and 90th percentile in 2026 (p.p. of GDP)	37.4	50.7	28.8	19.9	26.9	9.0	31.4	64.7	40.3	21.7	28.9	42.7	43.7	34.6	30.4	28.2	43.9	27.6	28.3	32.3	17.5	58.7	42.3	27.8	31.7	24.5	9.1
Historical SPB scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	LOW	LOW
Debt level (2032)	109.7	23.7	52.1	16.4	49.5	17.0	52.8	143.0	116.7	114.3	75.7	137.2	67.8	48.1	45.3	11.1	60.7	51.5	54.7	68.9	51.2	121.0	66.4	77.4	69.5	54.5	11.6
Debt trajectory (debt peak year)	2026	2024	2032	2021	2021	2024	2021	2021	2027	2027	2021	2021	2021	2022	2023	2021	2021	2025	2021	2021	2021	2021	2032	2027	2032	2021	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	86%	79%	33%	65%	38%	66%	77%	22%	73%	85%	48%	48%	29%	69%	53%	73%	59%	52%	83%	73%	75%	52%	75%	72%	45%	68%	60%
Adverse 'r-g' differential scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	143.0	38.6	71.6	17.5	66.8	27.2	48.8	165.6	136.1	131.4	82.6	174.8	83.6	52.5	42.4	19.5	73.7	78.4	67.5	81.8	51.7	136.3	82.0	101.6	76.4	68.2	12.4
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2032	2032	2021	2032	2023	2021	2021	2032	2032	2021	2021	2032	2032	2032	2032	2023	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	86%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	100%	97%	48%	94%	60%
Financial stress scenario	HIGH	LOW	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	LOW	LOW	LOW	LOW	MEDIUM	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW
Debt level (2032)	135.6	36.7	67.6	15.9	62.2	25.8	45.9	159.0	128.9	124.5	77.2	167.9	78.1	49.3	39.7	18.3	68.7	73.9	63.4	76.8	48.6	128.5	77.4	95.8	72.6	64.3	11.3
Debt trajectory (debt peak year)	2032	2032	2032	2021	2021	2032	2021	2021	2032	2032	2021	2032	2021	2022	2023	2021	2021	2032	2032	2021	2021	2032	2032	2032	2032	2022	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	98%	94%	81%	64%	71%	89%	65%	38%	92%	96%	48%	75%	42%	72%	35%	83%	67%	81%	92%	94%	69%	56%	100%	97%	48%	94%	60%
Lower SPB scenario	HIGH	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	MEDIUM	HIGH	HIGH	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM	LOW	LOW
Debt level (2032)	141.3	39.1	76.6	34.2	79.6	33.7	59.8	184.0	126.7	134.1	78.5	173.2	90.3	77.4	52.9	18.4	82.0	94.5	75.2	86.6	50.0	127.8	83.1	103.7	84.5	70.2	16.2
Debt trajectory (debt peak year)	2032	2032	2032	2023	2032	2032	2032	2021	2032	2032	2021	2032	2021	2032	2032	2021	2032	2032	2032	2032	2021	2021	2032	2032	2032	2023	2021
Fiscal consolidation space (percentile rank avg SPB 2023-32)	100%	95%	91%	96%	96%	98%	80%	51%	92%	100%	50%	95%	75%	100%	64%	83%	74%	99%	100%	98%	70%	58%	100%	100%	65%	97%	70%
Debt sustainability analysis - overall risk assessment	HIGH	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	MEDIUM	LOW	LOW	LOW	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH	MEDIUM	HIGH	HIGH	LOW	LOW

(1) All the thresholds and decision trees used to derive the DSA risk assessment are presented in Annex A1.

Source: European Commission.

Table A7.8: **Gross government debt projections (% of GDP) and underlying macro-fiscal assumptions, European Union - Baseline**

	2021	2022	2023	2024	2025	2026	2029	2032
Gross debt ratio	**92.1**	**90.0**	**89.1**	**88.7**	**87.9**	**87.5**	**87.9**	**89.2**
of which Oustanding (non maturing) debt	*70.6*	*71.2*	*71.1*	*71.1*	*70.5*	*70.1*	*69.8*	*70.3*
Rolled-over short-term debt	*7.8*	*7.8*	*7.7*	*7.6*	*7.5*	*7.4*	*7.4*	*7.5*
Rolled-over long-term debt	*7.3*	*7.5*	*7.6*	*7.6*	*7.6*	*7.6*	*7.7*	*7.9*
New short-term debt	*0.6*	*0.3*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*
New long-term debt	*5.8*	*3.2*	*2.5*	*2.2*	*2.1*	*2.2*	*2.7*	*3.1*
Changes in the debt ratio (-1+2+3)	**0.3**	**-2.1**	**-1.0**	**-0.4**	**-0.8**	**-0.4**	**0.2**	**0.6**
of which (1) Overall primary balance (1.1+1.2+1.3)	**-5.3**	**-2.4**	**-1.1**	**-1.2**	**-1.2**	**-1.3**	**-1.8**	**-2.1**
(1.1) Structural primary balance (1.1.1-1.1.2+1.1.3)	***-4.0***	***-2.4***	***-1.4***	***-1.4***	***-1.5***	***-1.5***	***-1.8***	***-2.1***
(1.1.1) Structural primary balance (before CoA)	*-4.0*	*-2.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*
(1.1.2) Cost of ageing (incl. revenues pensions tax)				*0.0*	*0.0*	*0.1*	*0.4*	*0.7*
(1.1.3) Property incomes				*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
(1.2) Cyclical component	***-1.4***	***-0.1***	***0.3***	***0.2***	***0.3***	***0.2***	***0.0***	***0.0***
(1.3) One-off and other temporary measures	***-0.1***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
(2) Snowball effect (interest rate/growth differential) (2.1+2.2+2.3)	**-4.7**	**-4.4**	**-2.6**	**-1.7**	**-2.0**	**-1.8**	**-1.8**	**-1.7**
(2.1) Interest expenditure	*1.2*	*1.1*	*1.1*	*1.0*	*0.9*	*0.9*	*0.9*	*1.0*
(2.2) Growth effect (real)	*-4.3*	*-3.7*	*-2.2*	*-1.2*	*-1.5*	*-1.2*	*-1.0*	*-1.0*
(2.3) Inflation effect	*-1.6*	*-1.8*	*-1.4*	*-1.5*	*-1.5*	*-1.6*	*-1.7*	*-1.8*
(3) Stock flow adjustments	***-0.2***	***-0.1***	***0.5***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
PM : Structural balance	***-5.3***	***-3.5***	***-2.6***	***-2.5***	***-2.5***	***-2.6***	***-2.9***	***-3.3***
Key macroeconomic assumptions								
Actual GDP growth (real)	5.0	4.3	2.5	1.4	1.7	1.4	1.2	1.1
Potential GDP growth (real)	1.5	1.8	1.9	1.5	1.5	1.5	1.2	1.1
Inflation (GDP deflator)	1.9	2.1	1.7	1.7	1.8	1.8	2.0	2.1
Implicit interest rate (nominal)	1.4	1.3	1.2	1.2	1.1	1.1	1.1	1.2

(1) Given that the drivers of the change in the government debt ratio for the EU as a whole are calculated as GDP-weighted averages of country-specific debt projections, small differences may exist between the total change in the government debt ratio and the sum of its drivers.
Source: European Commission.

Table A7.9: **Gross government debt projections (% of GDP) and underlying macro-fiscal assumptions, euro area - Baseline**

	2021	2022	2023	2024	2025	2026	2029	2032
Gross debt ratio	**100.0**	**97.9**	**97.0**	**97.0**	**96.5**	**96.3**	**97.0**	**99.0**
of which Oustanding (non maturing) debt	*76.3*	*77.2*	*77.1*	*77.4*	*76.9*	*76.6*	*76.6*	*77.7*
Rolled-over short-term debt	*8.5*	*8.6*	*8.6*	*8.7*	*8.6*	*8.6*	*8.7*	*8.9*
Rolled-over long-term debt	*8.1*	*8.3*	*8.4*	*8.4*	*8.5*	*8.5*	*8.6*	*8.9*
New short-term debt	*0.6*	*0.4*	*0.3*	*0.2*	*0.2*	*0.2*	*0.3*	*0.4*
New long-term debt	*6.3*	*3.5*	*2.6*	*2.2*	*2.2*	*2.3*	*2.8*	*3.2*
Changes in the debt ratio (-1+2+3)	**0.6**	**-2.1**	**-0.9**	**0.0**	**-0.5**	**-0.2**	**0.3**	**0.7**
of which (1) Overall primary balance (1.1+1.2+1.3)	**-5.7**	**-2.7**	**-1.2**	**-1.4**	**-1.4**	**-1.5**	**-2.0**	**-2.4**
(1.1) Structural primary balance (1.1.1-1.1.2+1.1.3)	***-4.3***	***-2.6***	***-1.6***	***-1.6***	***-1.6***	***-1.7***	***-2.0***	***-2.4***
(1.1.1) Structural primary balance (before CoA)	*-4.3*	*-2.6*	*-1.6*	*-1.6*	*-1.6*	*-1.6*	*-1.6*	*-1.6*
(1.1.2) Cost of ageing (incl. revenues pensions tax)				*0.0*	*0.1*	*0.1*	*0.5*	*0.8*
(1.1.3) Property incomes				*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
(1.2) Cyclical component	***-1.5***	***0.0***	***0.4***	***0.2***	***0.3***	***0.2***	***0.0***	***0.0***
(1.3) One-off and other temporary measures	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
(2) Snowball effect (interest rate/growth differential) (2.1+2.2+2.3)	**-5.0**	**-4.7**	**-2.6**	**-1.5**	**-2.0**	**-1.9**	**-1.9**	**-1.9**
(2.1) Interest expenditure	*1.2*	*1.1*	*1.0*	*1.0*	*0.9*	*0.8*	*0.8*	*0.9*
(2.2) Growth effect (real)	*-4.7*	*-4.1*	*-2.3*	*-1.0*	*-1.4*	*-1.1*	*-1.0*	*-0.9*
(2.3) Inflation effect	*-1.5*	*-1.8*	*-1.4*	*-1.5*	*-1.5*	*-1.6*	*-1.8*	*-1.9*
(3) Stock flow adjustments	***-0.1***	***0.0***	***0.6***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
PM : Structural balance	***-5.7***	***-3.9***	***-2.8***	***-2.7***	***-2.7***	***-2.7***	***-3.1***	***-3.6***
Key macroeconomic assumptions								
Actual GDP growth (real)	5.1	4.3	2.4	1.1	1.5	1.2	1.0	0.9
Potential GDP growth (real)	1.3	1.6	1.7	1.4	1.3	1.3	1.0	0.9
Inflation (GDP deflator)	1.7	1.9	1.5	1.6	1.6	1.7	1.9	2.0
Implicit interest rate (nominal)	1.3	1.2	1.1	1.0	0.9	0.9	0.9	1.0

(1) Given that the drivers of the change in the government debt ratio for the euro area as a whole are calculated as GDP-weighted averages of country-specific debt projections, small differences may exist between the total change in the government debt ratio and the sum of its drivers.
Source: European Commission.

Table A7.10: **Gross government debt projections and underlying structural fiscal effort (% of GDP) under the baseline, by country**

	Baseline				
	Debt			SPB	
	2023	2032	Peak year	Avg. 2023-32	Perc. rank
BE	114.6	133.6	2032	-3.6	98.3%
BG	26.8	36.4	2032	-1.9	93.8%
CZ	46.3	67.1	2032	-3.1	81.0%
DK	38.0	15.6	2021	2.5	63.9%
DE	68.1	61.6	2021	-0.4	70.8%
EE	21.4	25.7	2032	-1.8	89.3%
IE	51.1	45.7	2021	-0.5	65.3%
EL	192.1	154.7	2021	0.5	37.6%
ES	116.9	126.1	2032	-2.5	92.0%
FR	112.9	122.3	2032	-2.9	95.7%
HR	77.9	76.7	2021	-1.4	48.4%
IT	151.0	161.6	2032	-2.1	75.0%
CY	93.4	77.8	2021	-0.2	42.3%
LV	49.8	48.8	2022	-1.6	71.6%
LT	46.0	39.4	2023	-0.4	34.7%
LU	25.4	18.2	2021	0.8	83.1%
HU	76.4	68.1	2021	-1.3	67.1%
MT	63.6	73.2	2032	-3.3	80.7%
NL	56.1	62.8	2032	-1.2	92.1%
AT	77.6	76.3	2021	-0.8	94.4%
PL	49.5	48.3	2021	-1.4	69.0%
PT	122.7	126.2	2021	-0.8	56.0%
RO	53.2	76.9	2032	-4.2	80.5%
SI	76.0	95.2	2032	-4.3	97.3%
SK	59.1	72.2	2032	-2.5	47.5%
FI	71.0	63.9	2021	-0.7	94.2%
SE	31.2	11.2	2021	1.5	59.7%
EU	89.1	89.2	2021	-1.4	92.3%
EA	97.0	99.0	2021	-1.6	94.0%

Source: European Commission.

Table A7.11: **Gross government debt projections and underlying structural fiscal effort (% of GDP) under the 'historical SPB' scenario, by country**

	Historical SPB scenario						
	Debt			SPB			
	2023	2032	Peak year	Avg. 2023-32	Perc. rank	Diff. with baseline	Avg. 2006-20
BE	114.6	109.7	2026	-0.7	86.0%	2.9	0.3
BG	26.8	23.7	2024	-0.4	78.5%	1.5	0.1
CZ	46.3	52.1	2032	-1.4	33.0%	1.7	-0.8
DK	38.0	16.4	2021	2.4	65.1%	-0.1	2.3
DE	68.1	49.5	2021	1.1	38.2%	1.5	1.6
EE	21.4	17.0	2024	-0.7	65.8%	1.1	-0.3
IE	51.1	52.8	2021	-1.4	76.6%	-0.9	-1.7
EL	192.1	143.0	2021	1.7	22.3%	1.3	2.1
ES	116.9	116.7	2027	-1.4	72.6%	1.1	-1.0
FR	112.9	114.3	2027	-1.9	85.1%	1.0	-1.5
HR	77.9	75.7	2021	-1.2	47.5%	0.1	-1.2
IT	151.0	137.2	2021	0.7	47.5%	2.9	1.7
CY	93.4	67.8	2021	1.0	28.8%	1.2	1.4
LV	49.8	48.1	2022	-1.5	69.1%	0.1	-1.4
LT	46.0	45.3	2023	-1.1	53.1%	-0.7	-1.3
LU	25.4	11.1	2021	1.7	72.8%	0.9	2.0
HU	76.4	60.7	2021	-0.4	59.1%	0.9	-0.1
MT	63.6	51.5	2025	-0.6	51.6%	2.7	0.3
NL	56.1	54.7	2021	-0.2	83.3%	1.0	0.2
AT	77.6	68.9	2021	0.2	72.6%	0.9	0.5
PL	49.5	51.2	2021	-1.8	75.3%	-0.4	-1.9
PT	122.7	121.0	2021	-0.2	51.5%	0.6	0.0
RO	53.2	66.4	2032	-3.1	75.4%	1.2	-2.7
SI	76.0	77.4	2027	-2.1	72.3%	2.2	-1.3
SK	59.1	69.5	2032	-2.2	45.3%	0.3	-2.1
FI	71.0	54.5	2021	0.4	67.9%	1.2	0.8
SE	31.2	11.6	2021	1.5	60.0%	0.0	1.4
EU	89.1	79.2	2021	-0.2	70.7%	1.2	0.2
EA	97.0	87.4	2021	-0.2	75.1%	1.4	0.3

Source: European Commission.

Table A7.12: **Gross government debt projections and underlying structural fiscal effort (% of GDP) under the 'lower SPB' scenario, by country**

	Lower SPB scenario					
	Debt			SPB		
	2023	2032	Peak year	Avg. 2023-32	Perc. rank	Diff. with baseline in 2024
BE	115.8	141.3	2032	-4.4	100.0%	-0.8
BG	27.1	39.1	2032	-2.2	95.3%	-0.3
CZ	48.0	76.6	2032	-4.0	90.9%	-0.9
DK	42.0	34.2	2023	0.6	96.3%	-1.9
DE	69.6	79.6	2032	-2.4	96.3%	-2.1
EE	22.6	33.7	2032	-2.7	98.1%	-0.9
IE	52.1	59.8	2032	-2.2	79.5%	-1.7
EL	197.8	184.0	2021	-2.4	50.9%	-2.9
ES	117.4	126.7	2032	-2.5	92.0%	0.0
FR	113.3	134.1	2032	-4.2	99.7%	-1.3
HR	77.8	78.5	2021	-1.6	49.9%	-0.2
IT	151.4	173.2	2032	-3.3	95.2%	-1.2
CY	95.3	90.3	2021	-1.6	75.3%	-1.4
LV	53.8	77.4	2032	-4.7	99.8%	-3.2
LT	46.8	52.9	2032	-2.0	63.7%	-1.6
LU	25.3	18.4	2021	0.8	83.2%	0.0
HU	76.9	82.0	2032	-2.9	74.0%	-1.6
MT	66.9	94.5	2032	-5.6	98.9%	-2.4
NL	57.3	75.2	2032	-2.5	100.0%	-1.4
AT	78.6	86.6	2032	-1.9	97.5%	-1.2
PL	50.1	50.0	2021	-1.6	69.9%	-0.2
PT	122.5	127.8	2021	-1.0	57.5%	-0.2
RO	54.0	83.1	2032	-4.8	85.9%	-0.6
SI	77.0	103.7	2032	-5.3	100.0%	-1.0
SK	60.9	84.5	2032	-3.9	64.5%	-1.4
FI	71.2	70.2	2023	-1.5	96.7%	-0.8
SE	31.5	16.2	2021	0.9	70.3%	-0.6
EU	90.0	100.6	2032	-2.7	99.5%	-1.3
EA	97.9	111.3	2032	-3.0	99.8%	-1.4

Source: European Commission.

Table A7.13: **Gross government debt projections and underlying structural fiscal effort (% of GDP) under the 'adverse r-g' scenario, by country**

	Adverse 'r-g' scenario						
	Debt			SPB		r-g in 2032	
	2023	2032	Peak year	Avg. 2023-32	Perc. rank	Baseline	r-g scenario
BE	116.0	143.0	2032	-3.6	98.3%	-1.7%	-0.8%
BG	27.1	38.6	2032	-1.9	93.8%	-1.6%	-0.8%
CZ	46.8	71.6	2032	-3.1	81.0%	-1.2%	-0.3%
DK	38.4	17.5	2021	2.5	63.9%	-2.2%	-1.5%
DE	69.0	66.8	2021	-0.4	70.8%	-2.5%	-1.6%
EE	21.6	27.2	2032	-1.8	89.3%	-3.9%	-3.1%
IE	51.7	48.8	2021	-0.5	65.3%	-2.9%	-2.1%
EL	194.0	165.6	2021	0.5	37.6%	-1.9%	-1.2%
ES	118.2	136.1	2032	-2.5	92.0%	-1.3%	-0.5%
FR	114.2	131.4	2032	-2.9	95.7%	-2.0%	-1.1%
HR	78.8	82.6	2032	-1.4	48.4%	-1.6%	-0.7%
IT	152.9	174.8	2032	-2.1	75.0%	-0.7%	0.2%
CY	94.4	83.6	2021	-0.2	42.3%	-2.6%	-1.8%
LV	50.4	52.5	2032	-1.6	71.6%	-2.8%	-1.9%
LT	46.5	42.4	2023	-0.4	34.7%	-2.8%	-1.9%
LU	25.7	19.5	2021	0.8	83.1%	-3.1%	-2.3%
HU	77.3	73.7	2021	-1.3	67.1%	-1.5%	-0.6%
MT	64.4	78.4	2032	-3.3	80.7%	-3.2%	-2.3%
NL	56.8	67.5	2032	-1.2	92.1%	-2.1%	-1.2%
AT	78.5	81.8	2021	-0.8	94.4%	-2.2%	-1.3%
PL	50.1	51.7	2021	-1.4	69.0%	-2.6%	-1.7%
PT	124.2	136.3	2032	-0.8	56.0%	-1.0%	-0.2%
RO	53.7	82.0	2032	-4.2	80.5%	-0.5%	0.5%
SI	76.9	101.6	2032	-4.3	97.3%	-3.1%	-2.2%
SK	59.7	76.4	2032	-2.5	47.5%	-2.7%	-1.9%
FI	71.8	68.2	2023	-0.7	94.2%	-2.8%	-2.1%
SE	31.5	12.4	2021	1.5	59.7%	-2.9%	-2.4%
EU	90.1	96.2	2032	-1.4	92.3%	-2.0%	-1.1%
EA	98.2	106.7	2032	-1.6	94.0%	-2.0%	-1.1%

Source: European Commission.

Table A7.14: **Gross government debt projections and underlying structural fiscal effort (% of GDP) under the 'financial stress' scenario, by country**

	Financial stress scenario					
	Debt			SPB		LT interest rate: Diff. with baseline in 2022
	2023	2032	Peak year	Avg. 2023-32	Perc. rank	
BE	115.4	135.6	2032	-3.6	98.3%	2.4%
BG	26.9	36.7	2032	-1.9	93.8%	1.0%
CZ	46.5	67.6	2032	-3.1	81.0%	1.0%
DK	38.1	15.9	2021	2.5	63.9%	1.0%
DE	68.4	62.2	2021	-0.4	70.8%	1.0%
EE	21.5	25.8	2032	-1.8	89.3%	1.0%
IE	51.2	45.9	2021	-0.5	65.3%	1.0%
EL	193.1	159.0	2021	0.5	37.6%	6.1%
ES	117.9	128.9	2032	-2.5	92.0%	2.8%
FR	113.7	124.5	2032	-2.9	95.7%	2.5%
HR	78.1	77.2	2021	-1.4	48.4%	1.0%
IT	153.7	167.9	2032	-2.1	75.0%	4.9%
CY	93.5	78.1	2021	-0.2	42.3%	1.8%
LV	50.0	49.3	2022	-1.6	71.6%	1.0%
LT	46.1	39.7	2023	-0.4	34.7%	1.0%
LU	25.5	18.3	2021	0.8	83.1%	1.0%
HU	76.7	68.7	2021	-1.3	67.1%	1.0%
MT	63.9	73.9	2032	-3.3	80.7%	1.0%
NL	56.3	63.4	2032	-1.2	92.1%	1.0%
AT	77.9	76.8	2021	-0.8	94.4%	1.0%
PL	49.6	48.6	2021	-1.4	69.0%	1.0%
PT	123.9	128.5	2032	-0.8	56.0%	3.3%
RO	53.3	77.4	2032	-4.2	80.5%	1.0%
SI	76.3	95.8	2032	-4.3	97.3%	1.0%
SK	59.2	72.6	2032	-2.5	47.5%	1.0%
FI	71.1	64.3	2022	-0.7	94.2%	1.0%
SE	31.2	11.3	2021	1.5	59.7%	1.0%
EU	89.9	91.1	2021	-1.4	92.3%	2.0%
EA	97.9	101.1	2032	-1.6	94.0%	2.2%

Source: European Commission.

Table A7.15: **Gross government debt projections and underlying structural fiscal effort (% of GDP) under the 'updated SCP' scenario, by country**

Updated stability and convergence programme (SCP) scenario						
	Debt			SPB		
	2023	2032	Peak year	Avg. 2023-32	Perc. rank	Diff. with baseline in 2024
BE	114.7	129.9	2032	-3.5	97.9%	0.5
BG	27.1	27.4	2032	-1.4	89.0%	1.2
CZ	46.1	60.7	2032	-2.8	72.8%	0.7
DK	37.5	2.0	2021	3.5	38.0%	1.7
DE	68.1	52.3	2021	-0.3	69.6%	1.2
EE	21.4	20.0	2024	-1.7	88.5%	0.8
IE	51.4	53.9	2021	-1.9	78.4%	-1.1
EL	192.3	154.9	2021	-0.5	43.2%	0.0
ES	117.0	118.2	2021	-1.8	78.0%	1.0
FR	112.6	126.9	2032	-3.7	98.1%	-0.5
HR	78.0	85.1	2032	-2.3	58.1%	-1.0
IT	150.9	159.9	2032	-2.3	75.5%	0.2
CY	93.4	67.6	2021	0.1	35.6%	1.3
LV	50.0	48.6	2022	-2.5	80.0%	0.1
LT	46.1	29.5	2023	-0.7	42.3%	1.4
LU	25.3	14.7	2021	0.9	82.9%	0.4
HU	76.4	64.8	2021	-1.8	69.4%	0.5
MT	63.6	71.0	2032	-3.9	84.0%	0.3
NL	56.2	68.8	2032	-2.1	98.3%	-0.7
AT	77.6	70.3	2021	-0.9	95.3%	0.8
PL	49.6	54.9	2032	-2.3	80.0%	-0.8
PT	122.8	122.7	2021	-0.3	52.0%	0.4
RO	52.7	58.6	2032	-3.2	75.8%	2.1
SI	76.0	81.4	2032	-3.4	89.6%	1.8
SK	59.0	60.5	2021	-1.9	42.9%	1.5
FI	71.0	65.0	2021	-1.3	95.9%	-0.1
SE	31.7	28.3	2021	-0.3	95.7%	-2.1
EU	89.1	87.0	2021	-1.7	93.9%	0.3
EA	97.0	96.2	2021	-1.8	95.1%	0.4

Source: European Commission.

Table A7.16: **S1 indicator, baseline and alternative scenarios, by country (pps. of GDP)**

	Baseline	Non-demographic risk scenario	Lower productivity scenario	Historical SPB scenario	Adverse 'r-g' scenario
BE	8.4	8.7	8.5	4.1	9.4
BG	-1.4	-1.0	-1.4	-3.0	-1.0
CZ	2.5	3.0	2.6	1.2	3.0
DK	-5.3	-4.7	-5.2	-5.3	-4.8
DE	0.3	0.7	0.4	-2.0	1.0
EE	-3.1	-2.3	-3.0	-4.4	-2.7
IE	-0.6	-0.3	-0.6	2.0	-0.1
EL	6.8	7.1	6.8	2.2	8.0
ES	6.2	6.7	6.3	4.3	7.3
FR	6.3	6.8	6.3	4.4	7.3
HR	1.6	2.0	1.6	1.2	2.3
IT	10.3	10.6	10.4	5.6	11.7
CY	1.0	1.3	1.1	-1.5	1.8
LV	-0.9	-0.2	-0.8	-0.9	-0.3
LT	-1.4	-0.7	-1.3	0.4	-0.9
LU	-3.6	-3.3	-3.5	-4.0	-3.2
HU	1.3	2.0	1.5	0.7	2.0
MT	1.8	2.6	2.0	-1.9	2.5
NL	1.4	1.7	1.3	0.6	2.0
AT	2.0	2.4	2.0	0.7	2.7
PL	-0.6	0.4	-0.3	0.6	-0.1
PT	6.7	7.3	6.7	5.6	7.8
RO	3.9	4.6	4.3	3.9	4.5
SI	6.0	7.0	6.1	4.7	6.8
SK	3.2	3.8	3.4	4.4	3.7
FI	0.0	0.5	0.2	-2.2	0.6
SE	-5.7	-4.9	-5.6	-5.8	-5.3

(1) The upper and lower thresholds used for S1 are 0 and 2.5.
Source: European Commission.

A7.3. LONG-TERM FISCAL SUSTAINABILITY CHALLENGES

Table A7.17: **S2, baseline and alternative scenarios, by country (pps. of GDP)**

	Baseline	Non-demographic risk scenario	Lower productivity scenario	Historical SPB scenario	Adverse 'r-g' scenario
BE	7.8	9.6	8.6	3.9	8.0
BG	3.4	5.1	4.2	1.5	3.4
CZ	7.7	9.3	7.8	5.5	7.5
DK	-0.5	1.2	-0.9	-0.4	-0.5
DE	2.6	4.7	2.6	0.6	2.8
EE	0.5	6.0	0.7	-1.0	0.7
IE	5.7	7.8	5.6	6.9	5.3
EL	-2.5	0.7	-1.3	-3.2	-1.1
ES	2.2	4.8	3.2	0.7	3.3
FR	1.8	5.0	2.8	0.5	2.8
HR	1.3	3.9	1.6	1.1	1.8
IT	2.1	3.7	3.1	-1.7	3.7
CY	1.9	4.5	2.2	0.2	2.1
LV	0.7	4.8	1.0	0.6	1.2
LT	1.7	6.3	1.8	2.7	2.0
LU	7.1	9.3	7.1	6.0	6.0
HU	6.1	9.8	6.5	5.1	5.8
MT	10.2	13.7	10.2	6.7	9.0
NL	5.3	7.1	5.1	4.0	5.2
AT	3.5	5.3	3.9	2.3	3.7
PL	3.5	8.1	3.7	4.1	3.5
PT	0.0	7.5	1.1	-0.8	1.5
RO	4.7	8.5	5.6	3.3	5.4
SI	12.1	16.0	12.1	9.3	11.7
SK	10.6	14.5	10.6	10.4	10.0
FI	3.0	5.5	3.2	1.5	2.8
SE	0.8	5.2	0.5	0.8	0.4

(1) The upper and lower thresholds used for S2 are 2 and 6.
Source: European Commission.

REFERENCES

Executive summary

European Commission (2021a), 'European Economic Forecast Autumn 2021', *European Economy – Institutional Paper*, No. 160, November.

Pfeiffer P., Varga J. and in 't Veld J. (2021), 'Quantifying Spillovers of NextGenerationEU investment', *European Economy Discussion Papers*, No. 144, July.

PART I, Introduction

Carnot, N. and de Castro, F. (2015), 'The Discretionary Fiscal Effort: an assessment of fiscal policy and its output effect', *European Economy – Economic Papers*, No. 543.

Council of the European Union, ECOFIN (2015), 'Commonly agreed position on flexibility in the Stability and Growth Pact', *Council document number 14345/15 30*, November.

European Commission (2021a), 'European Economic Forecast Autumn 2021', *European Economy – Institutional Paper*, No. 160, November.

European Commission (2021b), 'Communication from the Commission to the European Parliament, the Council, and the European Central Bank on the 2022 Draft Budgetary Plans: overall assessment', COM(2021) 900 final, November.

European Commission (2020a), 'Debt Sustainability Monitor 2019', *European Economy — Institutional Paper*, No. 120, January.

European Commission (2020b), 'Communication from the Commission to the Council on the activation of the general escape clause of the Stability and Growth Pact', COM(2020) 123 final, 20 March.

European Commission (2019), 'Vade Mecum of the Stability and Growth Pact, 2019 edition', *European Economy — Institutional Paper*, No. 101, April.

European Commission (2015), 'Communication from the Commission to the European Parliament, the Council, the European Central Bank, the Economic and Social Committee, the Committee of the Regions and the European Investment Bank making the best use of the flexibility within the existing rules of the Stability and Growth Pact', COM(2015) 12 final, 13 January.

Havik K., Mc Morrow K., Orlandi F., Planas C., Raciborski R., Roeger W., Rossi A., Thum-Thysen A. and Vandermeulen V. (2014), 'The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps', *European Economy – Economic Paper*, No 535.

Mourre, G., Poissonnier, A. and Lausegger, M. (2019), 'The Semi-elasticities underlying the cyclically-adjusted budget balance: an update and further analysis', *European Economy - Discussion Paper*, No 98.

Pamies, S., Carnot, N., and Patarau, A. (2021), 'Do fundamentals explain differences between Euro Area sovereign interest rates?', *European Economy — Discussion Paper*, No 141, June.

Pfeiffer P., Varga J. and in 't Veld J. (2021), 'Quantifying Spillovers of NextGenerationEU investment', *European Economy Discussion Papers*, No. 144, July.

PART I, Chapter 1

Berti, K., M. Salto and M. Lequien (2012), 'An Early-Detection Index of Fiscal Stress for EU Countries', *European Economy — Economic Paper*, No. 475.

Bruns, M. and Poghosyan, T. (2016), 'Leading Indicators of Fiscal Distress: Evidence from the Extreme Bound Analysis', *IMF Working Paper*, No. 16/28.

Cerovic, S., Gerling, K., Hodge, A. and Medas, P. (2018), 'Predicting Fiscal Crises', *IMF Working paper*, No. 18 / 181.

European Commission (2021), 'Debt Sustainability Monitor 2020', *European Economy — Institutional Paper*, No. 143, February.

European Commission (2020), 'Debt Sustainability Monitor 2019', *European Economy — Institutional Paper*, No. 120, January.

European Commission (2016), '[The Macroeconomic Imbalance Procedure. Rationale, Process, Application: A Compendium]', *European Economy — Institutional Paper* No. 39, November".

Eurostat (2021), 'The European System of Accounts (ESA 2010)', Interactive online version.

Gabriele, C., Erce, A., Athanasopoulou, M. and Rojas, J. (2017), 'Debt stocks meet gross financing needs: a flow perspective into sustainability', *ESM Working paper series*, No. 24.

Pamies Sumner, S. and Berti, K. (2017), 'A complementary tool to monitor fiscal stress in European economies', *European Commission Discussion Paper*, No. 049.

PART I, Chapter 2

Berti, K. (2013), 'Stochastic public debt projections using the historical variance-covariance matrix approach for EU countries', *European Economy — Economic Paper*, No. 480.

Blanchard O., Leandro A. and Zettelmeyer J. (2021), 'Redesigning EU fiscal rules: from rules to standards', *Economic Policy*, 36(106), 195-236.

Bouabdallah, O., Checherita-Westphal, C., Warmedinger, T., de Stefani, R., Drudi, F., Setzer, R. and Westphal, A. (2017), "Debt sustainability analysis for euro area sovereigns: a methodological framework", ECB Occasional paper series, No. 185, April.

Camba-Mendez, G. and T. Werner (2017), "The inflation risk premium in the post-Lehman period", ECB Working Paper 2033, March 2017.

ECB (2018). Economic Bulletin, Issue 6/2018: "Interpreting recent developments in market based indicators of longer term inflation expectations".

ECB (2021). Economic Bulletin, Issue 8/2021, Box 4 entitled: "Decomposing market-based measures of inflation compensation into inflation expectations and risk premia".

IMF (2013), '[Staff guidance note for public debt sustainability analysis in market-access countries]'.

IMF (2021), 'Review of the debt sustainability framework for market access countries', *IMF Policy Paper*, No. 2021/003, January.

Martin, P., Pisani-Ferry, J. and Ragot, X. (2021), 'Reforming the European fiscal framework', *Les notes du conseil d'analyse économique*, No. 63, French Council of Economic Analysis.

PART I, Chapter 3

European Commission, (2018a), 'Debt Sustainability Monitor 2017', *European Economy — Institutional Paper*, 71.

European Commission (2018b), 'The 2018 Ageing Report – Economic & budgetary projections for the 28 EU Member States (2016-2070)', *European Economy — Institutional Paper*, 79.

European Commission (2019), 'Fiscal Sustainability Report 2018', *European Economy — Institutional Paper*, 94.

European Commission, (2020a), 'Debt Sustainability Monitor 2019', *European Economy — Institutional Paper*, 120.

European Commission (2020b), 'The 2021 Ageing Report – Underlying assumptions and projection methodologies', *European Economy — Institutional Paper*, 142.

European Commission (2021a), 'Debt Sustainability Monitor 2020', *European Economy — Institutional Paper*, 143.

European Commission (2021b), 'The 2021 Ageing Report – Economic & budgetary projections for the EU Member States (2019-2070)', *European Economy — Institutional Paper*, 148.

Eurostat (2020), 'Methodology of the Eurostat population projections 2019-based (EUROPOP2019)'.

PART I, Chapter 4

Abbas, A., Blattner, L., De Broeck, M., El-Ganainy, A. and Hu, M. (2014), "Sovereign Debt Composition in Advanced Economies: a Historical Perspective", IMF Working papers, No. 14 / 162.

Bellia M., Di Girolamo F.E., Pagano A., Petracco Giudici M., Pamies S. and Orlandi F. (forthcoming 2022). Impact of banks losses on public finances. *European Economy — Discussion Paper*, European Commission.

Benczur P., Berti K., Cariboni J., Di Girolamo F. E., Langedijk S., Pagano A., and Petracco Giudici M. (2015), "Banking Stress Scenarios for Public Debt Projections" European Economy Economic Papers 548.

Bouabdallah, O., Checherita-Westphal, C., Warmedinger, T., de Stefani, R., Drudi, F., Setzer, R. and Westphal, A. (2017), "Debt sustainability analysis for euro area sovereigns: a methodological framework", *ECB Occasional paper series*, No. 185, April.

Budnik K., Dimitrov I., Groß J., Jancoková M., Lampe M., Sorvillo B., Stular A., and Volk M. (2021). Policies in support of lending following the coronavirus (COVID-19) pandemic. ECB Occasional Paper Series No 257 / May 2021.

Cannas G., Cariboni J., Forys M., Joensson H., Langedijk S., Marchesi M., Ndacyayisenga N., Pagano A., and Petracco-Giudici M. (2013), "Quantitative Estimation of a Part of the Costs and Benefits of Bank Structural Separation", JRC Scientific and Technical Report, JRC 88531.

Cariboni J., Di Girolamo F. E., Maccaferri S., and Petracco Giudici M. (2015), "Assessing the Potential Reduction of DGS Funds According to Article 10(6) of Directive 2014/49/EU: a Simulation Approach Based on the Commission SYMBOL Model", European Commission JRC Scientific and Policy Report, forthcoming

Cariboni J., Petracco Giudici M., Pagano A., Marchesi M., and Cannas G. (2012), "Costs and Benefits of a New Bank Resolution Framework", European Commission JRC Scientific and Policy Report, JRC 78882.

EBA (2020). The EU banking sector: First insights into the COVID-19 impacts, Thematic note, EBA/Rep/2020/17.

Eller, M. and J. Holler (2018), "Digging into the composition of government debt in CESEE: a risk evaluation", Oesterreische Nationalbank (OeNB).

European Commission (2011a), Directorate-General for Economic and Financial Affairs, "Public Finances in EMU 2011", http://ec.europa.eu/economy_finance/publications/ european_economy/2011/pdf/ee-2011-3_en.pdf.

European Commission (2011b), "Directorate-General for Internal Market and Services: Commission Staff Working Document - Impact Assessment Accompanying the Proposal for a Directive of the European Parliament and of the Council Establishing a Framework for the Recovery and Resolution", SWD(2012) 166 final, http://ec.europa.eu/internal_market/bank/docs/crisis-management/2012_eu_framework/impact_assessment_final_en.pdf

European Commission (2012), "Fiscal Sustainability Report 2012", European Economy 8/2012.

European Commission (2014a), Directorate-General for Internal Market and Services, "Commission Staff Working Document - Economic Review of the Financial Regulation Agenda", http://ec.europa.eu/internal_market/finances/docs/general/20140515-erfra-working-document_en.pdf.

European Commission (2014b), Directorate-General for Competition, "State Aid Scoreboard 2014", http://ec.europa.eu/competition/state_aid/scoreboard/amounts_used_2008-2013.xls.

European Commission (2014c), "Assessing Public Debt Sustainability in EU Member States: A Guide", European Economy Occasional Paper No. 200.

European Commission (2016), Fiscal Sustainability Report, European Economy Institutional Papers, 018 January 2016.

European Commission (2017), "Debt Sustainability Monitor 2016", *European Economy Institutional Paper*, No. 047.

European Commission (2021), 'Communication from the Commission to the European Parliament, the Council, and the European Central Bank on the

2022 Draft Budgetary Plans: overall assessment', COM(2021) 900 final, November.

European Commission, ECB, SRB (2021). Monitoring report on risk reduction indicators, May 2021.

European Parliament and Council (2013), "Directive 2013/36/EU of the 26 June 2013 on Access to the Activity of Credit Institutions and the Prudential Supervision of Credit Institutions and Investment Firms, Amending Directive 2002/87/EC and Repealing Directives 2006/48/EC and 2006/49/EC, 2013", Official Journal of the European Union, L 176/338.

European Parliament and Council (2014a), "Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 Establishing a Framework for the Recovery and Resolution of Credit Institutions and Investment Firms and Amending Council Directive 82/891/EEC, and Directives 2001/24/EC, 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU, 2012/30/EU and 2013/36/EU, and Regulations (EU) No 1093/2010 and (EU) No 648/2012, of the European Parliament and of the Council" Official Journal of the European Union, L 173/190, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0059&from=EN

European Parliament and Council (2014b), "Regulation (EU) No 806/2014 of the European Parliament and of the Council of 15 July 2014 establishing uniform rules and a uniform procedure for the resolution of credit institutions and certain investment firms in the framework of a Single Resolution Mechanism and a Single Resolution Fund and amending Regulation (EU) No 1093/2010", Official Journal of the European Union, L 225/1 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014R0806.

Eurostat (2015), "Note on Stock of Liabilities of Trade Credits and Advances, April 2015".

Eurostat (2021a), "Note on stock of liabilities of trade credits and advances, October 2021".

Eurostat (2021b), "Stock-flow adjustment for the Member States, the euro area and the EU, for the period 2017-2020", October 2021 EDP notification.

Financial Stability Board (2014), "Adequacy of Loss-absorbing Capacity of Global Systemically Important Banks in Resolution, Consultative Document", http://www.financialstabilityboard.org/wp-content/uploads/TLAC-Condoc-6-Nov-2014-FINAL.pdf

Financial Stability Board (2016), 2016 update of list of global systemically important banks (GSIBs).

http://ec.europa.eu/competition/state_aid/scoreboard/financial_economic_crisis_aid_en.html.

IMF (2014), "World Economic Outlook: recovery strengthens, remains uneven", April.

IMF (2018), "Austria. Fiscal Transparency Evaluation", Country Report, No. 18/193.

Laeven L., and F. Valencia (2013), "Systemic Banking Crises Database", IMF Economic Review, 61, pp. 25–270.

Marchesi M., Petracco Giudici M., Cariboni J., Zedda S., and Campolongo F. (2012), "Macroeconomic Cost-benefit Analysis of Basel III Minimum Capital Requirements and of Introducing Deposit Guarantee Schemes and Resolution Funds", European Commission JRC Scientific and Policy Report, EUR 24603.

PART II, Chapter 1

Afman et al., (2021). 'An overview of the economics of the Recovery and Resilience Facility', in *Quarterly Report on the Euro Area (QREA)*, Vol. 20, No. 3, European Commission.

Bańkowski et al. (2021), 'The macroeconomic impact of the Next Generation EU instrument on the euro area', *ECB Occasional Paper,* No. 2021/255.

Bom, P., and Ligthart, J. (2014). 'What Have We Learned From Three Decades Of Research On The Productivity Of Public Capital?' Journal of Economic Surveys, Vol. 28, pp. 889-916.

Havik et al. (2014). “The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps”, *European Economy – Economic Papers*, No. 535.

Pfeiffer P., Varga J. and in ’t Veld J. (2021), ‘Quantifying Spillovers of NextGenerationEU investment’, *European Economy Discussion Papers*, No. 144, July.

Varga, J., and in ‘t Veld, J. (2014), ‘The Potential Growth Impact of Structural Reforms in the EU: A Benchmarking Exercise’, *European Economy – Economic Papers*, No. 541.

PART II, Chapter 2

Aglietta, M., L. Arrondel, T. Brand, L. De Fossé, G. Dufrénot, R. Du Tertre, E. Espagne, A. Faivre, Y. Guy, A. Masson, A. Mayerowitz, W. Oman, and A. Pottier, (2018), ‘Transformer le régime de croissance’, *Rapport Institut CDC pour la Recherche*, Paris.

Batten, S. (2018), ‘Climate change and the macro-economy: a critical review’, *Bank of England Staff Working Paper*, No. 706.

Batten, S., Sowerbutts, R., & Tanaka, M. (2020), ‘Climate change: Macroeconomic impact and implications for monetary policy’, *Ecological, Societal, and Technological Risks and the Financial Sector*, 13-38.

Battersby et al. (2021), ‘Green Budgeting: Towards Common Principles’, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Baur, M., Bruchez, P.A. & Nicol, S. (2021), ‘Climate Change and Long Term Fiscal Sustainability’, Organisation for Economic Co-operation and Development (OECD).

Bova, E. (2021), ‘Green Budgeting Practices in the EU: A First Review’, *European Economy — Discussion Paper* 140, May 2021, European Commission.

Canova, F. and Pappa, E. (2021), ‘Costly Disasters & the Role of Fiscal Policy: Evidence from US States’, *European Economy — Fellowship Initiative Discussion Paper* 151, November 2021.

Cebotari, A., & Youssef, K. (2020). Natural Disaster Insurance for Sovereigns: Issues, Challenges and Optimality, *IMF Working Paper*, WP/20/3.

CRED, Centre for Research on the Epidemiology of Disasters (2020), ‘The Human Cost of Disasters (2000–2019)’, United Nations Office for Disaster Risk Reduction (UNDRR).

Dietz, S., Ploeg, F. V. D., Rezai, A., & Venmans, F. (2020), ‘Are economists getting climate dynamics right and does it matter?’, *CESifo Working Paper* No. 8122.

Dimitrijevics et al. (2021), ‘Economic impacts of climate change and mitigation’, in *Quarterly Report on the Euro Area (QREA)*, Vol. 20, No. 1, European Commission.

European Environment Agency (2012), ‘Climate change, impacts and vulnerability in Europe’, Report No 12/2012.

European Commission (2013), ‘Green Paper on the insurance of natural and man-made disasters, COM(2013) 213 final’, Brussels.

European Commission (2018), ‘In-depth analysis in support on the European Commission COM (2018) 773 on A Clean Planet for All – A European strategic long-term vision for a prosperous, modern, competitite, and climate neutral economy’, Brussels.

European Commission (2020a), ‘Debt Sustainability Monitor 2019’, *European Economy — Institutional Paper*, 120, January 2020.

European Commission (2020b), ‘Report on Public Finances in the EMU’, *European Economy — Institutional Paper*, 133, July 2020.

European Commission (2021a), ‘Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2021) 82 final on Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change’, Brussels.

European Commission (2021b), ‘Communication Staff Working Document, Closing the climate protection gap - Scoping policy and data gaps', SWD (2021) 123 final.

European Commission (2021c), 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM (2021) 662 final on The EU economy after COVID-19: implications for economic governance', Brussels.

European Commission (2021d), 'Report on Public Finances in the EMU', *European Economy – Institutional Paper*, 147, February 2021.

Fache Rousová, L., Giuzio, M., Kapadia, S., Kumar, H., Mazzotta, L., Parker, M. and Zafeiris, D. (2021), 'Climate change, catastrophes and the macroeconomic benefits of insurance', *Financial Stability Report*, European Insurance and Occupational Pensions Authority, July 2021.

Farid, M., Keen, M., Papaioannou, M., Parry, I., Pattillo, C., & Ter-Martirosyan, A. (2016), 'After Paris: Fiscal, macroeconomic, and financial implications of climate change', *IMF Staff Discussion Note*, 16(1).

Feyen, E. H., Utz, R. J., Zuccardi Huertas, I. E., Bogdan, O., & Moon, J. (2020), 'Macro-financial aspects of climate change', *World Bank Policy Research working Paper*, (9109).

Feyen, L. et al. (2020), 'Climate change impacts and adaptation in Europe', JRC PESETA IV final report (No. JRC119178), *JRC Science for Policy Report*, Joint Research Centre, European Commission.

Global Facility for Disaster Reduction and Recovery (GFDRR) (2017), 'Damage and Loss Assessment (DaLA) methodology'.

Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Bangalore, M., & Beaudet, C. (2020), From poverty to disaster and back: A review of the literature. *Economics of Disasters and Climate Change*, 4(1), 223-247.

Heipertz, M., & Nickel, C. (2008), 'Climate change brings stormy days: case studies on the impact of extreme weather events on public finances', Available at SSRN 1997256.

Hsiang, S. M., & Jina, A. S. (2014), 'The causal effect of environmental catastrophe on long-run economic growth: Evidence from 6,700 cyclones', National Bureau of Economic Research, No. w20352.

Intergovernmental Panel on Climate Change (IPCC) (2012), 'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change', Cambridge University Press.

IPCC (2014), 'Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change', Geneva.

IPCC (2018), 'Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty', In Press.

IPCC (2021), 'Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', Cambridge University Press.

Krogstrup, S., & Oman, W. (2019), 'Macroeconomic and financial policies for climate change mitigation: A review of the literature', International Monetary Fund.

Lis, E. M., & Nickel, C. (2010), 'The impact of extreme weather events on budget balances', *International Tax and Public Finance*, 17(4), 378-399.

Melecky, M., & Raddatz, C. E. (2011), 'How do governments respond after catastrophes? Natural-disaster shocks and the fiscal stance', *Natural-Disaster Shocks and the Fiscal Stance* (February 1, 2011), World Bank Policy Research Working Paper, 5564.

Network for Greening the Financial System (NGFS) (2020), 'The Macroeconomic and Financial Stability Impacts of Climate Change

Research Priorities', Technical Document, June 2020.

Nordhaus, W.D. (2014), *A question of balance: weighing the options on global warming policies*, Yale University Press, London.

OECD (2015), *The Economic Consequences of Climate Change*, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264235410-en.

Pigato, M. (Ed.) (2019), *Fiscal policies for development and climate action*, World Bank Group, Washington D.C.

Pindyck, R. S. (2017), 'The use and misuse of models for climate policy?', *Review of Environmental Economics and Policy*, 11(1), 100-114.

Pisani-Ferry, J. (2021), '21-20 Climate Policy is Macroeconomic Policy, and the Implications Will Be Significant', *Policy Brief*, Peterson Institute for International Economics.

Raddatz, C. (2009), 'The Wrath of God: Macroeconomic Costs of Natural Disasters', *Policy Research Working Paper*, No. WPS 5039, Washington, DC: World Bank.

Radu, D. (2021), 'Disaster Risk Financing: Main Concepts and Evidence from EU Member States', *European Economy — Discussion Paper*, 150, October 2021, European Commission.

Schäfer et al., (2016), 'Making climate risk insurance work for the most vulnerable: seven guiding principles', *Policy report* 2016, No.1, UNU-EHS Publication Series.

Solow, R. M. (1971), 'The Economist's Approach to Pollution and Its Control', *Science*, 173(3996), 498-503.

Stern, N., & Stern, N. H. (2007), 'The economics of climate change: the Stern review', Cambridge University Press.

Stern, N. (2013), 'The structure of economic modeling of the potential impacts of climate change: grafting gross underestimation of risk onto already narrow science models', *Journal of Economic Literature*, 51(3), 838-59.

United Nations Framework Convention on Climate Change (UNFCC) (2021), 'Conference of the Parties serving as the meeting of the Parties to the Paris Agreement', Glasgow.

USGCRP (2018), 'Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment', Volume II: Report-in-Brief, U.S. Global Change Research Program, Washington, DC, USA, 186 pp. doi: 10.7930/NCA4.2018.RiB.

von Peter, G. von Dahlen, S. and S. Saxena (2012), 'Unmitigated disasters? New evidence on the macroeconomic cost of natural catastrophes', *BIS Working Papers*, No. 394.

Weitzman, M. L. (2011), 'Fat-tailed uncertainty in the economics of catastrophic climate change', *Review of Environmental Economics and Policy*, 5(2), 275-292.

World Bank (2021), 'Financial Risk and Opportunities to Build Resilience in Europe'.

Zenios, S. A. (2021), 'The risks from climate change to sovereign debt in Europe', Available at SSRN 3891078.

PART II, Chapter 3

Abbas, A., Akitoby, B., Andritzky, J., Berger, H., Komatsuzaki, T. and Tyson, J. (2013), 'Dealing with high debt in an era of low growth', *IMF Staff Discussion Note*, No 07.

Abbas, S. A., Pienkowski, A., Rogoff, K. (Editors) (2020), *Sovereign Debt: A Guide for Economists and Practitioners*, Oxford University Press.

Arena, M., Di Bella, G., Cuevas, A. Gracia, B., Nguyen, V. and Pienkowski, A. (2020), 'It is only natural: Europe's low interest rates', *International Monetary Fund Working Paper*, No. 20/116.

Bean C., Broda C., Ito T. and Kroszner R. (2015), 'Low for long? Causes and consequences of persistently low interest rates', *Geneva Reports on the World Economy*, CEPR Press.

Blanchard, O. (2019a). 'Public debt and low interest rates', *American Economic Review* 190(4), 1197-1229.

Blanchard O. (2019b), 'Public debt and low interest rates', *NBER Working Paper*, 25621.

Brand, C., Bielecki, M. and Penalver, A. (Eds.) (2018), 'The natural rate of interest: estimates, drivers, and challenges to monetary policy', *ECB Occasional Paper Series*, No 217.

Caballero R. J., Farhi E., and Gourinchas P-O. (2017), 'The Safe Assets Shortage Conundrum', *Journal of Economic Perspectives*, Volume 31, No 3, Summer 2017, 29–46.

Checherita-Westphal, C. and Domingues Semeano, J. (2020), 'Interest rate-growth differentials on government debt: an empirical investigation for the euro area', *ECB Working Paper Series*, No 2486.

Cochrane, J. H. (2021), 'r < g?'. *Manuscript.*

Corradin S., Grimm N., and Schwaab B. (2021), 'Euro area sovereign bond risk premia during the Covid-19 pandemic', *ECB Working Paper Series*, No 2561.

Escolano, J., Shabunina, A. and Woo, J. (2017) 'The puzzle of persistently negative interest- Rate–growth differentials: Financial repression or income catch-up?', *IMF Fiscal Studies*, 38(2), 179–217.

Eser, F., Lemke, W., Nyholm, K., Radde, S. and Vladu, A. (2019), 'Tracing the impact of the ECB's asset purchase programme on the yield curve', *ECB Working Paper*, No 2293, July.

European Central Bank (2019), 'Interest rate-growth differential and government debt dynamics', *ECB Economic Bulletin*, Issue 2/2019.

European Commission (2021), 'Report on Public Finances in EMU 2020 – Part III: Fiscal policy in a negative interest rate-growth differential environment–new evidence', *Institutional Paper* 147, 26 February, 61-80.

Farhi and Gourio 2018

Goy, G. and van den En, J.W. (2020), 'The impact of the COVID-19 crisis on the equilibrium interest rate', *Vox*, 20 April.

Holzmann R. and Valderrama M. T. (2020), Oesterreichische Nationalbank, 'Raising r*: Why, how, and if not now, when?', *SUERF Policy Note* Issue, No 253.

Jordà, O., S. R. Singh and A. M. Taylor (2020), 'Longer-Run Economic Consequences of Pandemics', *Federal Reserve Bank of San Francisco Working Paper*, 2020-09.

Lian W., Presbitero A. F., and Wiriadinata U. (2020), 'Public Debt and r - g at Risk', *IMF Working Paper*, WP/20/137.

Masuch, K., Moshammer, E. and Pierluigi, B. (2017), 'Institutions, public debt and growth in Europe', *Public Sector Economics*, No 160, 41 (2), 159-205.

Mauro, P., and Zhou, J. (2020). "r−g<0: Can we sleep more soundly?", *IMF Working Paper* 20/52.

McCoy, E. (2019), 'A Calibration of the Term Premia to the Euro Area', *European Economy – Discussion Paper*, No 110, September.

Pamies, S., Carnot, N., and Patarau, A. (2021), 'Do fundamentals explain differences between Euro Area sovereign interest rates?', *European Economy – Discussion Paper*, No 141, June.

Panizza, U. and Eichengrren, B. (2014), 'A surplus of ambition: can Europe rely on large primary surpluses to solve its debt problem?', *NBER Working Paper*, No 20316.

Rachel, L. and Smith, T. D. (2015), 'Secular drivers of the global real interest rate', *Bank of England Staff Working Paper*, No 571.

Reis, R. (2021), 'The constraint on public debt when r < g but g < m', Manuscript, available at https://personal.lse.ac.uk/reisr/papers/99-mpkrg.pdf.

Rogoff, K. S. (2020), 'Falling real interest rates, rising debt: A free lunch?', *Journal of Policy Modeling*, 42(4), 778–790.

Schmelzing, P. (2020), 'Eight centuries of global real interest rates, R-G, and the 'suprasecular' decline, 1311–2018', *Bank of England Staff Working Paper*, No 845.

Schuknecht, L. (2020), *Public Spending and the Role of the State: History, Performance, Risk and Remedies* (p.Iv). Cambridge: Cambridge University Press.

Turner, D. and Spinelli, F. (2012), 'Interest-rate-growth differential and government debt dynamics', *OECD Journal: Economic Studies*, Vol. 2012/1.

Annexes

Carnot, N. and de Castro, F. (2015), 'The Discretionary Fiscal Effort: an assessment of fiscal policy and its output effect', *European Economy – Economic Papers*, No. 543.

EUROPEAN ECONOMY INSTITUTIONAL PAPERS SERIES

European Economy Institutional Papers series can be accessed and downloaded free of charge from the following address:
https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en?field_eurovoc_taxonomy_target_id_selective=All&field_core_nal_countries_tid_selective=All&field_core_date_published_value[value][year]=All&field_core_tags_tid_i18n=22621.

Titles published before July 2015 can be accessed and downloaded free of charge from:

- http://ec.europa.eu/economy_finance/publications/european_economy/index_en.htm
  (the main reports, e.g. Economic Forecasts)
- http://ec.europa.eu/economy_finance/publications/occasional_paper/index_en.htm
  (the Occasional Papers)
- http://ec.europa.eu/economy_finance/publications/qr_euro_area/index_en.htm
  (the Quarterly Reports on the Euro Area)

Publications Office