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Medium-to-long term macroeconomic effects of the COVID crisis: an investigation with RHOMOLO

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The **JRC Working Papers on Territorial Modelling and Analysis** are published under the supervision of Simone Salotti, Andrea Conte, and Anabela M. Santos of JRC Seville, European Commission. This series mainly addresses the economic analysis related to the regional and territorial policies carried out in the European Union. The Working Papers of the series are mainly targeted to policy analysts and to the academic community and are to be considered as early-stage scientific papers containing relevant policy implications. They are meant to communicate to a broad audience preliminary research findings and to generate a debate and attract feedback for further improvements.

Executive Summary

The potential long-term macroeoconomic implications of the COVID-19 crisis is a debated issue, both in advanced and developing economies. There are reasons to believe that potential output might have suffered a large dent as a consquence of the crisis due to, for instance, people exiting the labour force, permanent shifts in consumption and investment preferences, and/or foregone investments in crucial assets. This is especially apparent in specific EU economies where the virus containment measures led to a sustained reduction in labour force participation rates which have not yet recovered pre-pandemic levels.

This paper attempts at shedding light on this issue by using a novel approach to model the potential macroeconomic impact of the crisis. This approach rests on the use of pre-, peri-, and post-COVID quarterly data on key macroeconomic indicators, making forward projections of these, and incorporating the latter in the RHOMOLO model in order to investigate the effects on future GDP and consumption. Two main insights arise from the analysis. First, we show that both the length and the strength of the recovery paths over the medium to long terms are likely to differ across EU Member States. This is due to the size of the initial health shocks combined with the policy responses, both in terms of restrictions to the economic activity and of the fiscal support measures implemented. Second, bolstering productive private investment and ensuring fiscal support continuity might prevent scarring effects on the economic fabric. In light of our analysis, this may be especially true in countries such as Latvia, Finland, Germany, and Spain.

The question whether the crisis has inflicted sizeable economic damage will continue to be analysed in the near future. It will likely not be settled until more post-crisis data are available, and when the virus will be finally deemed to be under control. In the EU context, the negative legacy of the crisis might be worsened by rising geopolitical tensions and unfavourable inflation dynamics. It might also add to other pressing, deep-rooted challenges such as climate change and rising income inequality.

Contents

Foreword

This report serves as an accompanying document to the "Productivity and competitiveness developments in the EU" policy note elaborated by DG ECFIN and DG JRC colleagues. Specifically, the present document provides a detailed description of the analysis whose main results are shown in section 3.1 ("Post-crisis effects on employment, investment and consumption") of said policy note. As such, it is intended to inform the interested reader about the methodological and analytical approach adopted to investigate the issue of the medium- to long- term economic consequences of the COVID19 crisis in the EU.

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Abstract

This paper provides an analysis of scenarios on the evolution of the EU GDP and aggregate consumption over the period 2020-2030, focusing on the role played by the COVID-19 shock. The gap between estimated pre-crisis trends and projected paths for three important variables are obtained using forecasting tools. These variables are the labour force participation rate, private investment, and public consumption, all of which have been significantly disrupted during and after the crisis. By using these projections as shocks in the RHOMOLO model, a number of interesting results on the potential impact of the crisis on future economic growth are obtained. A comparative analysis across EU Member States reveals important differences as regards the potential severity of the issue.

1 Introduction

The COVID-19 crisis that erupted at the end of the first quarter of 2020 threw most EU Member States into an unprecedented recession. The economic crisis was primarily driven by the health crisis, chiefly through the restrictions and bottlenecks that containment measures imposed onto the economic system. The stringency of the measures varied substantially across countries and time. The health crisis entailed both direct and indirect negative economic effects. The former are best illustrated by the asymmetry of the *economic* shock, created by a common *health* shock, among sectors. In particular, the sectors more exposed to social contact (e.g., accommodation and food service activities) were more hardly hit, whereas others prospered (e.g., e-commerce). The indirect effects, on the other hand, mainly comprise possible changes in consumer preferences and attitudes due to heightened uncertainty, which can also negatively impact investment. Preliminary evidence shows that countries that endured more stringent lockdowns in the first half of 2020 experienced larger growth declines relative to pre-COVID-19 forecasts, even after controlling for the severity of the local epidemic (IMF, 2020). This evidence for an effect of the measures onto economic outcomes is complemented by evidence for the existence of "voluntary" social distancing (IMF, 2020). The latter implies that lifting lockdowns and other restrictions may not rapidly lead to as swift an economic recovery as originally expected.

This shift in preferences is only one among several examples of the potential structural changes to the economic system that the health crisis may bring about. As it happened with other sufficiently protracted recessions, there exists a non-negligible risk of *hysteresis*, that is a situation where unemployment and/or absences from work for relatively long spells may lead to permanent increases in structural unemployment and an associated reduction in potential output.[1] One of the causes behind the worsening of long-term unemployment is the erosion of skills, which may lead a less productive workforce. This is a consequence of either structural shifts in the economy which render workers specialized in certain sectors unemployable in other sectors, and/or subdued overall demand for prolonged periods of time, such as that engendered by permanent shifts in preferences. Importantly, these negative effects may be amplified by labour market rigidities (Orlandi, 2012). Albeit the current crisis differs in nature with respect to its immediate predecessor, as it is the result of developments that are exogenous to the economic system, the ensuing changes in preferences and the asymmetry of the shock across sectors may still lead to a certain permanent slack in the labour market as well as to shifts in the composition of investment. These forces are likely to differ in strength across EU Member States, due to, for instance, the quality of labour market institutions.

As opposed to previous crises where supply-side factors such as oil price shocks and oversized housing and financial sectors played key roles, there are a priori no reasons to believe that the current crisis may have a direct, permanent impact on the economies' fundamentals or production capacity. This, however, does not preclude the aforementioned demand-side factors from exerting a large enough negative effect on supply-side ones, such as human capital and even technological progress, thus yielding an overall negative impact on the economic fabric. Some analysts have suggested that strong and long enough recessions may exert negative long-term effects on output levels as well as on growth rates (Ball, 2014).[2]

Hence, although the need to dampen the short-term detrimental effects of the crisis has attracted most policy and research attention in the last two years, the potential negative effects of the crisis over longer time horizons should also be studied. This is echoed in some of the most recent forecast publications of key international institutions. The European Commission acknowledged that, although real GDP is projected to return to pre-crisis levels in the near term, "[…] the outlook remains subject to pandemic-related downside risks, including the potential entrenchment of flagging labour force participation […]". On the other hand, a word of caution is made when stating that "NGEU/RRF should supplement national efforts targeted at those most affected by the pandemic, which remains important to prevent scarring." (European Commission, 2021).[3]

Likewise, the IMF underlines that the potential for deep *scarring* effects is larger for medium and low-income countries, albeit it also warns that the risk of scarring cannot be fully discounted even for advanced economies,

[1] *Hysteresis* is also defined as "the hypothesis that recessions may have permanent effects on the level of output relative to trend" (Blanchard et al., 2015). This is the same as saying that recessions may cause reductions in potential output. The concept of hysteresis is however similar from both the labour and output perspectives, as structural unemployment and potential output are intimately intertwined.

[2] Even if the long-run rate of technological progress remained unscathed as a result of the crisis, to the extent that key investments to support long-run output (such as R&D) are postponed in the face of more short-term challenges, productivity gains and therefore the production capacity of the economy may well be harmed over the medium-to-long term.

[3] NGEU stands for *Next Generation EU*, while RRF stands for *Recovery and Resilience Funds*.

underlining that "the risks of derailments and persistent scarring [...] remain so long as the pandemic continues" and that "as the recovery progresses, policymakers will need to shift to measures that aim to reverse scarring from the crisis" (IMF, 2021).

At the time of writing, all EU economies have initiated their recovery process, at different rates, while the pandemic has lost centre stage in the international economic policy arena against a background of rising, acute geopolitical tensions. It is still too early to tell whether the recovery is strong enough to have sidestepped the sort of scars aforementioned. A more definite answer to this will only be possible after more data are available and thus a more robust estimation for the post-crisis trends can be made. This paper aims at shedding light on this. By using data until the third quarter of 2021, we investigate whether a shift in trend in the main macroeconomic indicators might have occurred after the crisis in the EU Member States.

The paper is organised as follows. First, we provide a brief literature review of the most salient analyses that have been conducted so far on the potential medium- to long- term effects of the crisis. Then, a succinct summary of the quarterly developments in labour force participation,investment rates and public consumption across EU countries is provided. This is accompanied by a discussion of the approach followed to make forward projections of these three variables, which are then fed into the RHOMOLO model for scenario analysis purposes. Third, we provide a brief description of the main mechanisms in the model underlying the simulation results. Finally, we conclude by showing the main results at the Member State level and providing a short comparative analysis.

2 Review of the literature on the potential scarring effects of the COVID-19 crisis.

In this section, we succinctly review the main international economic institutions' views on the likely impact of the crisis as well as other contributions explicitly investigating different scenarios and/or quantifying the impact of the COVID-19 recession from an analytical standpoint. We discuss solely the works focusing on the medium- to long-term effects.

At the onset of the crisis, the focus of policy makers was mostly on pressing short-term needs. Concerning the medium-term outlook throughout 2020, the majority of forecasts from international institutions largely predicted a 'V-shaped' recovery (European Commission (2020a and 2020b), OECD (2020)). This implies that most analysts believed that the economies would return to their pre-crisis growth paths once the crisis was over, thus assuming no significant scarring effects.

However, the assumptions on which those forecasts rested were mostly overridden by developments in the last quarter of 2020 and during the whole of 2021, when stringent anti-COVID measures were in many cases reinstated, as the health crisis regained momentum. In the Commission's Spring 2020 forecast it was already acknowledged that "the pandemic could become more severe and last much longer than assumed, requiring more stringent and longer lasting containment measures than assumed in this baseline scenario. This would result in much worse outcomes as shown by the scenario analysis presented in this document. This would also be the case in a scenario where a second wave of infections take place later this year." (European Commission, 2020a). This scenario materialized toward the end of 2020 and during 2021.

The scenario analysis presented in the Commission's Spring 2020 forecast focuses only on the conceivable economic impacts linked to different assumptions regarding the evolution of the pandemic in the years 2020 and 2021, thus leaving out the medium- to long-term impacts.[4] It is however important to note that both the 'longer lasting' and 'second wave' scenarios discussed in this analysis seem to have materialized at the end of 2020 and throughout 2021. These are based on a state of play that is the most conducive to delivering *scarring* effects, such as increases in precautionary savings, longer duration of containment measures, and heightened uncertainty.

[4] The Spring 2020 forecast document touches however upon longer term issues by stating that "The pandemic could leave permanent scars in the EU economy that are not taken into account in the central scenario of the Spring forecast [...] More permanent scars than currently expected could also characterise labour market developments (hysteresis effects)." (European Commission, 2020a).

Although there is no explicit discussion of medium-term scenarios in the Commission's Autumn 2021 forecasting round, the possibility of scarring effects is still acknowledged as a downside risk. The main assumption is that the EU economy will converge to the level expected by the pre-pandemic trend in 2023 (European Commission, 2021). This however remains subject to a great deal of uncertainty, not least because of the very recent developments in terms of geopolitical tensions, and the ensuing massive supply disruptions that the latest forecasting round did not capture. It is also acknowledged that the pandemic is not fully over yet, and that new waves featuring new variants of the virus could still emerge.

The OECD (2021) delves into the scarring phenomenon in the original use of the term, namely the impact that lengthy inactivity spells might bear on individuals' future labour market prospects. The report highlights that "a widening gap may develop between those who have weathered the crisis through reduced hours and short periods on temporary layoff and those who have found themselves jobless", with the latter risking long-term scars. This specific result on labour market outcomes translates into another important message; while the positive macroeconomic outlook also extends to the labour market, it will be important to be aware that long-term scars are likely to remain, even as unemployment rates fall.

A thorough discussion of the different channels through which the pandemic might leave permanent scars in the economic fabric is provided in Cerra et al. (2021). First, the authors mention the widely known link between protracted periods of inactivity away from the labour market and the erosion of skills and/or the deterioration of job matches. These authors also underline the role played by the potential impact of the uneven shock across age groups in the labour market. They show that the labour market participation shock was larger for younger cohorts of workers.[5] The impact on these groups might leave large scars on the economic fabric, as it could affect human capital accumulation to a larger extent than the impacts on other groups. Second, a major source of hysteresis is the slowdown of investment in capital, technology or R&D by firms. Lower confidence indicators of economic agents and investors about the future might persist even if we witness a strong recovery after the crisis. Third, the crisis has also been unique in its effects on schooling. This will likely reduce the pace of human capital accumulation, adversely impacting the growth rate of the economy's supply potential. Fourth, larger sovereign and corporate debts increase the risk of future debt and financial crises, which often precede periods of low growth and high unemployment. Fifth, as previously mentioned, the pandemic may have made economic agents more risk-averse. Sixth, the potential impact on trade patterns and supply chains is an additional factor that could trigger hysteresis, as the phenomenon of *reshoring* and the design of new supply chains might lead to efficiency losses. Finally, the rise in inequality due to the crisis is another channel through which output scarring can take place. According to the authors, the sum of all these factors that are specific to the current crisis could add to an unusually large amount of long-term negative effects, as high as 12 percent of GDP in the medium term and 5–6 percent in the long term.

Another source of risk is the fact that, during the pandemic, extraordinary fiscal support measures were put in place to prevent massive insolvency rates. The European Systemic Risk Board (ESRB, 2021) warns of the big threat of a wave of insolvencies once the currently remaining support measures are phased out. Furthermore, it has been suggested that students affected by school closures during the pandemic may experience 3 percent lower lifetime incomes, unless catch-up measures are put in place (Hanushek and Woessmann, 2020). The authors estimate that this could translate into a lower long-term level of output, through productivity losses, in countries where education closures were most prominent. Moreover, as pointed out before, the virus may even become endemic (Phillips, 2021), thereby shifting global travel patterns, which may not return to pre-pandemic levels soon (Hellwig et al., 2021).

Evidence for the UK, gathered in an analysis of the role of monetary policy, points to the non-negligible effect of long withdrawal spells from the labour market onto long-term unemployment (Ramsden, 2020). It is estimated that "during periods of high unemployment, the number of unemployed people who have been out of work for a prolonged period typically increases". David Ramsden, Deputy Governor for Markets & Banking at the Bank of England, pointed out in a speech that the Bank of England's Monetary Policy Committee expected in November 2020 that "the long-term effects of COVID, taken together, are likely to reduce the supply capacity of the economy – its potential level of output – by around 1¾ percent" (BoE, 2020). This represents a permanent shortfall, or at least a very persistent one, on top of the impact of the immediate downturn. He then proceeds to argue that monetary policy has an important role to play in preventing these long-term scars, as opposed to

[5] This is also underlined by the ILO, which states that the pandemic has raised a serious risk of scarring many youth in the Europe and Central Asia region. "Delayed labour market entry, or entry into lower-quality jobs than would otherwise have been taken, or prolonged or repeated spells of unemployment or inactivity can have long-term implications for young people's career paths and earning prospects" (ILO, 2022).

the conventional view that monetary policy is neutral in the long-run.[6] In a similar, more recent contribution, and focusing on the monetary policy implications of the crisis for the UK, Professor and Bank of England's MPC member Jonathan Haskel investigates the possibility of scarring by looking at the different determinants of output and their evolution until mid-2021 (BoE, 2021). Based on labour market, investment, and household and business expectations data, he concludes that "the immense support for the economy over the pandemic looks like it might have averted deep scarring". However, he also warned about *too early* of a withdrawal of monetary stimulus by claiming that at the time "risk-management considerations" worked against "a pre-emptive tightening of monetary policy".

IFS (2021) asserts that a faster recovery could minimise the permanent economic damage inflicted by the pandemic. It is estimated that, provided that a speedy recovery materialises, foregone GDP could be limited to just 1–1.5 percent. However, a slower recovery could mean larger hysteresis effects and greater permanent losses. Coupled with the continuous negative impact of Brexit on the UK capacity, and the assessment of COVID-19 impacts, they expect the economy to be "2.5 percent smaller in 2024–25 than under the pre-pandemic forecast". They conclude that continued policy support is still key to secure a complete economic recovery and prevent scarring, given the direct correlation between the speed of the recovery and the likelihood of scarring. All in all, a House of Common's Library report provides a brief overview of the contributions on the potential damage of the crisis for the UK economy, concluding that "most forecasters expect some scarring, but they differ on quite how much" (Commons Library, 2021).

Turning to direct analyses of the potential scarring effects of the Great Lockdown, and still in the context of the UK economy, Oxford Economics (2021) offers an exploration of different scenarios based on assumptions behind key drivers of growth. In particular, their baseline forecast predicts that the crisis "will cut the long-term level of world GDP by around 2 percent". However, additional unfavourable developments might bring long-term GDP losses of 5 percent. The latter result is obtained by worse-than-expected performances in six main metrics: i) sharply rising public and corporate debt, ii) a persistent rise in unemployment, iii) weaker world trade growth, iv) persistently low investment, v) the interruption of new business formations and labour turnover, and vi) tighter credit conditions.[7] The quantification of the macroeconomic impact of these channels allows for considerable overlap among them.

An analysis of developments in the labour market, capital, and TFP until the second quarter of 2021, compared with the aftermath of the Great Recession, is presented by ECB (2021). Although the main conclusion is that measures of the impact on global potential output of the pandemic seem to indicate that its level has declined, albeit to a lower extent than during the Great Recession, it is also acknowledged that "lasting damage to the labour market may arise from hysteresis effects if people remain out of work for longer, lose their skills or become discouraged".

Cerra et al. (2020) do not directly conduct an assessment of the possible consequences of the current crisis for potential output, but discuss the most recent literature on the *hysteresis* phenomenon, concluding that there seems to be mounting evidence for the need to implement more active monetary and fiscal policies to avoid the permanent scars of downturns. A number of cited studies explicitly show that the depth of a recession has a significant effect on the loss of potential output for advanced countries.

In an *ex-post* exercise, Ball (2014) presents estimates of the long-term effects of the global financial recession of 2008–2009 on output in 23 countries. He measured these effects by comparing estimates of potential output in 2014 from the OECD and IMF to the path that potential output was following in 2007, according to estimates at the time. The average loss, weighted by the size of individual economies, is 8.4 percent. Most countries have experienced strong hysteresis effects: shortfalls of actual output from pre-recession trends have reduced potential output almost one-for-one. In the hardest-hit economies, the current potential growth rate is lower than beore the crisis, implying that the lost potential output is growing over time. This analysis differs from ours in that it is an *ex-post* evaluation of the impact of the Great Recession based on hard data, rather than an ex-ante evaluation of the possible dent of the current crisis on long-term economic prospects.

[6] Interestingly, evidence is also provided of the fact that the crisis is disproportionately affecting lower-productivity sectors (e.g., service sectors). A shift toward more productive sectors would constitute a positive development in terms of the economy's production capacity.

[7] The latter factor may be particularly relevant in the wake of the rapidly rising inflation at the time of writing.

A recent study on past health crisis is provided by Ma, Rogers, and Zhou (2020), who analyse the immediate and medium-term impacts of six recent modern health crises based on announcements of the pandemic/epidemic event as a public health emergency of international concern. Beyond the initial decline in GDP growth, they find that output remains below the pre-shock level five years later and the effects are as large as those resulting from systemic banking crises.

In a multi-country econometric framework focusing on the role played by increased global volatility on the crisis' economic impacts, Chudik et al. (2020) estimate that the US and the UK are likely to experience deep and long-lasting effects, while the probability that China's GDP growth will be higher than the one obtained in a no-pandemic scenario already in 2021 is higher than 50 percent. According to these authors, the odds for the Euro area are skewed negatively, but there is some probability that it may recover faster than the US by the end of 2021 (albeit without yet closing the gap with respect to the counterfactual no-pandemic scenario).

Jorda et al. (2020) uses historical data on pandemic and war episodes to conclude that the former are usually followed by very long periods (4 to 20 years) of subdued real interest rates.[8] The authors thus conclude that although their research shows that we can expect a long period of reduced investment and consumption, there are also reasons to believe that the current pandemic might not lead to such prolonged low-interest rate environments. This is namely because i) the death toll of COVID-19 relative to the total population could be smaller than that of some of the major pandemics of the past (due to better health technology), ii) COVID-19 affects primarily the elderly, who are no longer in the labour force and tend to save relatively more than the young, and iii) aggressive counter-pandemic fiscal expansions will further boost public debt, reducing the national saving rate and possibly putting upward pressure on real interest rates.

Cardani et al. (2021) examine the short-term economic effects of the COVID-19 shock in the euro area through the lens of a DSGE model. Leaning on a shock decomposition analysis, they estimate that "lockdown shocks" ("forced savings" and labour hoarding) played a dominant role in explaining the quarterly pattern of real GDP growth in 2020, complemented by a negative contribution. They also document the negative impact of persistent precautionary savings, and the relatively modest rsponse of inflation. Although their investigation offers very important insights into the drivers of the recession itself, the analysis is silent about the potential negative consequences of the crisis beyond the year 2020.

Investigating the role played by supply and demand in explaining the overall negative economic performance registered throughout 2020 in the US, Baquee and Fahri (2022) use a Keynesian approach to show that complementarities in factors of production and across sectors implied that the aggregate demand stimulus put in place during the crisis was not entirely effective due to the shock being asymmetric across sectors. Although not focused on the long-term consequences of the crisis, their analysis suggests that the measures implemented to lift the US out of the crisis may not have been as effective as in other types of crisis, hence potentially leaving more room for acute economic scars.

Reissl et al. (2021) utilize an input-output model to estimate the economic impact of lockdowns in Italy during 2020. Focusing ton the shocks to the productive capacity implied by the lockdown measures as well as their propagation and feedback effects on final demand, the authors show that, when estimated on data from the first "hard" lockdown, the model closely reproduces the observed economic dynamics during spring 2020. They also compare the effect of the actual 'soft' lockdown from the fall and winter of 2020 to a hypothetical second 'hard' lockdown and find that it was much less costly in terms of economic loss. However, no analyses of longer term impacts is provided.

In a very similar vein, Febrero and Bermejo (2021) also employ input-output techniques to estimate the impact of containment measures at the outburst of the pandemic in Spain. Writing their paper in spring 2020, they simulated for the whole year 2020 the effects of the lockdown of the population and the shutdown of a large part of the production system for several weeks. This was a supply-side shock that they predicted it would be followed by a demand-side shock whose impact was expected to be even larger toward the end of 2020. In 2021, they anticipated that the expected weak recovery would not be sufficient to offset the initial negative shock. Although their modellling strategy was sound in that it turned out to be rather accurate, they do not provide forecasts beyond the 2021, or entertain possible scenarios that might unfold after the crisis.

[8] The exact opposite happens following wars due to the capital-destruction effect of this type of shock.

The only study thus far featuring an analysis of the effects of the current crisis on potential output is provided by Bodnar et al. (2020). Focusing on the Euro area, these authors first discuss the two interpretations of potential output generally utilized in the literature, which depend on an assessment of the extent to which the economy is operating at full capacity. It is clear that the crisis has affected capacity utilization differently across sectors. The authors show that the COVID-19 shock originates from both demand and supply sources. They argue that the coronavirus and, in particular, the related containment and lockdown measures are likely to (negatively) affect most components of potential output, namely labour and capital input and TFP. Based on the experience of the great financial crisis, it is reasonable to expect an increase in the NAIRU despite the estimated decline registered in recent years as a consequence of labour market reforms in several Euro area countries. As opposed to the Great Recession, the COVID-19 shock is affecting all major sectors to a considerable degree and this simultaneous decline may increase the probability of hysteresis effects occurring. This may imply a larger and more immediate impact on the NAIRU than that seen as a result of the great financial crisis. The authors employ several statistical models to generate a pooled estimate of the level of potential output based on past and recent data. They conclude that potential output may remain well below the path suggested by pre-crisis projections. In addition, they estimate that the changes in the unemployment rates and hours worked per employee throughout 2020 could be the most affected by the current crisis, thus rendering labour the most important factor behind the drop in potential output.

Examinations of the potential scarring impact of the crisis in specific EU countries include those of by the Parliamentary Budget Office (2021) and by Fiaschi and Tealdi (2022). The former presents a brief discussion of the potential labour market scarring in Ireland. It focuses on the labour market implications of the crisis and accompanying risks, mentioning that the withdrawal of income support may lead to a labour market with greater demographic inequality, rising poverty, and fewer jobs.[9] This labour market scarring will, in turn, "have long-term implications for the economy and will result in higher long-term unemployment and lower output". One of its main messages is that the policy focus should shift to re-skilling, through further education and training, so that the most affected workers can transition toward other sectors and prevent long-term scarring. On the other hand, Fiaschi and Tealdi (2022) explore the impacts of the pandemic on the Italian labour market. They undertake an empirical analysis, using labour force data, focused on women's labour force participation, and conclude that the flow of young women with children from employment to inactivity, which started in the beginning of the pandemic, persisted until the end of 2020, making likely the presence of long-lasting scarring effects on the Italian female labour force participation. The potential macroeconomic repercussions of these effects are however not discussed.

Among the analyses that downplay the relevance of the crisis regarding its potential for macroeconomic scarring, Fitch Ratings (2021) produced new estimates of medium-term potential "GDP growth for the largest developed markets (DMs) that show significantly less scarring than anticipated in the early days of the Covid-19 pandemic". This is because, according to the authors, the pandemic shock "was not preceded by the build-up of large macroeconomic or financial imbalances". In addition, "the scale and speed of the macro policy response were unprecedented, helping to cushion private-sector balance sheets and support aggregate demand". Nonetheless, it is also stated that "policy support has also come with its own costs - increased inflation, higher public debt burdens and a risk of a further rise in "zombie firms", which could reduce productivity" and growth potential.

In line with the latter, the Bank of Finland's December 2020 forecast states that, in the specific case of the Finnish economy, "the crisis caused by COVID-19 is not expected to be as deep as the global financial crisis and the recovery is expected to be faster" (Bank of Finland, 2021). This conclusion is mainly drawn on the observation that "in the recession caused by the COVID-19 pandemic it is mainly service industries that have suffered", and so in the medium term the economy "will see a return to the growth rates that preceded the crisis". However, it is also acknowledged that "the crisis may leave longer-lasting scars than anticipated in such areas as employment, capital stock and productivity". Examples include hysteresis effects of long-term unemployment, low levels of investment and a slowdown in the reallocation of resources. In this paper we investigate the former two factors.

From the standpoint of trust in public authorities, Aksoy et al. (2022) argue that there might be a scarring effect on the confidence of citizens vis-à-vis governments across the globe and their policies, to varying degrees, in

[9] In line with our own projections for the labour participation rate, the authors highlight that "the flow to inactivity coupled with difficulties in job matching, due to skills mismatch, human capital loss, and other scarring effects may lead to negative implications for the labour force participation rate throughout the recovery period for some groups".

the coming years. In their own words, "Covid-19 is likely to become a catalyst and accelerator of ongoing trends", including "the ongoing erosion of trust in governments and science", the implications of which can be substantially negative. This growing distrust might in turn worsen the effectiveness of other public policies — much like the loss of effectiveness of the transmission mechanism of monetary policy in the face of the *de-anchoring* of inflation expectations — of potential weighing down on overall economic performance.

Our work differs from the literature discussed above along various dimensions. First, as opposed to the analyses that rely on a qualitative narrative of potential scenarios following the current crisis, and/or on model-free quantitative estimations, our contribution makes use of both recent data and a general equilibrium modelling tool to delineate possible economic developments over the next eight years. An important value added in this sense is our ability to explain the mechanisms behind the results obtained, based on the RHOMOLO CGE model.[10] Second, our focus is solely on the medium- to long-term potential macroeconomic impact of the crisis, thus beyond its effects over the immediate future. Although some of the studies summarized above employ quantitative techniques (e.g., VARs) to gauge the impact of the crisis, these are mainly focused on the short-term (i.e., one or two years after the crisis started, around 2020 Q2). Third, this is the first study, to our knowledge, that focuses purely on the role of labour market and investment channels and their macroeconomic impacts.

It is important to underline that the analysis and results presented subsequently are not to be interpreted as point forecasts, nor they represent alternative predictions about the future economic landscape to those provided by existing forecasts from different institutions and analysts.[11]

Next we provide a brief discussion of our approach to analyse the possible macroeconomic impact of crisis-induced changes in the labour market, investment and public consumption expenditures in the EU economies.

3 Data and methodology

In this section we provide a discussion of the data and methodology used for projecting forward the chosen exogenous variables, which are then fed into RHOMOLO to conduct impact analysis. First, we provide an overview of developments in these variables in 2020. We then we provide a brief description on how they are projected forward until 2030.

3.1 Latest developments

The analysis presented in this report uses quarterly data until the third quarter of 2021 on labour force participation rates, private aggregate investment, and government expenditure for twenty-six EU countries.[12] These are the exogenous variables that we feed into the RHOMOLO model to investigate their impact on GDP, household consumption, and employment.

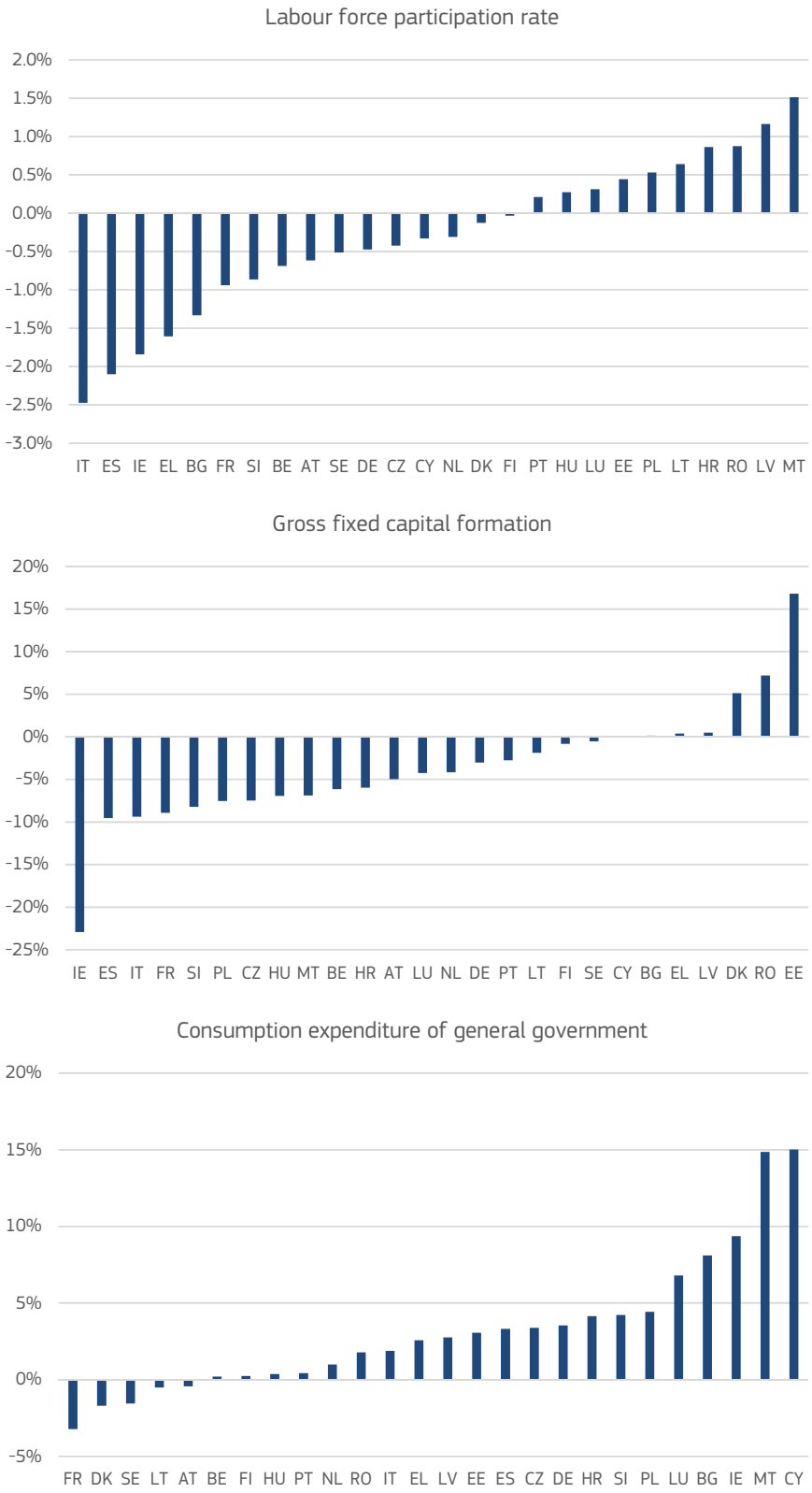
[10] For an up-to-date description of the model, see Lecca et al. (2018).

[11] In this respect, our exercise should be entirely fathomed as a future scenario analysis based on an informed guess that utilizes the latest labour market participation, private investment, and public expenditure data.

[12] The only country excluded is SK due to lack of data.

Figure **1** displays the change in these three variables from 2019 to 2020. As it can be observed, there are major differences across Member States in terms of the extent of these changes, which can be roughly interpreted as the size of both the labour market (supply) and private investment and government expenditure (demand) shocks.

Figure 1. Percentage change in labour force participation rates, gross fixed capital formation, and final consumption expenditure of general government across Member States, 2019-2020.



Note: SK is excluded due to data limitations. *Source*: Eurostat. Quarterly labour force survey for labour force participation rates (activity rates in the 15-64 age bracket) and quarterly national accounts for gross fixed capital formation (item P51G, seasonally and calendar adjusted) and consumption expenditure of general government (item P3_S13, seasonally and calendar adjusted).

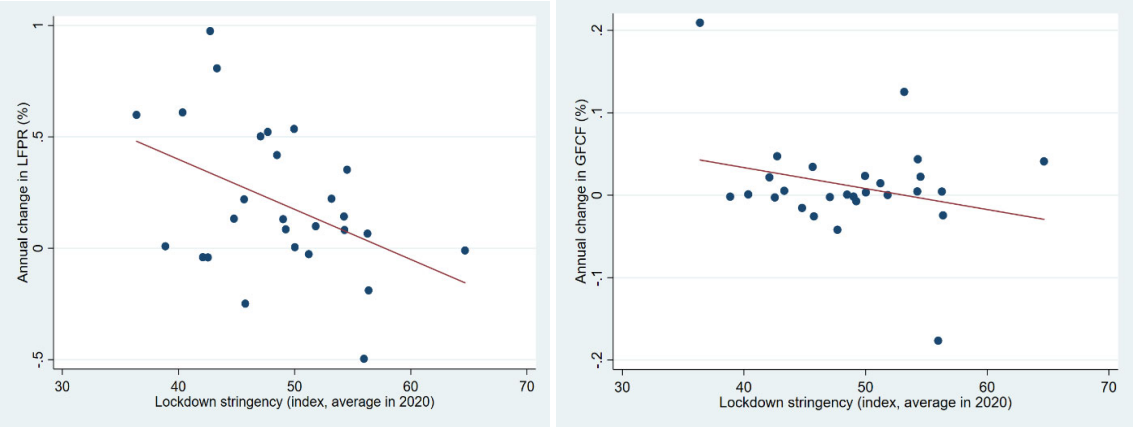
Italy experienced the largest drop in the labour force participation rate, while Ireland's private investment took the largest hit of all the twenty-six Member States analysed.[13] Italy, Spain, and France are however the largest EU economies where both indicators have decreased by substantially more than in the average country. There seems to exist a weak, positive correlation between reductions in investment and in labour force participation across countries. However, these variations also respond to country-specific factors, with the stringency of state interventions to contain the pandemic likely playing a crucial role. By contrast, there is no clear correlation between either of these two indicators and the sign and size of the government response, as apparent from

[13] Although these data are sourced directly from national accounts, it is important to bear in mind that Irish gross fixed capital formation data is highly volatile, owing mostly to the way the capital series are calculated (see Annex 3). The simulation results for Ireland presented hereunder must thus be interpreted with caution.

Figure **1. Percentage change in labour force participation rates, gross fixed capital formation, and final consumption expenditure of general government across Member States, 2019-2020.** The latter was also the result of many factors, including the status of the public finances at the time of the COVID shock.

Figure 2 confirms that there is a negative, albeit weak correlation, between the stringency of the measures put in place by the different governments and the variation registered in both investment and labour force participation in 2020.

Figure 2. Lockdown stringency in 2020 and percentage change in labour force participation rates and gross fixed capital formation across Member States in 2019-2020.



Note: SK is excluded due to data limitations. The correlation coefficients stand at approximately -0.43 and -0.27 for the changes in the labour force participation rate and gross fixed capital formation, respectively. The lockdown stringency indicator is compiled by Haver Analytics as part of the Oxford Coronavirus Government Response Tracker.

An important observation stemming from Figure 2 is that the containment measures affected more directly labour force participation than investment, as the latter was mostly indirectly affected by the economic crisis following the health shock, with the postponement of investment plans and increases in risk premia.[14]

3.2 Forward projections

Data on these three variables are projected forward as follows. First, for each variable in each country, an exponential smoothing function is fitted on historical values.[15] Based on this estimation, forward projections until the last quarter of year 2030 are generated, with the resulting quarterly series finally annualized.

The choice of the exponential smoothing function as a projection technique in our case rests on the fact that it captures better the level of persistence in a given series and places more weight on recent observations.[16] Hence, this approach is more apt to capture the potential *scarring* effects that recent changes in these variables might lead to, which is the main goal of this analysis.

Second, a pre-crisis trend or baseline path for each variable is estimated by fitting a linear or MA(4) trend on historical values. To ensure that the pre-crisis trend is duly captured, only data until 2019Q4 are used to fit it. The criterion of choice in this case is based on the goodness-of-fit. This estimated pre-crisis trend is simply projected forward to obtain the values for the baseline, no-COVID scenario in the period 2020-2030.

Third, using the deviation between the predicted series and the estimated trend/baseline values implied by the pre-crisis data, we obtain the labour force participation rate, and private and public investment *shocks* for the

[14] This is in line with recent results in ECB (2021).

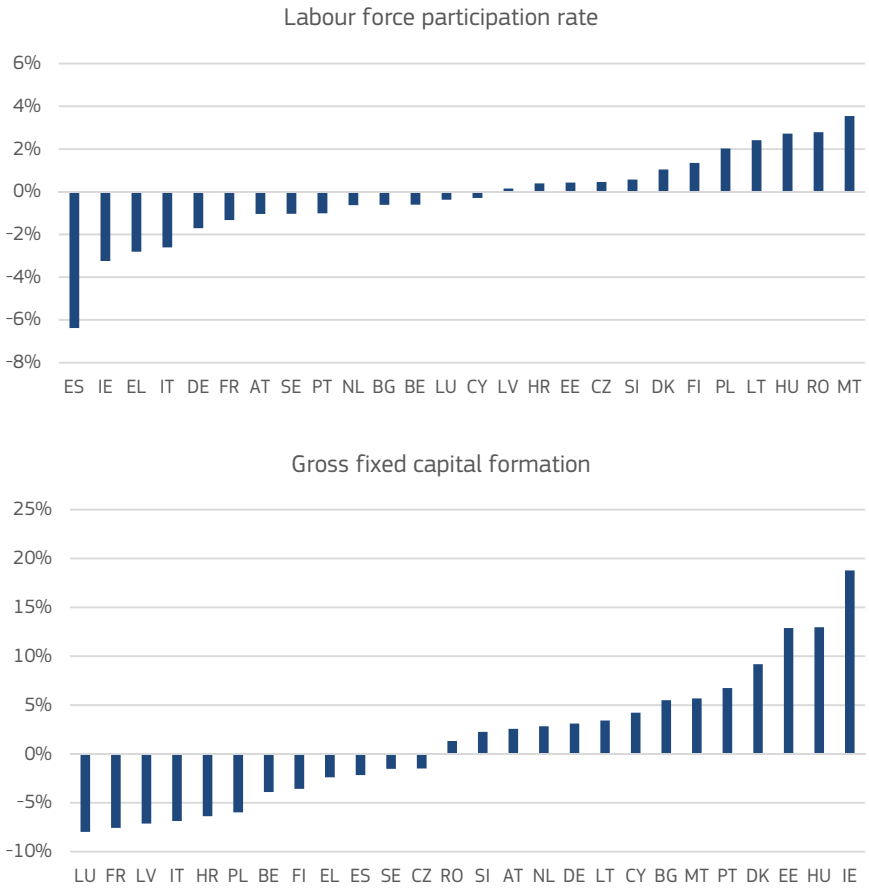
[15] For the three variables, the endpoint of the historical series used is 2021Q3. The starting quarter for data on both gross fixed capital formation and consumption expenditure of general government is 1995Q1, whereas it is 1998Q1 for labour market participation, due to data limitations for previous years and quarters. For a handful of countries, mostly Member States which joined the EU after 2000, the starting years are slightly later.

[16] We use the built-in exponential smoothing forecast available in Excel 2016. For a more technical description of the exponential smoothing function, please see Annex 1.

period 2020-2030.[17] These are then fed into the RHOMOLO model to examine their effects on the main macroeconomic variables (GDP, consumption, unemployment) over the same period.[18]

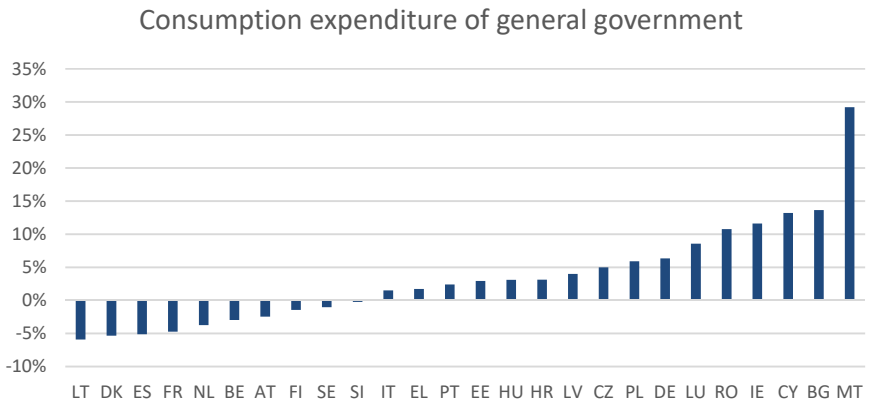
The next charts depict the deviation in 2020 of the predicted values of the labour force participation rate and overall private and public investment with respect to their estimated pre-crisis trend value.

Figure 3. Deviations of labour force participation rates, gross fixed capital formation, and consumption expenditure of general government from trend in 2020.



[17] Note that the estimated values implied by the pre-crisis trend for the years 2020 and 2021 need not coincide with the *actual* readings for these variables. This is the same as saying that the analysed economies need not have been at their steady state at the time of the COVID-19 shock. This in turn implies that the shocks imposed onto the three exogenous variables in the year 2020 are positive in countries for which their *actual* 2020 levels were estimated to lie above the levels implied by their pre-crisis trends (See Figure 3).

[18] Similar to the previous clarification, note that the resulting impacts for the years 2020 and 2021 for all three endogenous outcome variables simulated in the model are not equal to the actual variations observed in the data. They rather reflect the difference between the *shock* (based on the exponential smoothing forecast) and *baseline* (pre-crisis trend) scenarios.



Note: SK is excluded due to data limitations.

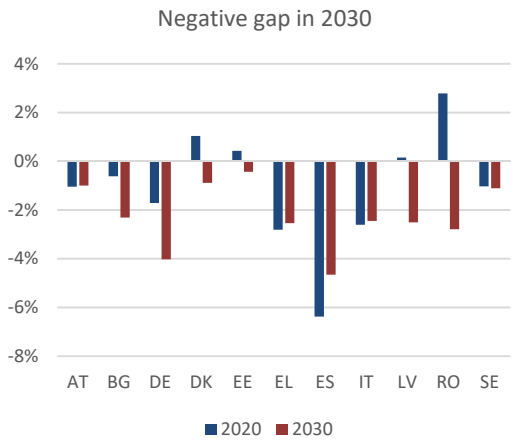
The graphs above show that Spain and Luxembourg were the worst hit countries in 2020 in terms of, respectively, the size of the reductions in labour force participation rates and private investment relative to their pre-crisis trend. Additionally, countries such as France and Italy withstood a larger decline in both of these variables than the average country. These declines in Spain and Italy were not matched by a corresponding increase in government expenditure, relative to baseline, to support the economy. The simulated macroeconomic impacts in the period 2020-2030 hinge not only on the size of the initial shocks in these variables, but also on whether they return to their pre-crisis trend, and if so, at which speed of convergence.[19] This is driven both by the estimation technique used for calculating forward projections (i.e., exponential smoothing), which captures the degree of persistence of these shocks in the series, and by the specific linear trend fitted on pre-crisis data. The charts in

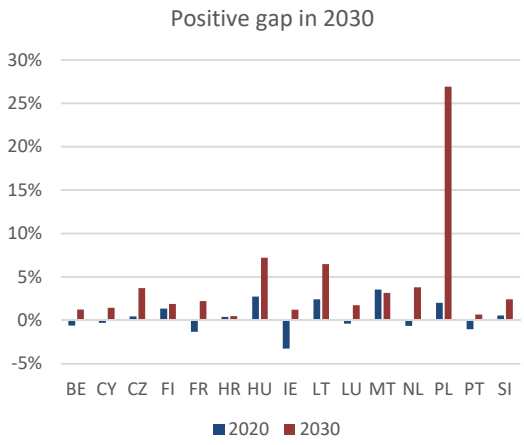
Figure 4 display the size of the initial perturbation and the projected size of the deviations in the last year of the simulation period for the three exogenous variables.

Figure 4. Deviations from trend of labour force participation rates and gross fixed capital formation over the period 2020-30, selected countries.

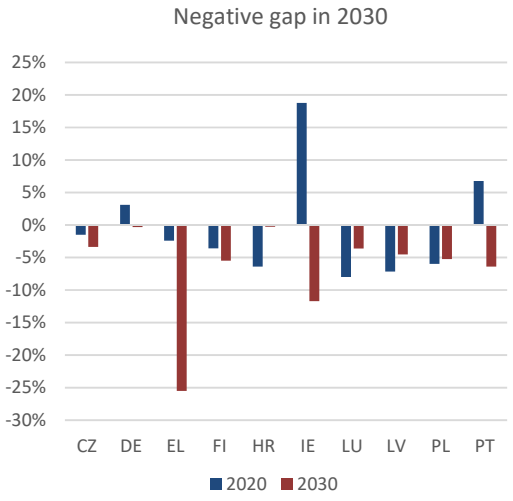
Labour force participation rates

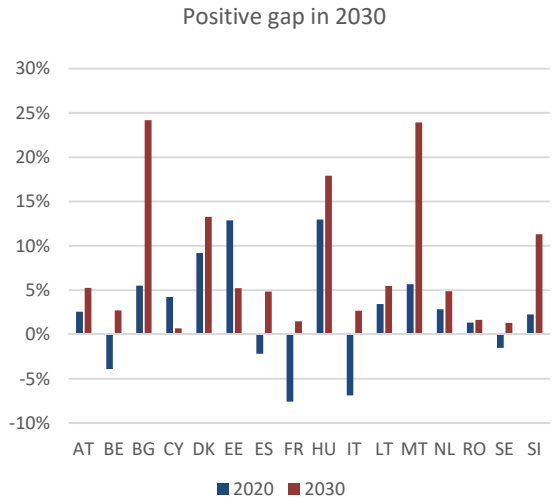
[19] It is important to note that the deviations of the shocked variables from trend are not forced to equal zero in the last year of the simulation (2030). This is because we are interested in the macroeconomic effects in the period 2020-2030, not on convergence over the long-term. If convergence was forced, the results for that period of analysis would be conditioned by this assumption.



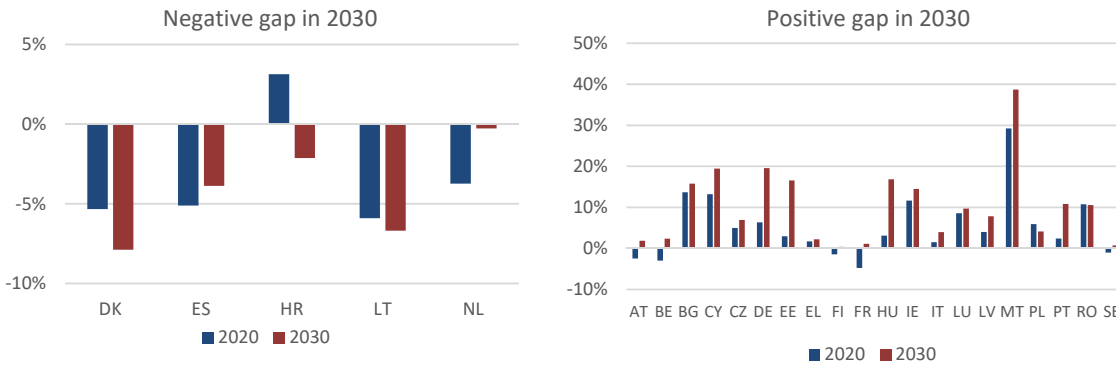


Gross fixed capital formation





Consumption expenditure of general government



Note: SK is excluded due to data limitations. *Source*: RHOMOLO and own simulations based on Eurostat data.

Figure 4 shows that there does not exist a strong correlation between the size of the initial shock in the year 2020 and the gap with respect to the pre-crisis trend in 2030. This observation applies irrespective of whether a positive or a negative gap between forecast and trend is predicted in 2030. In some cases, the initial shock is relatively small, whereas the gap in the ending year is relatively large. This in turn owes to a diverging relationship between the forecasted series and the path implied by the estimated pre-crisis trend. Concerning labour force participation, we observe a positive correlation between the size of the initial shock and the gap prevailing in 2030 in Spain. This country suffered the largest negative labour force participation rate shock in 2020, and, at the same time, its negative gap in the predicted value of this variable with respect to its pre-crisis trend is the largest in 2030. By contrast, although Romania exhibited an estimated positive gap in 2020 with respect to its pre-crisis trend, this gap is estimated to turn negative and large, relative to other Member States, by 2030. Among the set of countries exhibiting a positive gap in labour force participation in 2030, Poland stands out for a strong widening of this gap over the period 2020-2030.

Regarding private aggregate investment, Greece is expected to be in a scenario of a high negative gap with respect to the pre-crisis trend by 2030, while the initially positive gap for Ireland is expected to worsen significantly and turn negative by the end of the simulation period.[20] On the contrary, private aggregate investment might be reinforced by the crisis in countries such as Bulgaria, Hungary, and Malta, which are expected to exhibit strongly positive gaps with respect to the pre-crisis trend by 2030. Finally, government consumption, in line with the actual fiscal responses that took place in many countries during 2020 — and their persistence over time —, is projected to remain above the pre-crisis trend in 2030 in the majority of the EU countries. This means that in our COVID shock scenario, fiscal policy, as (partially) captured by government consumption, is projected to remain more expansionary, relative to baseline, in the 2020-2030 simulation period.[21]

The following step is to input the projections of the three variables just discussed into the RHOMOLO model. The next section lays out the most relevant elements and mechanisms at play in the model that condition the simulated macroeconomic response to these shocks. It also shows the main results of our simulation exercise.

[20] The gross fixed capital formation series for both variables is highly volatile, and thus the somewhat large values of the results should be interpreted with caution.

[21] It is important to reiterate that the changes shown in this graph do not reflect the actual year-on-year change in the period 2019-2020 in government consumption. For instance, even though it is well-known that government expenditure increased substantially throughout 2020 in support of economic activity in Spain in the year 2020, our historical analysis implies that this object is estimated to still have been below trend in 2020, and that it will not manage to entirely converge back to trend by 2030.

4 The RHOMOLO model with endogenous labour supply and main results

4.1 A brief description of the implementation of the labour market and investment shocks

In order to investigate the macroeconomic impact of the estimated labour market, investment and government consumption shocks, obtained as explained in the previous section, we use the version of the RHOMOLO model described in Lecca et al. (2018).[22]

The RHOMOLO model is a spatial Computable General Equilibrium model that covers 267 EU and UK NUTS2 regions plus one single exogenous region representing the Rest of the World (ROW). Spatial interactions between regional economies are captured through trade in goods and services, income flows, and factor mobility. In each region firms in ten economic sectors produces commodities combining intermediate goods, capital and labour using a technology represented by a nested CES function. Firms in a subset of the economic sectors operate under monopolistic competition while firms in the remaining sectors operate under perfect competition. Final goods are consumed by Households, Governments and Investors (in the form of capital goods), whilst firms consume intermediate inputs. Trade between and within regions is costly, implying that the shipping of goods entails transport costs assumed to be of the iceberg type. Transport costs are specific to sectors and trading partners. The model distinguishes three different labour categories corresponding to the skill/education level (low, medium, high). The model is recursively dynamic with myopic expectations, and it is solved sequentially with stocks upgraded at the beginning of each year.

In this study we resort to the endogenous labour supply version of the RHOMOLO model developed in Christensen and Persyn (2022). This version augments the baseline model by incorporating endogenous labour supply decisions by individuals, both at the *intensive* (i.e., number of hours worked) and *extensive* margins (i.e., the decision whether to actively participate in the labour market or not). This permits the conduct of policy impact evaluations which take into account these important labour market channels. In general, the inclusion of endogenous labour supply primarily influences the response of the unemployment rate; negative shocks tend to reduce average hours worked and discourage workers from remaining in the labour force, thereby attenuating the rise in the unemployment rate compared to the fixed labour supply version.

In the baseline model with exogenous labour supply, all adjustments in total hours worked in response to shocks take place entirely through changes in the unemployment rate. By contrast, in the model featuring endogenous labour supply, the effect on total hours worked of any shock can be decomposed into the variations in the population of working age, the unemployment rate, the participation rate and the hours worked per employee. The latter three components are explicitly captured as variables in the model, whereas population growth is exogenously given.[23] In our analysis, the participation rate is replaced with our data-based projections in our simulations.

The modelling of unemployment follows Blanchflower and Oswald (1995) and adopts a wage curve — an empirical regularity describing the negative relation between wages and unemployment. This approach allows for a pragmatic introduction of unemployment, while avoiding strong assumptions on the underlying labour market imperfections causing it.[24] The wage curve implies that the wage is set above its market clearing level, hence creating involuntary unemployment.

The wage curve is given by

$$\log\left(\frac{W_{r,e}}{P_r^c}\right) = \alpha_r - \varepsilon_r \log(u_{r,e})$$

[22] An example of a policy application using the model can be found in Christensen et al. (2019).

[23] Define total hours worked as $TotH = AvgH * \frac{EMP}{LF} * \frac{LF}{POP} * POP$, where $AvgH$ are average hours worked, EMP is employment, LF is the labour force and POP is population of working age. This can also be expresses as $TotH = AvgH * (1 - u) * PRT * POP$ where u is the unemployment rate and PRT is the labour market participation rate.

[24] Three theories of wage determination in imperfectly competitive labour markets are consistent with a wage curve. These are: collective wage bargaining (McDonald and Solow, 1981), efficiency wages (Shapiro and Stiglitz, 1984) and search and matching (Pissarides, 1990).

where $W_{r,e}$ is the wage for skills of type *e* in region *r*, P_r^c is the consumer price index, u is the unemployment rate and ε is the long-run wage curve elasticity. The relation between labour supply, LS, and labour demand, LD, for each skills type in each region is given by.

$$\sum_j LD_{j,e} = (1 - u_e)LS_e$$

where *j* denotes economic sectors. Hence, in effect the unemployment rate captures the inequality between labour supply and labour demand caused by wage rigidity.

For our purposes, since the goal is to examine the potential economic impact of the projected paths for the labour participation rate, fixed capital formation, and government consumption expenditure in the period 2020-2030, we overwrite the projected paths for these series in the model and introduce them as exogenous shocks. This effectively means that labour supply decisions are switched off in the model both at the *intensive* and *extensive* margins. However, by using the new endogenous labour supply module, we can take advantage of some of the new features in this model (such as calibration of hours worked and labour market participation by skills group, wage differentials and households' labour and non-labour income), and at the same time still shock the participation rate directly.[25]

In addition to the labour force participation rate, we shock public consumption and private sector investment. Private investment is modelled in a fashion which is consistent with the neoclassical theory of firms' profit maximisation. In particular, investment is a function of returns to capital, *rk*, the user cost of capital, *uck* , the depreciation rate, δ, and the existing capital stock, K in a given period:

$$I_{r,j} = \delta_r K_{r,j} \left(\frac{rk_{r,j}}{uck_{r,j}} \right)^{\nu}$$

where parameter ν governs the speed of adjustment. The user cost of capital is in turn determined by the depreciation rate, the risk free interest rate, *r*, the investment price at EU level, P_{EU}, and an exogenous risk premium, *rp*, which is the margin of adjustment used to translate the estimated investment shock into the model.

$$uck_{r,j} = (r\delta_r)P_{EU} + \Delta P_{EU} + rp_{r,i}$$

A positive gap in investment with respect to the pre-crisis trend translates into a reduction in the risk premium, while a negative gap implies a higher risk premium in the main scenario relative to the baseline, no-COVID scenario.[26] Thus, as is the case for the labour force participation rate, the equation governing investment dynamics is effectively turned off and replaced by our exogenous projections in order to gauge the impact on other macroeconomic variables. [27]

Finally, government consumption is effectively treated as an exogenous policy lever in RHOMOLO, which means that there are no specific objectives (e.g., fiscal rules) governing its behaviour. We thus just simply use our projections on government expenditure directly into the model.[28]

Shocks to labour market participation, public consumption and private investment for the 26 Member States are simulated simultaneously in the model. It is important to stress that, contrary to other scenario analyses, the joint labour market participation, private investment (risk premium), and government consumption shocks need not be temporary; all variables might not eventually return to their pre-crisis/steady state growth rates, allowing thus for the possibility of permanent gaps. This implies, in turn, that the results presented hereunder on the impacts on GDP and household consumption reflect the difference between two scenarios simulated in

[25] Due to lack of data, however, the same percentage point change in the participation rate is assumed across all skill levels. Our shocks, as they are calculated at the national level, cannot be regionalized in a meaningful way, and are thus assumed identical across regions within a given country.

[26] As pointed out in the first section on the related literature, the main reason for the contraction in investment during the crisis was a major increase in uncertainty regarding the future state of aggregate demand. The risk premium in the model captures precisely that uncertainty, implying, all else equal, a greater return demanded by lenders and thus a lower demand for capital by borrowers.

[27] In practice, risk premia are endogenized and adjusted such that the projected changes in private sector investment are reached.

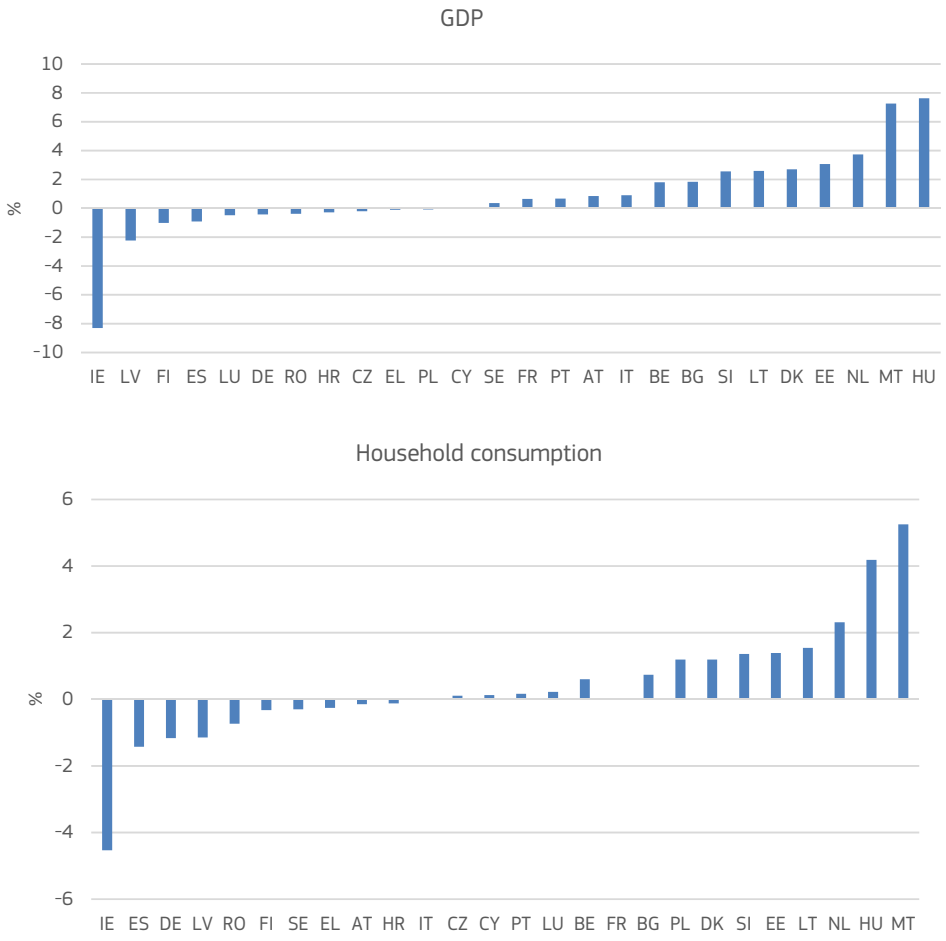
[28] This effectively means that no counterpart adjustment on the fiscal revenue side is imposed.

the model: one, the baseline/*no-COVID* scenario — estimated based on pre-2020 data — and, two, the *COVID* shock scenario obtained based on our exponential smoothing projections for the exogenous variables — estimated based on data until 2021 Q3.[29]

4.2 Results

This section presents the impact on the main macroeconomic variables for twenty-six Member States of the estimated projections for labour market participation, investment, public consumption translated into model shocks.[30] The charts in Figure 5 show the average annual impact on GDP and consumption across the 2020-2030 period arising from country-specific estimations of such paths in the same time period.

Figure 5. Impact on GDP and households' consumption of the projected changes in the labour force participation, gross fixed capital formation, and consumption of general government (2020-2030 average annual deviation from steady state).



Note: SK is excluded due to lack of data. Results for Ireland must be interpreted with caution, given the very volatile data for investment in that country. Simulations are based on JRC's RHOMOLO model. Projections for the participation rate, and private investment and government consumption are based on an exponential smoothing fitted on values from 1998Q1 to 2021Q3. Potentially conditioning factors such as capacity utilization of both labour and capital inputs are kept constant.

As apparent from Figure 5, the projected changes in participation rates, private investment, and government consumption, lead to a mixed picture across countries in terms of their average impacts on GDP and household

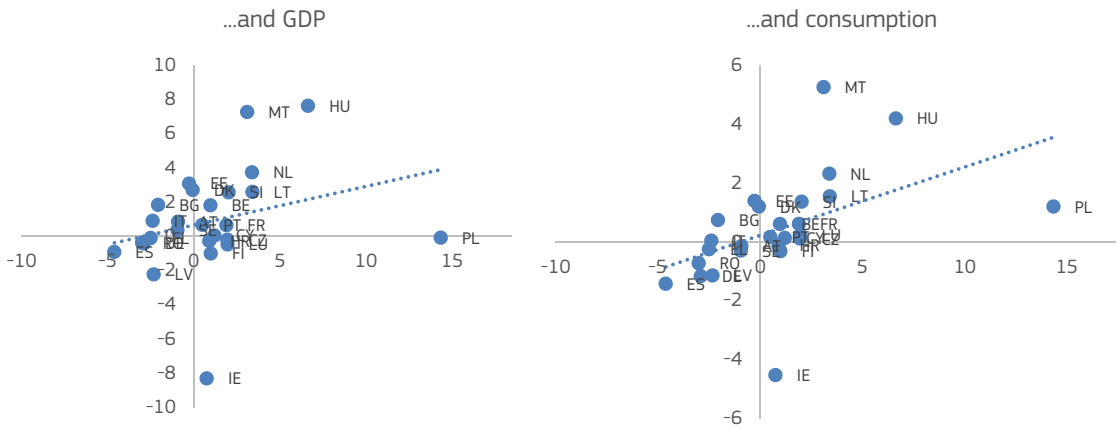
[29] The fitted projections for the three exogenous variables and all countries simulated, along with confidence intervals, are shown in Annex 3.

[30] This includes all Member States except Slovakia.

consumption. The effects differ significantly across countries in terms of their size.[31] The largest negative impact of the combined labour force participation, investment, and government consumption shocks on GDP and households' consumption in the 2020-2030 period would be borne by Ireland.[32] Germany, Latvia, and Spain are also among the most negatively affected countries in terms of these two variables. This is mainly driven by unfavourable labour market dynamics in the case of Latvia and Spain, with private investment and public consumption adding to this negative effect in each country. For Germany, lower participation rates and a worsening capital formation over time mostly explain the results. Finland is also one of the Member States that may suffer the most severe consequences of the pandemic compared to other countries. This is mainly due to the negative investment impact. By contrast, Hungary, Malta, and the Netherlands are the countries which might exit the crisis not only unscathed, but on a stronger footing relative to what their pre-crisis trends implied. Finally, it is also worth mentioning that the response of consumption is in general much more sensitive to the participation rate than to the investment shock, and vice versa for GDP. This is because changes in the participation rate directly affects households' income and therefore consumption.[33] By contrast, investment shocks directly affect output through capital accumulation. These shocks affect households' consumption only indirectly, through changes in capital income, thus yielding a lower impact.[34] In addition, shocks to the participation rate and investment also indirectly affect GDP and consumption thurough changes in factor prices, commodity prices and trade.

The charts in Figure 6 help to understand the relationship between the size of the shocks and the simulation results for GDP and consumption.

Figure 6. Correlation between the size of the three different types of shocks and the average response of GDP and consumption in the period 2020-2030 (percentage, GDP and consumption in the y-axis).



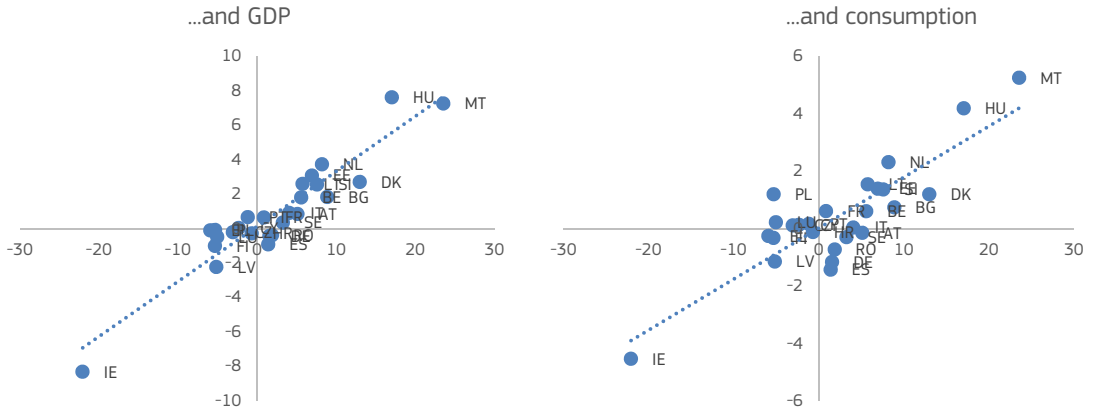
[31] The latest datapoint used is 2020Q2. This is the first quarter where the earliest economic impacts of the crisis became apparent, and the last quarter for which complete data across countries are available at the time of writing.

[32] Please note that the results for Ireland are subject to a great deal of uncertainty, given the high underlying volatility in the investment data for this country. Also, please note that the deviations shown in Figure 3 refer to the year 2020 only, and, although Ireland's gross fixed capital formation was estimated to be much higher than its trend in that year, the estimated deviations for the remaining years until 2030 show that it diverges rapidly and strongly from trend (see Figure 6). This helps explain the results observed in terms of GDP and consumption.

[33] It also affects the unemployment rate and hence wage setting through the wage curve.

[34] Note that the increase in investment is mirrored by an increasing in savings, so as to satisfy the economies' resource constraint. Consumption rises only with a lag to all shocks, after the GDP gains materialize

Gross fixed capital formation…



Consumption expenditure of general government…

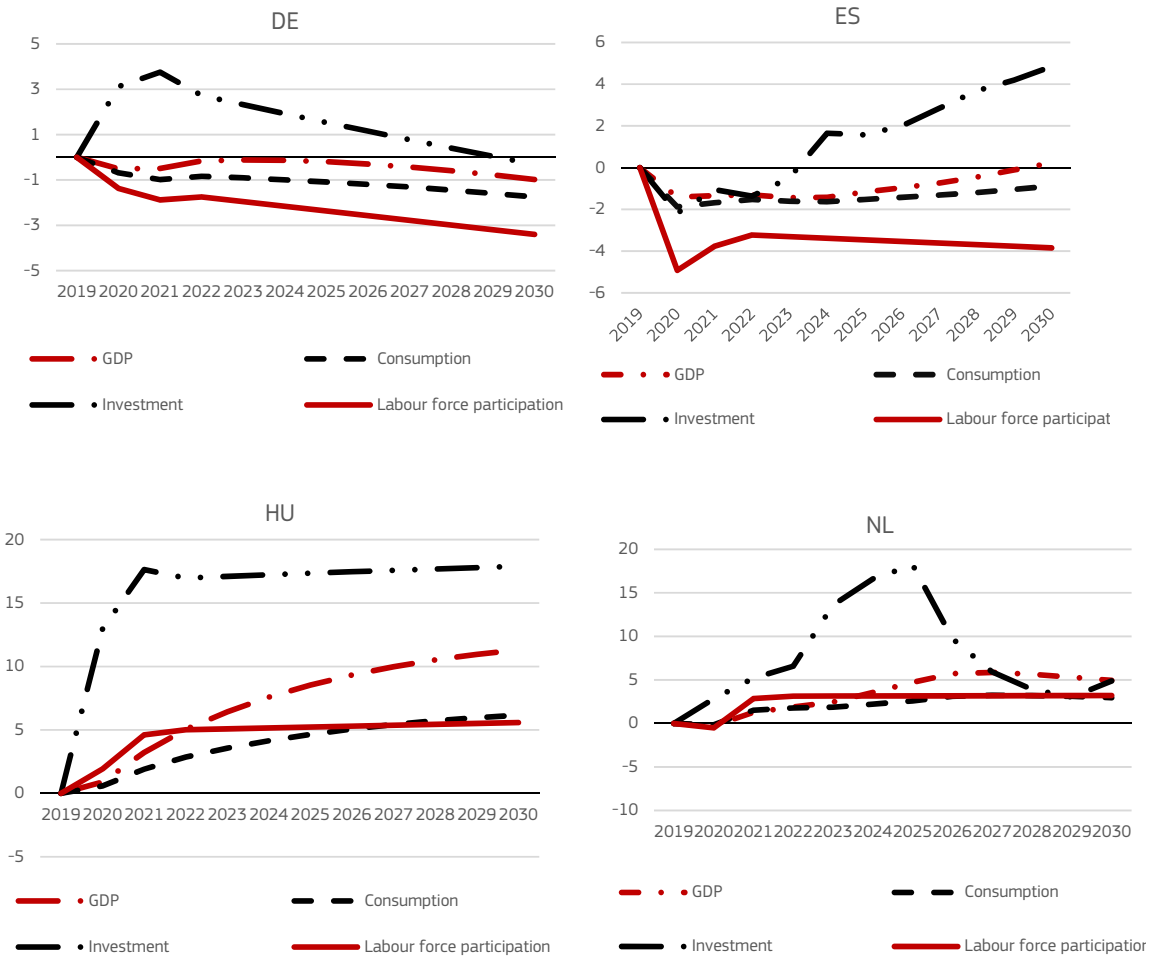
There is a strongly positive correlation between the sign and size of the shock and the resulting effects on GDP and consumption. This correlation is especially strong for private investment, since both GDP and households' consumption are especially sensitive to the accumulated capital stock.[35]

As for the dynamics and the speed of convergence for the different countries, the panel in

[35] It is important to re-emphasis that our analysis only captures the impact on GDP and consumption, leaving aside other important issues such as the impact on fiscal and debt sustainability, crowding-out of private demand, and inflationary pressures going forward. These concerns are especially relevant in the case of the government consumption shock.

Figure 7 shows the trajectories followed by GDP and consumption in the period 2020-2030 for some of the most impacted economies according to **Figure 5**:[36]

Figure 7. Responses of GDP, consumption and unemployment to the projected paths for the labour force participation rate and gross fixed capital formation.



Note: simulations results from the RHOMOLO model based on exogenous projections for the participation rate, private investment, and government consumption. Exogenous projections based on an exponential smoothing function fitted on values from 1998Q1 to 2021Q3. Country impacts are simulated using as shocks the country-specific projected labour force participation, gross fixed capital formation rates, and consumption expenditure of general government. The latter is not shown, as it has a much smaller impact on the aggregate economy compared to other two shocks (it was included mainly for completeness). Other mediating factors such as capacity utilization of both labour and capital inputs are kept constant.

The most important general observation is that there are quite persistent effects on GDP and consumption stemming from the three shocks. In addition, as the model features a mechanistic consumption-savings

[36] Ireland is excluded due to the very volatile data for investment in that country. The graphs for the rest of Member States covered can be found in Annex 2.

behaviour, by which these two objects are a fixed proportion of household income, deviations in consumption tend to track those in GDP.[37]

In Germany and Spain, the relatively large negative labour force participation shocks are estimated to be partially offset by a favourable outlook for investment. Nevertheless, the latter is insufficient to neutralise the net impact on GDP and consumption. In the COVID-19 shock scenario, consumption and GDP are lower than in the baseline scenario in the period 2020-2030 for both these economies. Despite the relatively large labour market and investment shocks recorded in 2020 in Spain, the slack in investment is not projected to be as protracted as in Germany, implying that both GDP and consumption recover more swiftly than in other countries.[38] The negative effect on German GDP and consumption is more persistent, given that the two main shocks act in the same direction.[39]

By contrast, Hungary and the Netherlands benefit from a stronger-than-trend growth in both the labour force participation rate and investment. Investment in the Netherlands in the COVID shock scenario is however predicted to subside compared to the pre-crisis baseline around midway of the period analysed. In both countries, GDP and consumption are expected to stabilize at a constant positive gap with respect to the pre-COVID trend.

Labour productivity is not included in these graphs since only small changes are observed. This is due to the fact that changes in total number of hours worked and changes in GDP tend to offset each other.[40] Toward the end of the period, however, slight reductions in labour productivity are obtained in those countries that exhibit a negative output gap with respect to the values implied by the pre-crisis trend.

It is also important to note that the speed with which the endogenous macroeconomic variables deviate or converge back to their baseline hinges crucially on the assumptions concerning wage determination. The default option in the model is that wage bargaining is represented by a wage curve, whose implication is that higher levels of unemployment decrease workers' bargaining power, thereby exerting downward pressure on real wages. The wage curve reflects an imperfectly competitive environment where unemployment not only acts as "discipline device" but also as a market clearing mechanism. The wage curve setting allows for a persistent deviation of unemployment from its initial baseline level.

5 Conclusions

The simulation results presented in this report highlight the relevance of policies that promote productive private investment and government expenditure, as well as those preventing mass withdrawal from the labour market, to prevent scarring effects on the economic fabric.[41] In light of our analysis, this may be a relevant issue in countries such as Latvia, Finland, Germany, or Spain, where, according to the data gathered until the third quarter of 2021 and our projected scenarios, these risks appear to be especially large.

Several waves of stringent measures in the EU to control the pandemic took place throughout 2020, and especially in the last quarter of last year. Some of these persisted well into the first quarter of 2022. At the time of writing, although the health situation in the EU has improved, and the most stringent restrictions have been lifted, it is still early to tell if the cumulative negative impact from the different waves of measures may have a significantly negative impact for the remainder of the decade. Our analysis attempts at shedding light on this, by providing a comparative analysis which pinpoints in which Member States the issue of economic *hysteresis* from the crisis may be more relevant.

It follows from our investigation that it is crucial to prevent continued withdrawals from the labour market and to bolster investment to boost the resilience of the economic fabric to the COVID-19 shock. Long spells out of

[37] The impact on unemployment is omitted because its dynamics are very closely linked with labour force participation's in the model. This implies that it is a mirror image of labour force participation and thus declines (increases) whenever the latter decreases (increases), while other forces such as aggregate demand play a minor role.

[38] Based on our approach to projecting labour force participation and investment rates forward, this is in turn related to the way the series for investment in Spain has behaved historically.

[39] Convergence back to the pre-crisis steady state is not fully achieved in any of these two variables.

[40] In addition, it is important to bear in mind that the total effect of the three shocks on labour productivity is not fully captured. This is because the model does not feature human capital and technological progress. An erosion of the former and a slowdown of the latter can lead to sizeable losses in productivity growth. R&D investment is generally regarded as one of the main drivers behind innovation and technological progress, whereas reductions in labour force participation in certain sectors (e.g., permanent withdrawal of workers in technologically advanced sectors) can be highly detrimental to labour productivity. Therefore, the simulation results in terms of the impact on productivity should be interpreted as belonging to the lower end of the range of the total negative effect of the crisis one con expect (in the absence of compensatory forces/policies).

[41] Note that the simulations presented abstract from any potential compensatory fiscal, monetary and other policies that might be implemented in the period simulated. However, the shape these will take and the impact they will have is at the time of writing difficult to predict.

the labour force carry a higher risk of entailing a more profound impact on the EU economy over the medium and long term. Physical distancing measures caused some disruption to schooling, especially in 2020, although it is still unclear whether it will be large enough to cause a significant drop in human capital accumulation. This is important as the latter is generally viewed as a key component in increasing productive capacity in future. It is also worth emphasising that cyclical unemployment has historically tended to have persistently negative effects on both existing and new workers. On the other hand, workers who have not suffered prolonged spells of inactivity and who have shifted to remote working might be upgrading their IT skills, raising prospects for productivity gains. Reskilling and upskilling policies focused on revamping and/or preventing the decay in human capital play in any case a crucial role in circumventing potential *hysteretic* effects on the labour market.

Concerning physical capital, it is likely that there will be a shift in its composition, which might drive an increase in private and public health infrastructure. Permanent shifts in preferences for different investment goods may also lead to shifts in the sectoral distribution of investment.

The current consensus is that the policy responses to boost economic recovery need to be in line with the specific features of the COVID crisis legacy. In this sense, that premature fiscal tightening should be avoided, and additional short-term support should be given to prevent scarring. Likewise, there is a risk that countries resort to excessive protectionism to fend off future similar crisis. However, the reshoring of global value chains may lead to efficiency losses, thereby potentially leading to other problems such as sluggish productivity growth in the EU. Structural reforms that target bottlenecks to boost productivity growth are viewed by many analysts as a central element of a sound plan of policy action. Similarly, in the context of the EU, deep, liquid and integrated capital markets can help resolve debt overhangs after the pandemic and may provide new impetus for growth (Claeys et al., 2021).

Our analysis shows that the recovery paths over the medium and long terms are likely to differ across countries, due to the size of the shocks combined with the policy responses, mainly in terms of the restrictions to economic activity and the fiscal support measures implemented. It also shows that the impact of the crisis on economic growth may be more protracted than initially thought. This legacy may affect the observed secular decline in potential growth, which adds to immediate challenges, such as geopolitical tensions, and other existing pressing issues such as climate change, digitalisation, increasing market concentration, and rising income inequality.

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Annexes

Annex 1. The exponential smoothing function

Exponential smoothing is a time-series data technique which is used mainly to smooth data by removing high-frequency cyclical components. Its primary feature in comparison with competing techniques (e.g., simple moving average) is that it assigns exponentially decreasing weights over time, so that the recent past carries a higher weight in projecting future values for the time series. In economics, this technique is used to identify historical patterns of trend or seasonality in the data and then extrapolate these patterns forward into a given forecast period. Its accuracy depends on the degree to which established patterns of change are apparent and constant over time.

The built-in Excel capability employed in our analysis uses the triple smoothing technique, meaning that not only the level and trend components, but also the seasonal component is captured.[42] Algebraically, the forecasting equations read as follows:

$$s_t = \alpha \frac{x_t}{c_{t-L}} + (1-\alpha)(s_{t-1} + b_{t-1})$$

$$b_t = \beta(s_t - s_{t-1}) + (1-\beta)b_{t-1}$$

$$c_t = \gamma \frac{x_t}{s_t} + (1-\gamma)c_{t-L}$$

$$F_{t+m} = (s_t + mb_t)c_{t-L+1+((m-1) \bmod L)}$$

where x_t is the actual value of the variable in period t, s_t represents the smoothed value of the stationary part, b_t is the sequence of best estimates of the linear trend that are superimposed on the seasonal changes, c_t is the sequence of seasonal correction factors, L is the length of the seasonal cycle, and F_{t+m} is the forecasted value in period $t+m$. The key smoothing parameters (α, β, γ) needed to obtain future projections are estimated by minimising the root mean squared error (RMSE) of the gap between the actual and forecasted in-sample values of the series.[43]

The degree of confidence in the projections calculated using this method differs substantially across the countries analysed, owing in turn to the quality and volatility of the underlying data. For this reason, we have also resorted to simple linear trend projections in cases where the exponential smoothing model provides rather unreliable forecasts due to a poor fit to the data.[44] In general, however, we have opted for using exponential smoothing when deemed appropriate, since this method is able to capture better the persistence of the deviations from trend (i.e., shocks) which is of critical importance for the purposes of our analysis.

After obtaining point forecasts of the labour market participation and investment series until 2030, it is necessary to compare them with the predicted trend (or steady state) values. In order to estimate the latter, we have resorted to linear, moving average and, in only one case, polynomial functions.[45] We have however opted for the linear projection whenever feasible as it provides a better estimation of long-term trends.[46] The resulting deviations between forecasted and trend values so-calculated are then incorporated into the model as shocks.

[42] For more information on the exponential smoothing forecast capability of Excel, please see https://www.real-statistics.com/time-series-analysis/basic-time-series-forecasting/excel-2016-forecasting-functions/

[43] Excel 2016 provides an automated version of the functions that perform these calculations. In a dialog box, the user can choose criteria such as the level of confidence for constructing confidence intervals, the forecast starting and end periods, and the length of the seasonal component. In the projections made for this report, we have chosen to let the latter be automatically detected by the software.

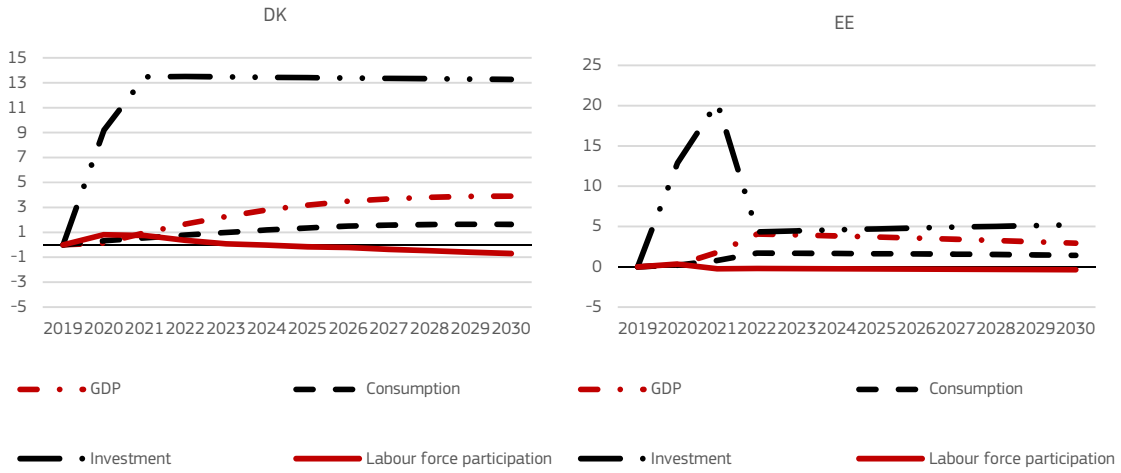
[44] This is the case for CY, HR, HU, LU, and PL.

[45] A polynomial of order five was fitted to estimate CZ's trend in the participation rate.

[46] A binding condition for our analysis is that both variables converge back to their steady state levels by 2030.This is needed for us to be able to incorporate the shocks into the model. In case where the estimated series and linear trend values were diverting (meaning that the shock increases in size over time and becomes permanent) a moving average of order two has been used to estimate the trend values to ensure the closing of the gap between these and the point forecasts.

Annex 2. Simulation results for all countries*

* All variables except the labour force participation rate are expressed in percentage deviations from the implied values of the estimated pre-crisis trend. Deviations for the labour force participation rate are in percentage points.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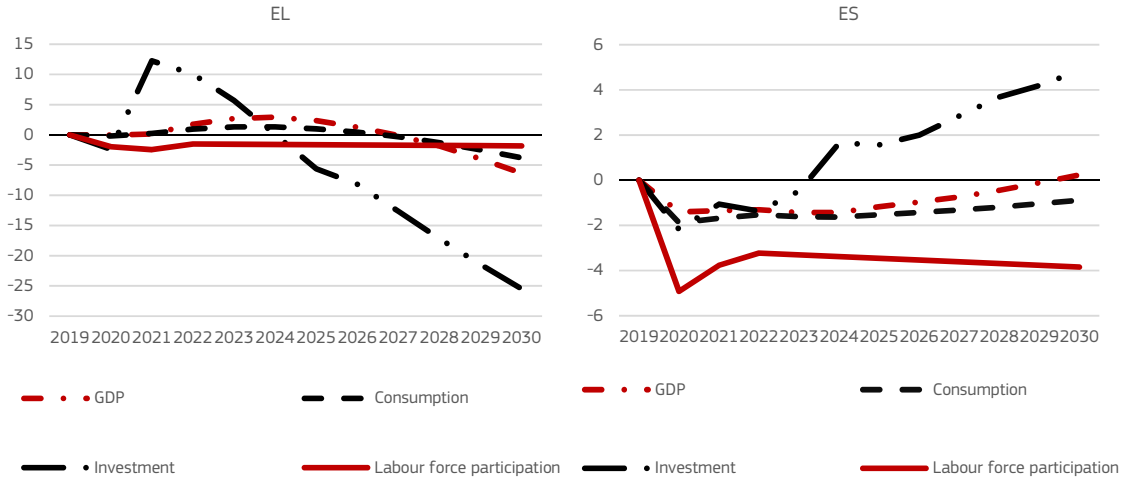
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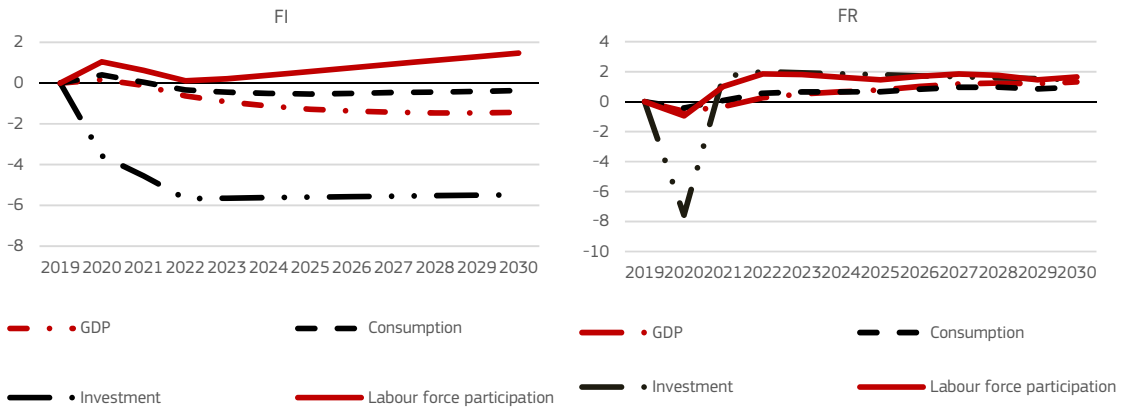
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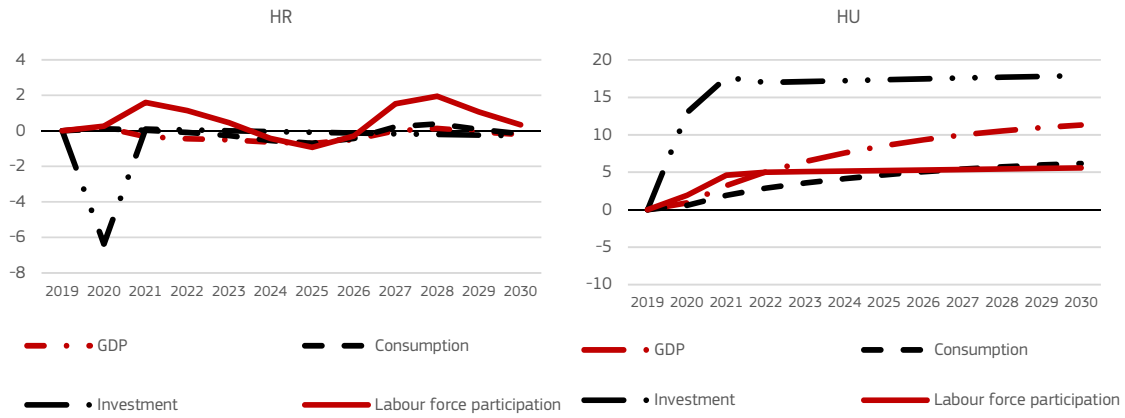
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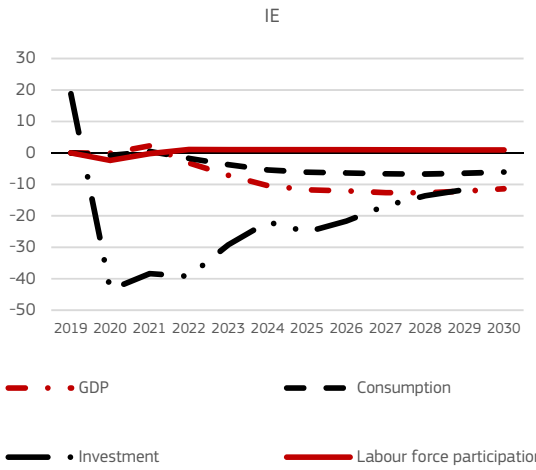
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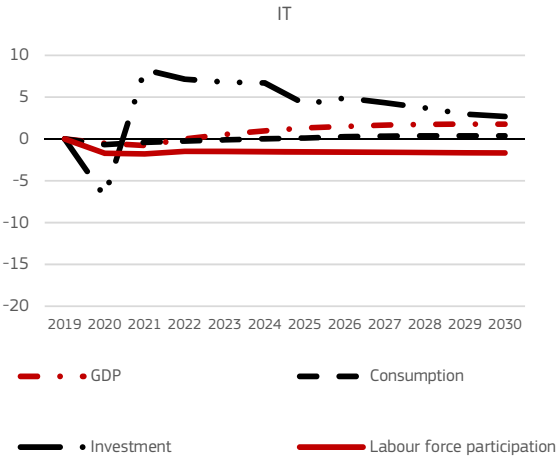
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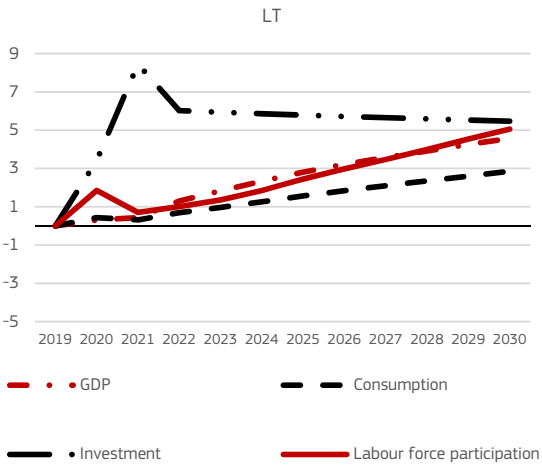
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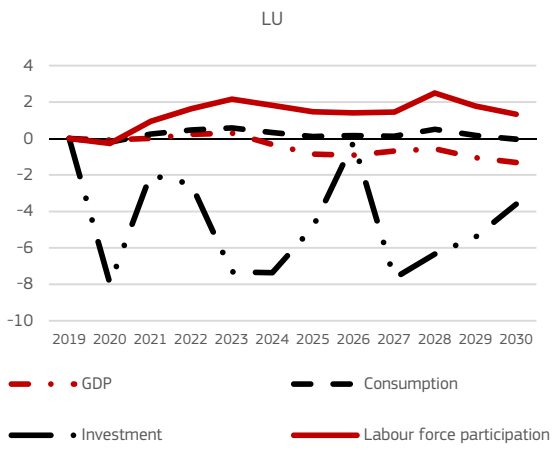
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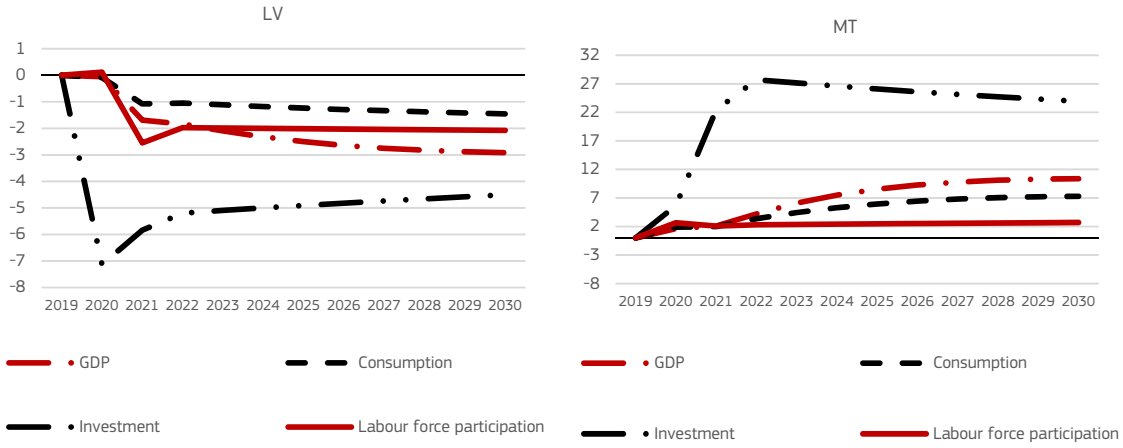
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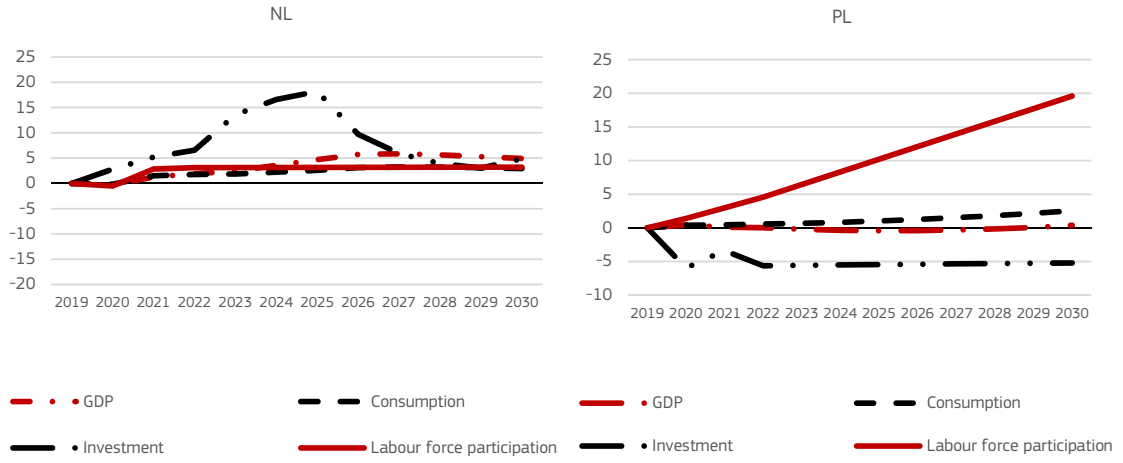
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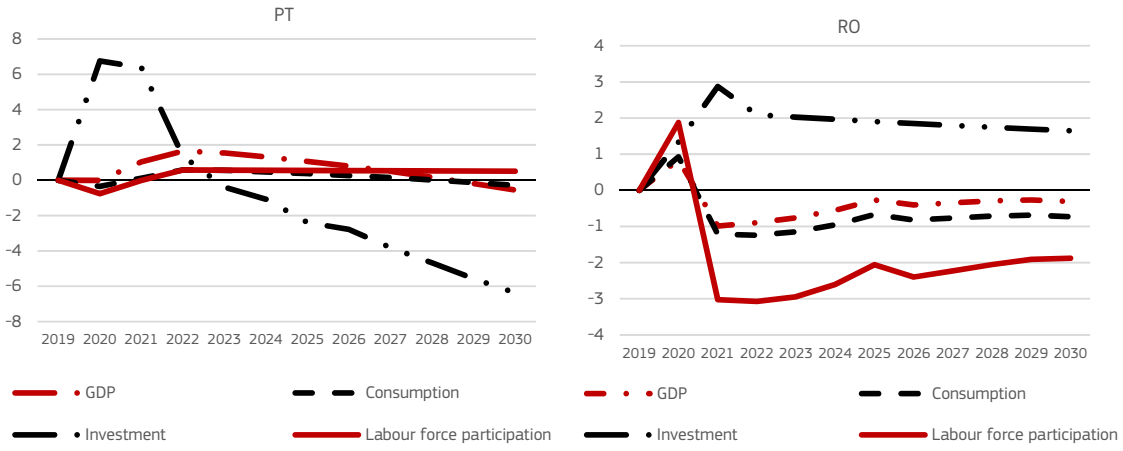
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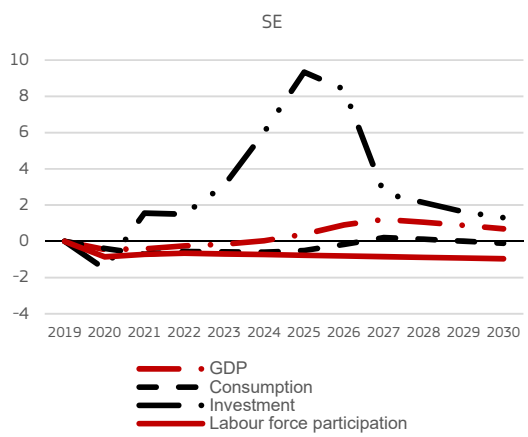
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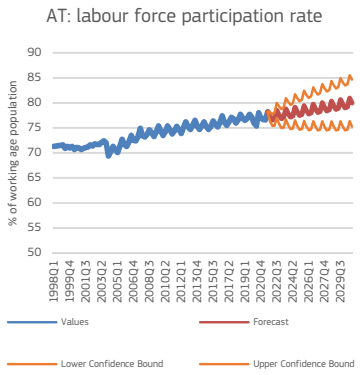
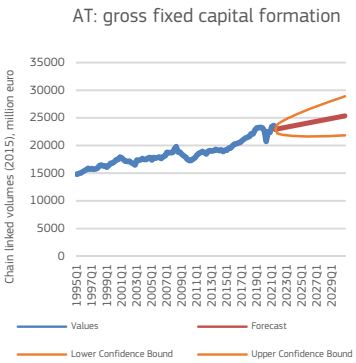
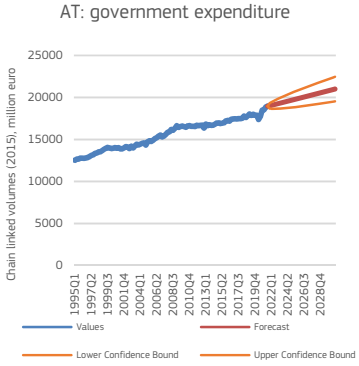
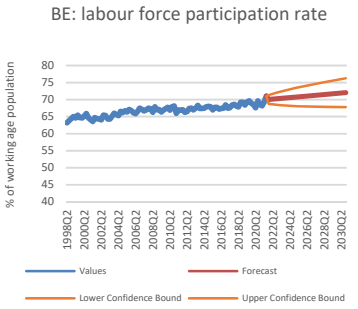
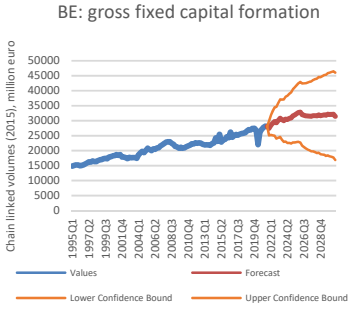
Annex 3. Exponential smoothing forecasts and confidence intervals for all countries.

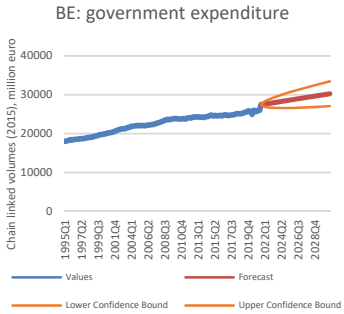


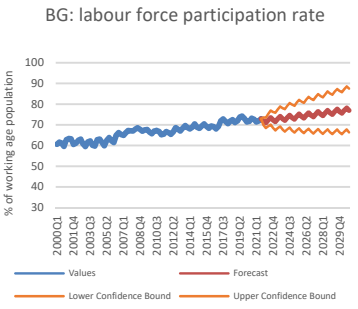


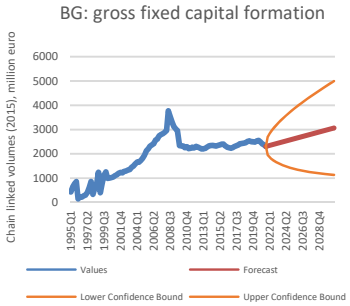


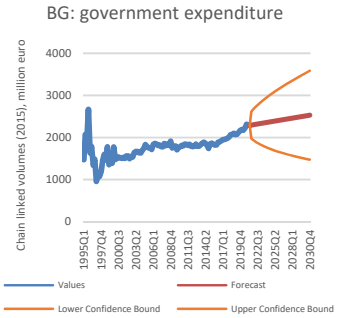


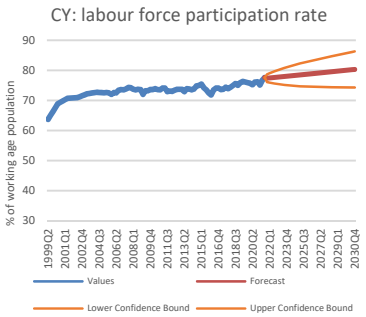


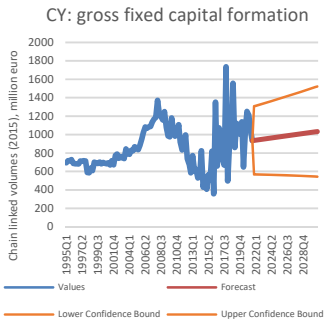


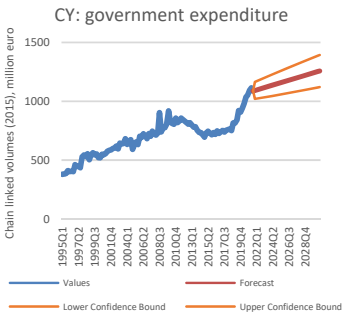


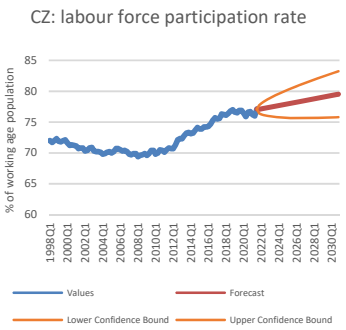


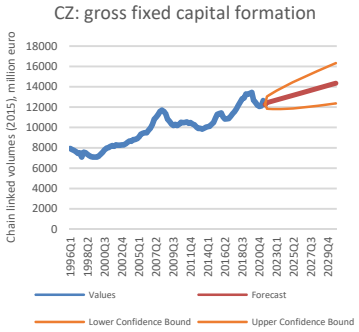


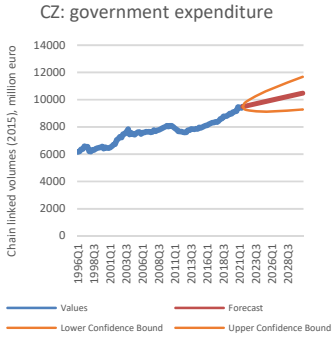


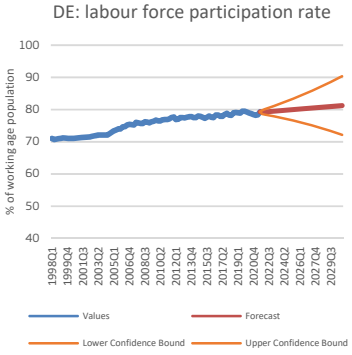


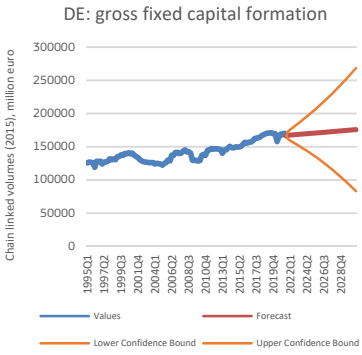


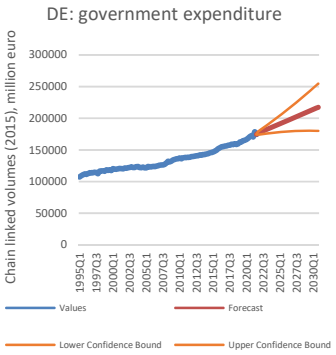

CZ: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

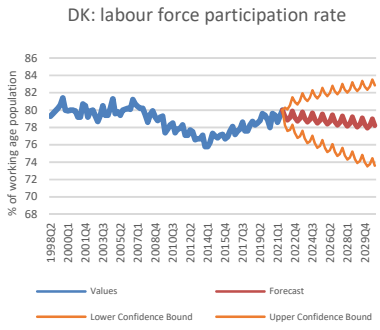

CZ: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

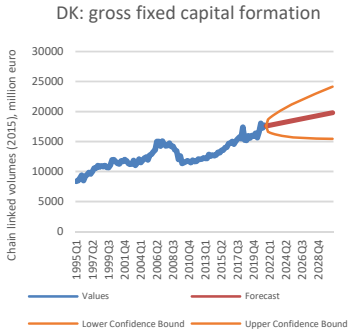

CZ: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

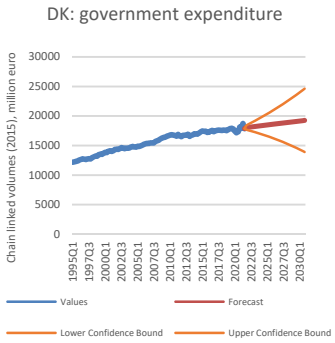

DE: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

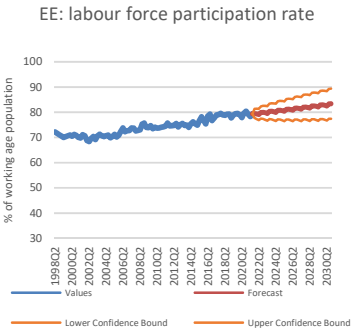

DE: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

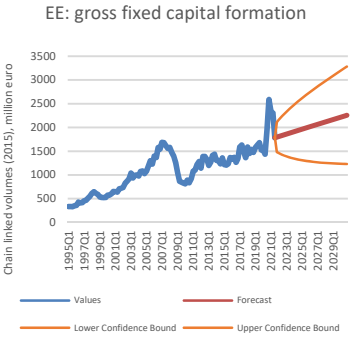

DE: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

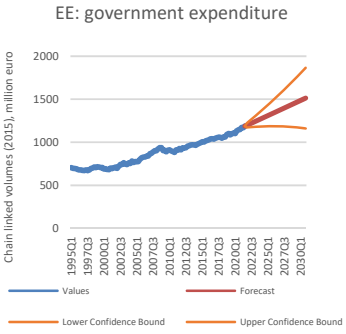

DK: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

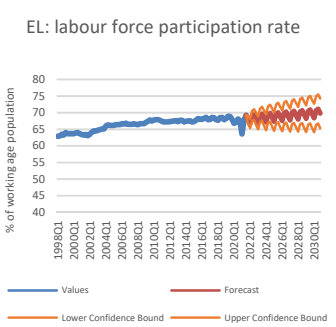

DK: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

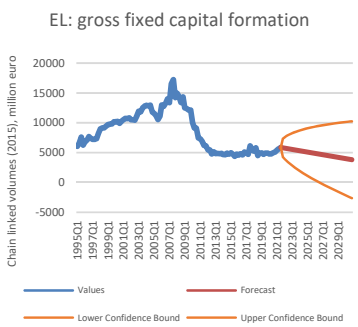

DK: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

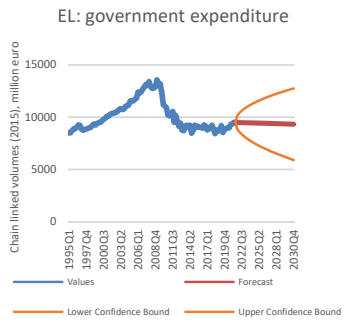

EE: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

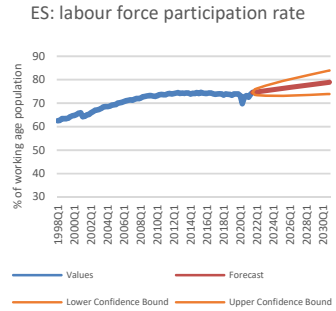

EE: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

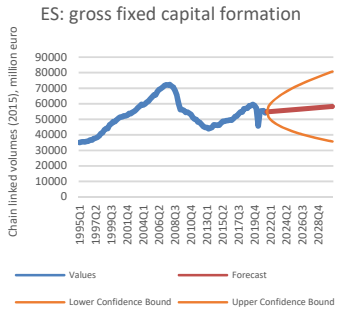

EE: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

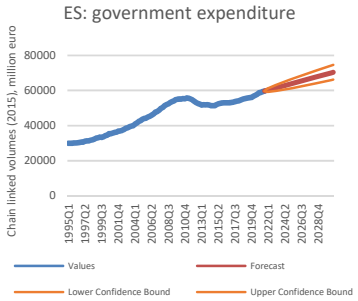

EL: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

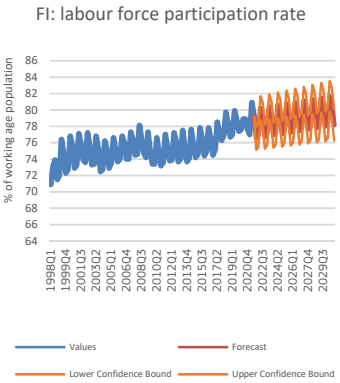

EL: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

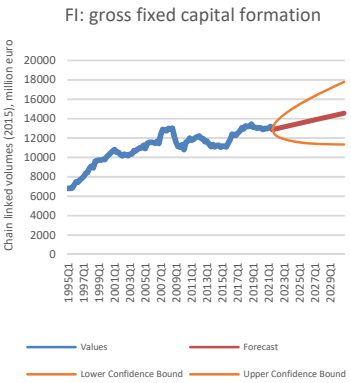

EL: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

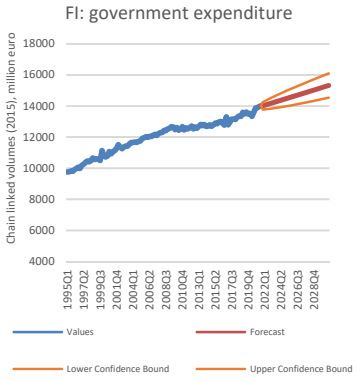

ES: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

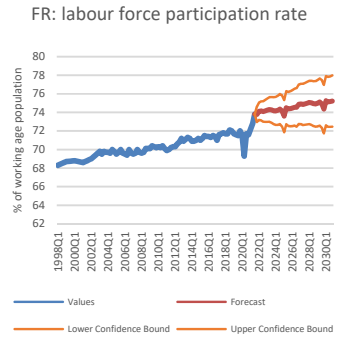

ES: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

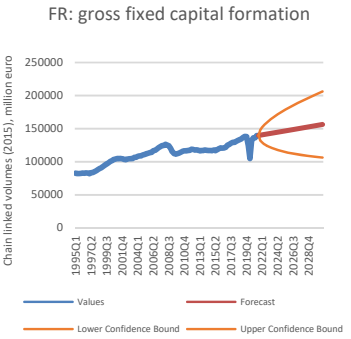

ES: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

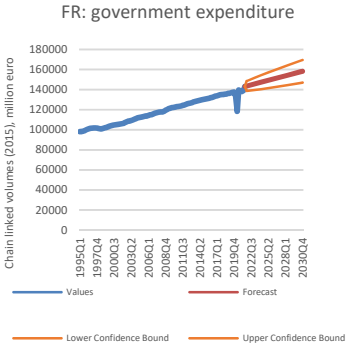

FI: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

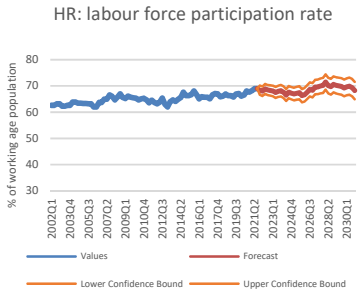

FI: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

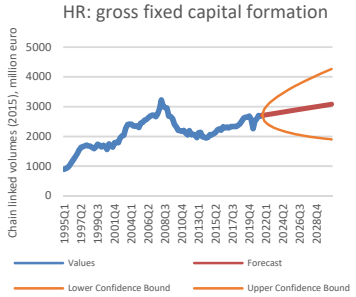

FI: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

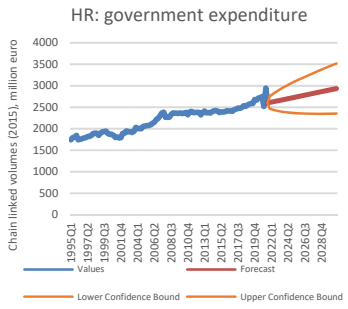

FR: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

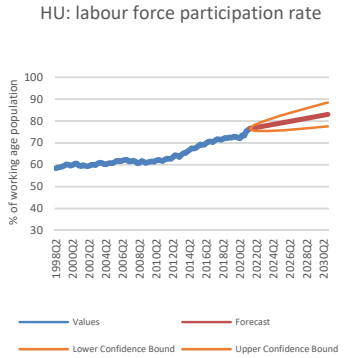

FR: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

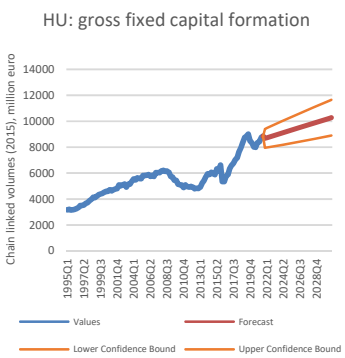

FR: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

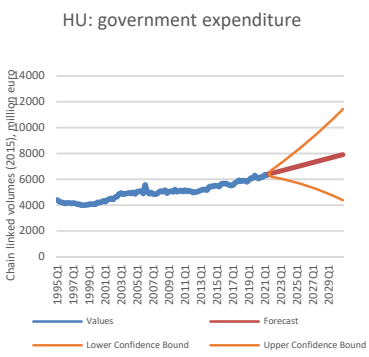

HR: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

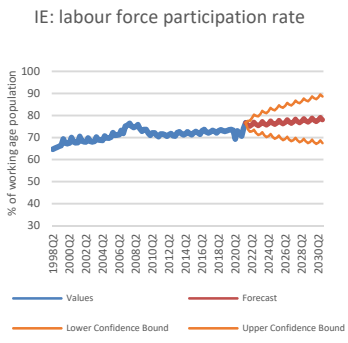

HR: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

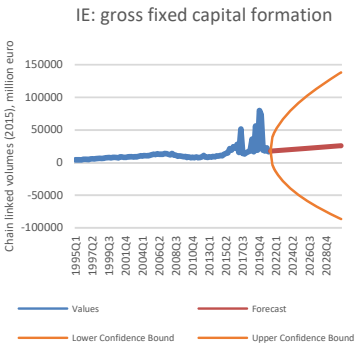

HR: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

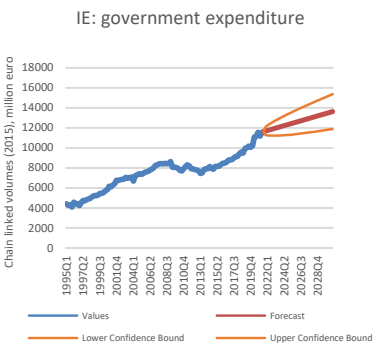

HU: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

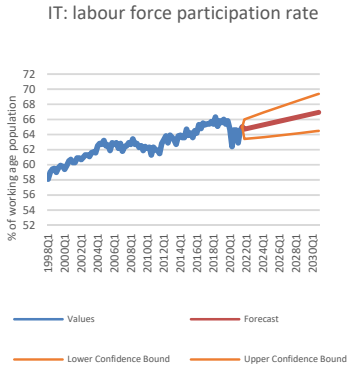

HU: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

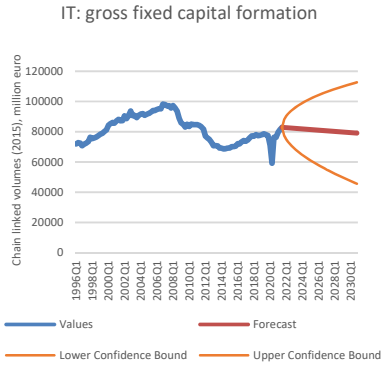

HU: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

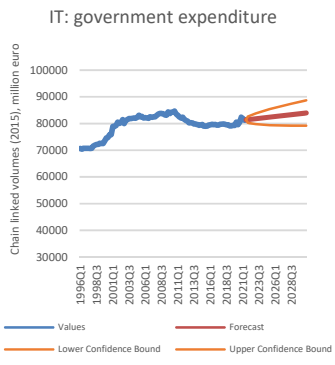

IE: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

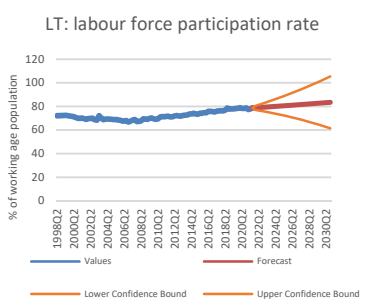

IE: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

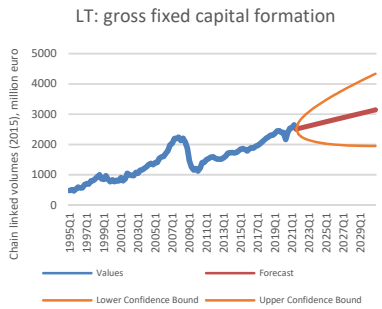

IE: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

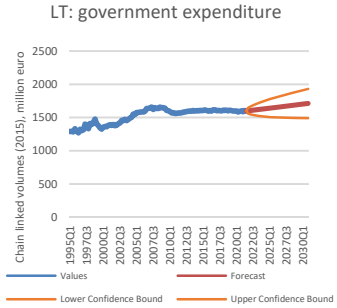

IT: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

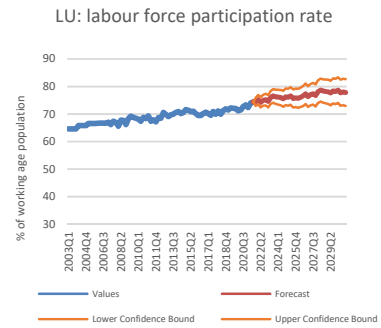

IT: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

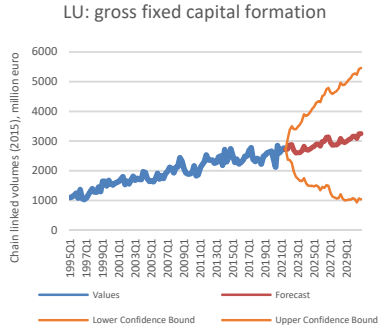

IT: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

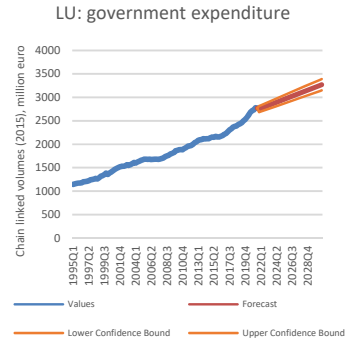

LT: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

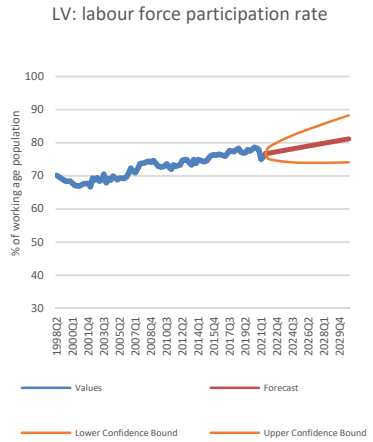

LT: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

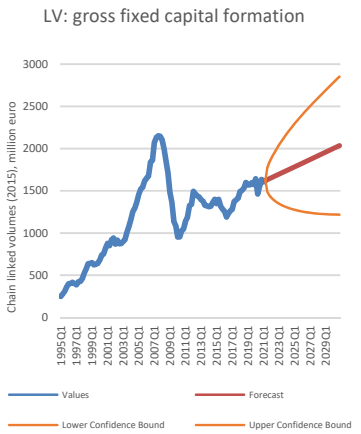

LT: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

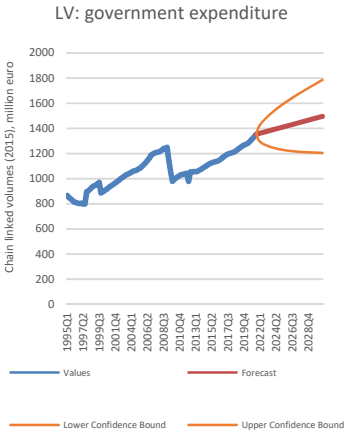

LU: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

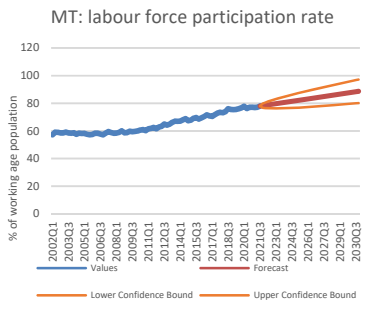

LU: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

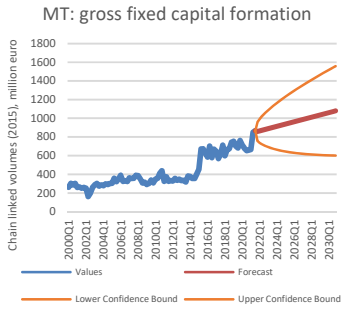

LU: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

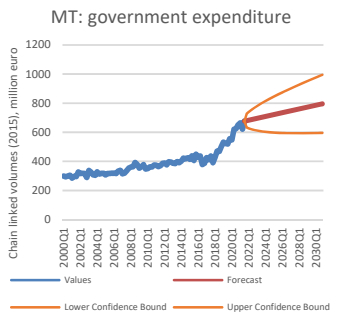

LV: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

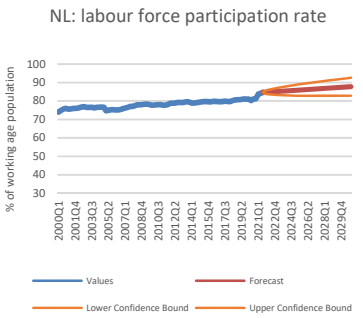

LV: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

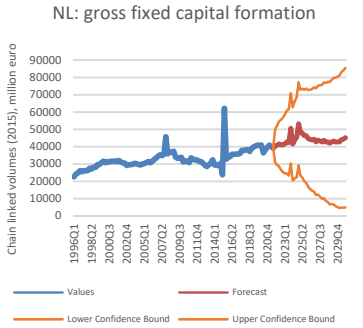

LV: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

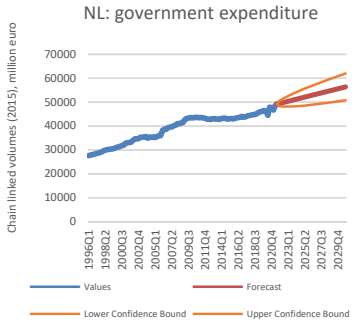

MT: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

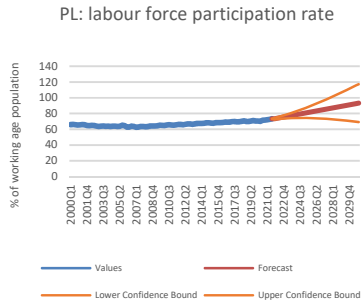

MT: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

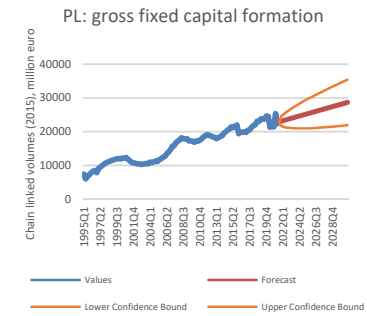

MT: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

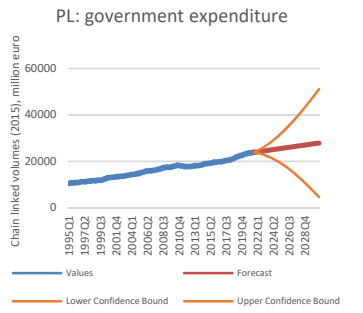

NL: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

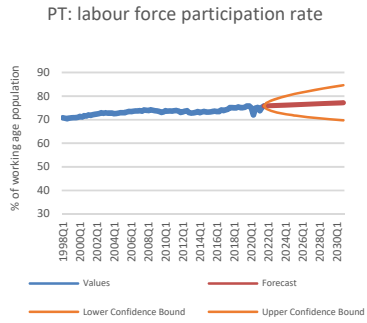

NL: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

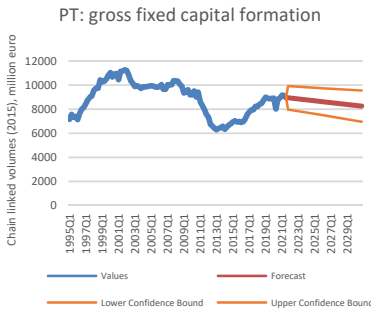

NL: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

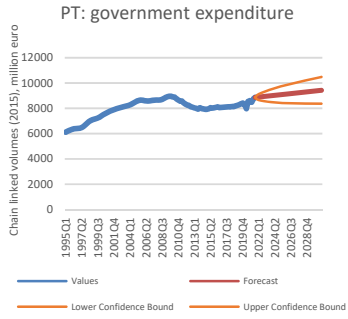

PL: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

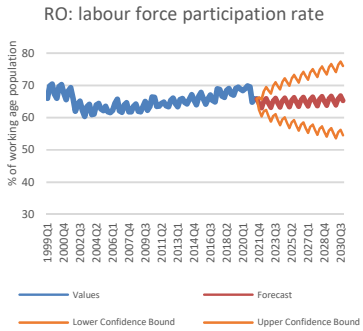

PL: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

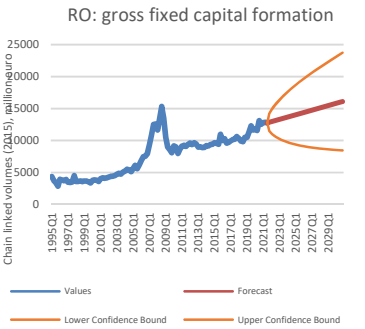

PL: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

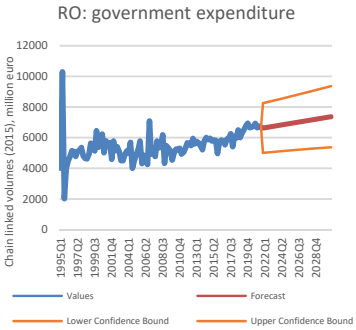

PT: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

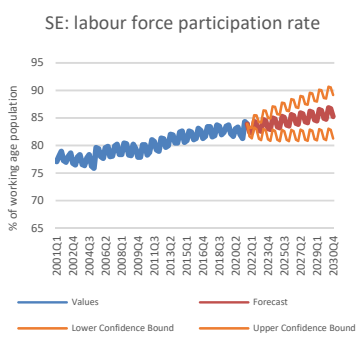

PT: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

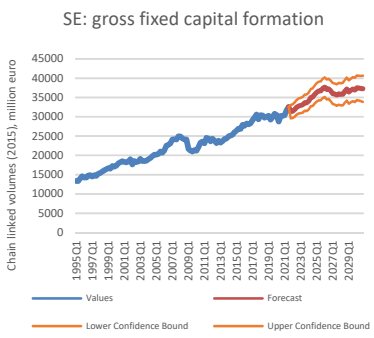

PT: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

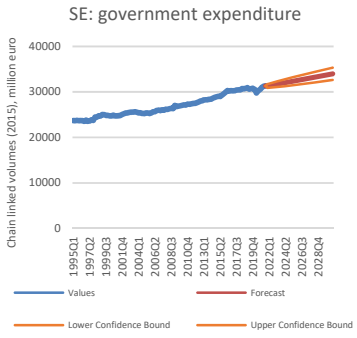

RO: labour force participation rate
% of working age population
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

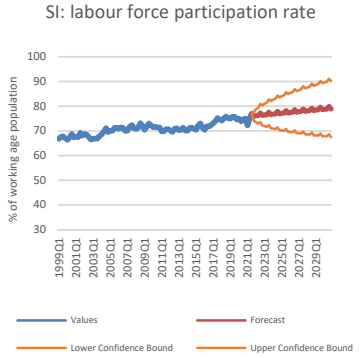

RO: gross fixed capital formation
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

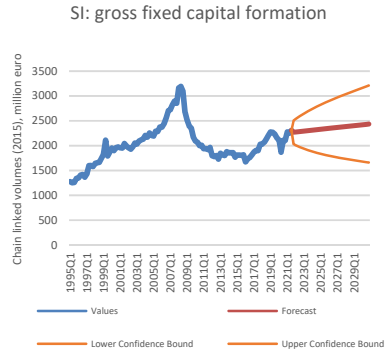

RO: government expenditure
Chain linked volumes (2015), million euro
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

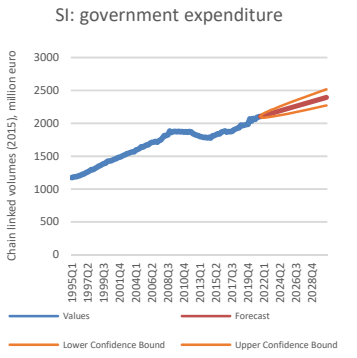

SE: labour force participation rate
% of working age population
95
90
85
80
75
70
65
2001Q1
2002Q4
2004Q3
2006Q2
2008Q1
2009Q4
2011Q3
2013Q2
2015Q1
2016Q4
2018Q3
2020Q2
2022Q1
2023Q4
2025Q3
2027Q2
2029Q1
2030Q4
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound


SE: gross fixed capital formation
Chain linked volumes (2015), million euro
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1995Q1
1997Q1
1999Q1
2001Q1
2003Q1
2005Q1
2007Q1
2009Q1
2011Q1
2013Q1
2015Q1
2017Q1
2019Q1
2021Q1
2023Q1
2025Q1
2027Q1
2029Q1
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound


SE: government expenditure
Chain linked volumes (2015), million euro
40000
30000
20000
10000
0
1995Q1
1997Q2
1999Q3
2001Q4
2004Q1
2006Q2
2008Q3
2010Q4
2013Q1
2015Q2
2017Q3
2019Q4
2022Q1
2024Q2
2026Q3
2028Q4
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound


SI: labour force participation rate
% of working age population
100
90
80
70
60
50
40
30
1999Q1
2001Q1
2003Q1
2005Q1
2007Q1
2009Q1
2011Q1
2013Q1
2015Q1
2017Q1
2019Q1
2021Q1
2023Q1
2025Q1
2027Q1
2029Q1
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound


SI: gross fixed capital formation
Chain linked volumes (2015), million euro
3500
3000
2500
2000
1500
1000
500
0
1995Q1
1997Q1
1999Q1
2001Q1
2003Q1
2005Q1
2007Q1
2009Q1
2011Q1
2013Q1
2015Q1
2017Q1
2019Q1
2021Q1
2023Q1
2025Q1
2027Q1
2029Q1
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound


SI: government expenditure
Chain linked volumes (2015), million euro
3000
2500
2000
1500
1000
500
0
1995Q1
1997Q2
1999Q3
2001Q4
2004Q1
2006Q2
2008Q3
2010Q4
2013Q1
2015Q2
2017Q3
2019Q4
2022Q1
2024Q2
2026Q3
2028Q4
Values
Forecast
Lower Confidence Bound
Upper Confidence Bound

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