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Santiago Calvo Ramos, Joana Elisa Maldonado, Anneleen Vandeplass and István Ványolós

Abstract

This paper provides a review of estimates of the prevalence of long COVID in the EU, and a tentative assessment of its economic impact, in particular on labour supply. This tentative approach yields an estimated prevalence of long COVID cases of around 1.7% of the EU population in 2021 and 2.9% in 2022, resulting in a negative impact on labour supply of 0.2–0.3% in 2021 and 0.3–0.5% in 2022. In person-equivalents, this means long COVID would have reduced labour supply by 364,000–663,000 in 2021 and by 621,000–1,112,000 in 2022, combining the effect of lower productivity, higher sick leaves, lower hours, and increased unemployment or inactivity. The lower bound of this range is close to a recent estimate put forward for the US (Abraham & Rendell, 2023). These figures imply that long COVID could have caused an output loss of 0.1–0.2% in 2021 and 0.2–0.3% in 2022. Available labour market data suggest a mixed picture when it comes to the impact of long COVID. Overall, the possible role of long COVID in the rising trend in sick leave, disability and activity-limiting health factors, warrants careful monitoring going forward, due to its potential impact on labour supply and labour productivity, and on public finances through increased social benefits, pensions, health care and long-term care expenditure.

JEL Classification: E23, E24, I18, J01, J21, J22, O5

Keywords: long COVID, economic impact, labour supply, EU output loss

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INTRODUCTION

Long COVID is a post-acute infection syndrome associated with physiological dysfunction (Iwasaki & Putrino, 2023). Its impact on the economy and on labour market participation has been gaining attention as economies started to emerge from the pandemic. To date, evidence remains scant, partly due to the lack of a harmonised definition of long COVID, but also to the paucity of information on its prevalence and impact on individuals' capacity to work, also reflecting the wide spectrum in observed symptoms and their gravity.¹

While they may no longer consider COVID-19 a public health emergency of international concern, the World Health Organization (WHO) acknowledged in May 2023 that millions of people continue to be infected and re-infected, and that hundreds of millions of people around the world are in need of longer-term care now and in the foreseeable future as a result of post-COVID-19 conditions (WHO, 2023). Long COVID symptoms can affect individuals' capacity to participate in the labour market, either in the form of reduced productivity (e.g. due to fatigue, post-exertional malaise, lack of concentration or other neurological symptoms of long COVID), absenteeism and sick leave, or through increased unemployment or inactivity. Additional economic effects could arise from diagnostic and treatment costs, labour shortages and indirect effects on the cost of labour, inflation, and supply chains, ultimately affecting GDP and economic growth.

To the best of our knowledge, so far, no study has explicitly addressed the impact of long COVID on the EU labour market. The present paper provides a tentative assessment using available estimates from surveys, clinical follow-up studies and model simulations of the prevalence of long COVID.

This tentative approach yields an estimated prevalence of long COVID cases of around 1.7% of the EU population in 2021 and 2.9% in 2022, resulting in a negative impact on labour supply of 0.2–0.3% in 2021 and 0.3–0.5% in 2022. In person-equivalents, this means long COVID is assumed to have reduced labour supply by 364,000 – 663,000 in 2021 and by 621,000 – 1,112,000 in 2022 – combining the effect of lower productivity, higher sick leaves, lower hours, and increased unemployment or inactivity. The lower bound of this range is close to a recent estimate put forward for the US (Abraham & Rendell, 2023). These figures imply that, with a labour elasticity of the potential output level of 65%, long COVID is estimated to have caused an output loss of 0.1–0.2% in 2021 and 0.2–0.3% in 2022.

Available labour market data suggest a mixed picture when it comes to the impact of long COVID. On the one hand, observed activity and employment rates in the EU recovered to historically high levels in 2022 after the COVID-19-related recession, in spite of strong headwinds. Data on all-cause absences from work, while on an upward trend, do not show an upward shift on aggregate after the initial 2020 shock. At the same time, there is a notable gender difference, with women returning in 2023 to previous trends in absences, while men are doing better than what a continuation of previous trends would suggest.

Other indicators suggest that in 2022, health-related issues (COVID-19-related or of other origin) contributed more than in previous years to a reduction in labour supply at the external (i.e. transition into inactivity) and the internal margin (i.e. a reduction in hours). Notably, there has been a sizeable increase in sick leave reported by several EU Member States in 2022, with acute COVID, long COVID and seasonal respiratory illnesses all likely to have been significant contributors.² There has also been an increase in people reporting disability or long-term illness, people inactive due to illness or disability and in part-time work due to illness or disability. The timing and distribution of these observations (with women being more severely affected) could mean that long COVID is a contributing factor. Overall, the health impact of long COVID warrants careful monitoring going

¹ For example, long COVID can manifest as severe pulmonary, cardiovascular and neurological impairments, lead (inter alia) to persistent fatigue, memory loss and/or mental confusion, but it can also appear as loss of taste or smell to different degrees, which would in most cases have a less limiting impact on individuals' activities.

² The discrepancy of the evolution of this indicator versus absences from work may be due to those absences that are not related to illness or disability.

forward, due to its potential impact on labour supply, productivity and on public finances through expenditures on income support, pensions, health care and long-term care.

Beyond their aggregate impact, long COVID cases are not evenly distributed across the population. They are more common, for example, among women, people living in more deprived areas and those with underlying health conditions. In terms of the sectoral distribution, the largest negative effects of long COVID are expected in contact-intensive services such as health care and long-term care, where they add to existing structural shortages. Finally, the education sector could suffer a disproportionate impact as well, exacerbating existing teacher shortages.

While there remains considerable uncertainty regarding the future evolution of COVID-19 and long COVID numbers, available data suggest that long COVID prevalence peaked in 2022 and then dropped and stabilised at a lower but still significant level (Burns, 2023; UK ONS, 2023, US CDC, 2023). Since April 2022, regular waves of COVID-19 infections occurred in Europe, with a smaller burden on the hospital sector due to vaccination and greater population immunity but with a still large number of infections, even if they are increasingly underestimated by gradually reduced testing³. The low levels of testing, in particular for the working-age population, make it likely that diagnosing long COVID will become more difficult in the future, at least until more accurate diagnostic techniques have been developed based on biomarkers.

Vaccination with first-generation vaccines has been found to reduce the risk of long COVID by 15% to 41%, thus offering some, but not full protection.⁴ Omicron (2022-onwards) variants have shown to be less likely to cause long COVID per infection than earlier variants (e.g. Durstenfeld et al., 2023), although the high numbers of infections driven by the first Omicron variants still caused an increase in the total number of long COVID cases (Wise, 2022).

If society's immunity increases over time and, in particular, if COVID-19 cases decline, long COVID cases are set to further decline as well; though for some, long COVID conditions are likely to persist for their lifetime. Under more pessimistic scenarios with regard to the development of immunity and evolution of new variants, the burden of long COVID could still be elevated for a number of years to come (Saad-Roy et al., 2023).

Development of new treatments (see Davis, 2023 for a summary of current candidates) as well as interventions to significantly reduce infections, such as second-generation COVID vaccines (see Cohen, 2023) and improved indoor air quality legislation (such as the new Belgian Indoor Air Quality law, see Lewis (2023)) can further reduce the long-term burden of long COVID.

ESTIMATING THE ECONOMIC COSTS OF LONG COVID

This paper estimates the economic cost of long COVID through its direct impacts on the labour market. It uses prevalence estimates of long COVID and assumptions on how it affects the capacity to work of those affected to calculate the impact on the labour supply.

The direct implications of long COVID for affected individuals concern their capacity to work, and their productivity at work. Some individuals might continue to work, but at a lower productivity level, some might reduce their hours worked, including as a result of temporary absences, and some might stop working at all.

For a more comprehensive assessment of the economic costs of long COVID, one would also need to take into account indirect labour market impacts, as well as costs beyond the labour market. For instance, long COVID could put upward pressure on labour shortages and labour costs, by reducing productivity and/or by putting

³ Studies aiming to detect the real level of cases estimate a prevalence of COVID far above that implied by officially reported cases (see for example University of Mainz (2023) and the analysis of wastewater in the Netherlands, which suggests continuing waves of infections despite reported cases remaining low (RIVM, 2023a). This phenomenon has been exacerbated since 2022 as PCR testing has become more restrictive, with a stronger focus on high-risk individuals (WHO, 2023).

⁴ While for some individuals, vaccination might worsen the symptoms of long COVID or trigger long COVID symptoms in healthy individuals, the existing evidence shows overall positive effects from vaccination. Numbers on risk reduction from Davis et al. (2023). Byambasuren et al. (2023) present a systematic review of the effect of COVID-19 vaccination on long COVID.

upward pressure on wages by exacerbating labour shortages. Additional economic costs are likely to occur in the form of diagnostic and treatment costs, sick leave compensation and hospitalisation, but also in the form of additional income support, including pensions. The assessment of these costs is however beyond the scope of this paper.

ESTIMATES OF LONG COVID CASES

Different terms (e.g., post-COVID-19 syndrome, post viral syndrome of COVID-19, post acute sequelae of COVID-19) and definitions are used in the literature to describe long COVID, which is increasingly recognised as a separate clinical disease with a spectrum of different symptoms or symptom clusters (see e.g. A. Fischer et al., 2022). In 2021, the WHO established the following definition (WHO, 2022a):

'Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis. Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others and generally have an impact on everyday functioning. Symptoms may be new onset, following initial recovery from an acute COVID 19 episode or persist from the initial illness. Symptoms may also fluctuate or relapse over time.'

Due to varying and broad definitions, diagnosis of the condition remains difficult in practice, and it is likely that many cases remain unrecognised (Knuppel et al., 2023).

As a result, data on the prevalence or the incidence of long COVID are sparse. Note that in this paper, an important distinction is made between the concept of *prevalence* and the concept of *incidence*. Whereas *prevalence* measures the number of cases of a disease in a specific population during a specific time period (similar to a 'stock' variable), *incidence* measures the number of new cases arising in a specific population, such as COVID-19 cases, during a specific time period (similar to a 'flow' variable, but only measuring entries, not exits).

Table 1 provides a non-exhaustive overview of recent studies of varying geographical scope that present estimates of long COVID cases, expressed either as a share of individuals with COVID-19 infections or as a proportion of the population. The figure in the last column of Table 1 extrapolates the study estimates to the EU population. Survey studies with small or non-representative samples are not included.⁵ Individuals are considered to suffer from long COVID if they suffer from new or ongoing COVID-19 related symptoms three months after infection (WHO definition), unless otherwise noted.

Study design matters for the study findings, particularly in the case of long COVID. Symptoms commonly associated with long COVID infections were already present in the population prior to the pandemic. That means that, without a matched control group, it would be difficult to establish whether symptoms have appeared because of COVID-19 or if they had also emerged in the absence of COVID-19 (e.g., they could be triggered by other viral infections or other conditions). Also sample selection plays an important role, notably where and how study participants have been recruited (in the hospital versus the community), through random sampling or voluntary survey participation, in-person or remote survey participation, and whether the identification of long COVID cases relies on clinical diagnosis or on self-reporting.

Most of the listed studies look at the *incidence* of long COVID, notably the proportion of COVID-19 infected individuals that develop long COVID. The estimates of the incidence of long COVID are very wide-ranging, going from 6.2% to 50.6% of COVID-19 infections. In a prominent early long COVID study used by the WHO for official estimates, Wulf et al. (2022a) estimate that 6.2% of individuals with symptomatic COVID-19 infections develop long COVID. They also provide country-specific estimates of long COVID cases for countries across the world, drawing on estimates of COVID-19 infections by the Institute for Health Metrics and Evaluations (IHME), which correct for underreporting in official data on confirmed cases. They estimate that a cumulative total of

⁵ An additional study not included in Table 1 was conducted in Belgium (Smith et al., 2022). The study suggests that of the patients involved in the study (2-3000), 47% still had symptoms after 3 months, 32% after 6 months. Such study however is likely subject to selection bias since only 6% of the people who were invited to participate eventually participated in the first round of the survey. The high non-response rate could be explained by the fact that those who have fully recovered were less likely to participate in the survey, thus overestimating long COVID incidence.

about 5.6 million individuals have been affected by long COVID in the EU27 in 2020 and 2021, covering up to 1.2% of the population if there were no repeat infections.⁶

A study from the Netherlands suggests a higher number, with almost 13% of COVID-19 infections triggering long COVID conditions following the WHO definition (Ballering et al., 2022). A US survey of patients seeking care estimates 20% of COVID-19 infections in the working population to result in at least one long COVID-related symptom remaining present or emerging 1-12 months after infection (Bull-Otterson et al., 2022). The latter study is likely to suffer from selection bias, however, as the reasons for seeking care are likely correlated with the probability of developing long COVID; moreover, it applies a broader definition, considering symptoms persisting or emerging after 4 weeks instead of 3 months, which automatically leads to higher estimates.

As a first indirect approach, studies on the incidence of long COVID as a proportion of COVID-19 infections can be combined with data on estimated cumulative COVID-19 infections to infer the cumulative number of long COVID infections. However, official data on confirmed COVID-19 cases are broadly acknowledged to underrepresent the true number of infections: among other reasons, not everyone decides to or has the opportunity to get tested when presenting COVID-19 related symptoms; access to testing services has often been restricted due to capacity constraints; tests may be inaccurate; and a certain proportion of infections (around one third according to Wulf et al., 2022a) remains asymptomatic and therefore mostly unnoticed. Official data put the number of confirmed COVID-19 cases in the EU over the period 2020-2022 at around 180 million; however, research suggests that the true number of infections might be several times higher. For example, a recent study based on UK data suggests that officially confirmed cases only represent 20-40% of genuine COVID-19 infections, implying that the real cumulative incidence of COVID-19 would be around three times the official number (Colman et al., 2023).

To convert data on cumulative incidence into data on prevalence, assumptions on symptom duration are required. Unfortunately, to date, evidence on the duration of long COVID is mixed and complicated by the relapsing and remitting nature of the condition (UK APPGC, 2022), even though it is clear that it can take weeks, months, or years for patients to recover. Early evidence by Wulf et al. (2022a) suggested that for 1 out of 7 long COVID patients, symptoms last beyond 12 months. Servier et al. (2023) also underline the persistent nature of symptoms for many patients.

Several studies provide direct estimates of *prevalence* instead, i.e., the number of people that have long COVID at one specific point in time. In an earlier version of Wulf et al. (2022a), Wulf et al. (2022b) incorporate estimated figures of true infections, incidence and average duration to estimate long COVID prevalence in the EU at 0.04% of the population on average in 2020 and 0.32% in 2021. These estimates were however not included in the peer-reviewed published version of the paper. They are based on a number of assumptions, such as that asymptomatic COVID-19 cases do not produce long COVID conditions, which has been put into question by some other studies (e.g. Ma et al., 2023) and may therefore imply downward bias.⁷ Moreover, Wulf et al. (2022a)'s assumptions on the incidence of long COVID symptoms among COVID-19 infections are also on the lower side, which could relate to the early publication (non-inclusion of later studies). If the incidence were rather around 12.7%, as in Ballering et al. (2022), the prevalence figures would double to around 0.64% in 2021.

A prominent study by the UK Office for National Statistics (ONS) with a large sample size suggests that in February 2023, 3% of individuals in a representative sample of the overall population were experiencing long COVID-related conditions – similar to the average prevalence over 2022 (2.9%) (UK ONS, 2023). In 2021, the average prevalence was around 40% lower than in 2022, at 1.7% (UK ONS, 2023). The European Union Expert Panel on effective ways of investing in Health used this source to produce their 3% ballpark figure for long COVID prevalence in the EU in 2022 (EXPH, 2022). It is important to note here, however, that the UK ONS study applies a different definition of long COVID than the WHO. In particular, it considers symptoms remaining or in

⁶ It is likely that some individuals were affected repeatedly, and are thus counted twice or thrice among those 5.6 million, implying that strictly speaking, the affected proportion of the population would be less than 1.2%.

⁷ Assuming that 30% of the COVID-19 infections are asymptomatic (see Wulf et al., 2022a) and that asymptomatic infections have an 80% lower risk of leading to long COVID (Ma et al., 2023), this would imply a possible downward bias of around 10% for the prevalence estimate.

place 4 weeks after a COVID-19 infection, in contrast with the WHO definition, which considers persistent symptoms or new symptoms that develop 12 weeks (3 months) after initial COVID-19 infection.⁸

Finally, a recent survey by the French Public Health Agency, based on telephone interviews with a randomly selected sample of more than 10,000 adults over the period September–November 2022 estimates a prevalence of long COVID of 4% of the adult population (aged 18+), using the WHO definition (SPF, 2023). The estimated prevalence in this study is in line with their earlier rapid assessment survey (carried out in Spring 2022 among more than 27,000 voluntary participants) and in the same ballpark as the UK report, despite the differences in definition. Those reporting at least moderate problems in fulfilling their daily activities are estimated at 2.4% of the population and those reporting severe problems are estimated at 1.2%.

Table 1 Long COVID estimates projected to the EU population

Source	Definition	Population	Study design	Long COVID incidence	
				In COVID-19 infections	Cumulative total in the EU population
Wulf et al. (2022a) (global)	At least 1 of 3 self-reported symptom clusters 3 months after symptomatic infection	1.2 million individuals from 22 countries globally over 2020-21	Meta-analysis of 54 studies and 2 databases (corrected for COVID-19 underreporting and COVID-negative control groups)	6.2% of symptomatic infections 0.9% persisting after 12 months	5.55 million (1.2%) for 2020-21 as reported in the paper
Ballering et al. (2022) (Netherlands)	Persistence of COVID-19 related symptoms 3-5 months after confirmed infection	76,422 individuals followed over 16 months from March 2020–August 2021	Population-based cohort study with matched control (corrected for COVID-negative control groups but not for COVID-19 underreporting)	12.7%	23 million (5.1%) for 2020-22 based on confirmed COVID-19 cases
Bull-Otterson et al. (2022), US Center for Disease, Control and Prevention	At least 1 post-COVID-19 attributable condition 1-12 months after infection	353,154 individuals seeking care (incl. COVID-19 patients and control group) over 2020-21	Survey with matched control (corrected for COVID-negative control groups but not for COVID-19 underreporting)	20% (working age) 25% (aged ≥65 years)	36 million (8%) for 2020-22 based on confirmed COVID-19 cases

⁸ The shorter duration of symptoms than in the WHO definition suggests the UK ONS study could overestimate prevalence. At the same time, the fact that it excludes new symptoms that develop after the acute phase of the infection could lead to underestimation.

Santé Publique France (2022)	Persisting COVID-19 symptoms 3-18 months after infection	27,537 voluntarily participating adults in France (March-April 2022)	Survey (self-reported long-COVID conditions) (not corrected for COVID-negative control groups nor for COVID-19 underreporting)	30% after 3 months 20% after 18 months	54 million (12.1%) for 2020-22 based on confirmed COVID-19 cases
Hastie et al. (2022), Scotland	Remaining COVID-19 symptoms 6-18 months after confirmed symptomatic infection	96,238 adults (incl. prior laboratory-confirmed COVID-19 infections and uninfected control group)	Survey (self-reported long-COVID conditions) (not corrected for COVID-negative control groups nor for COVID-19 underreporting)	6% not recovered 42% partially recovered 52% fully recovered	86.4 million (19.3%) for 2020-22 based on confirmed COVID-19 cases
European Centre for Disease Prevention and Control (2022) ⁹	WHO		Meta-analysis of 61 cohort studies (not corrected for COVID-negative control groups nor for COVID-19 underreporting)	50.6% of infections 66.5% (hospitalised COVID-19 patients) 73.8% (COVID-19 patients in ICU)	91.6 million (20.5%) for 2020-22 based on confirmed COVID-19 cases

Reporting prevalence of long COVID in the population, rather than the incidence of new cases

Source	Definition	Population	Study design	Long COVID prevalence rate	Long COVID estimated EU prevalence
<i>Wulf et al. (2022b) (global) (early-stage research, not peer-reviewed)</i>	At least 1 of 3 self-reported symptom clusters 3 months after symptomatic infection	1.2 million individuals from 22 countries globally over 2020-21	Meta-analysis of 54 studies and 2 databases. Prevalence indirectly derived from IHME modelled incidence and assumptions on duration drawn from meta-analysis.	0.08% of global population over 2020; 0.38% of global population over 2021	357,988 (0.08%) over 2020; 1.7 million (0.38%) over 2021
<i>Jeffrey et al. (2023) (early-stage research, not peer-reviewed)</i>	Identified as patients presenting to	5,104,198 adults resident in Scotland and	Identification based on different types	1.8% among participants over	8.1 million (1.8%) in 2020-

⁹ The study admits that the results are high compared to other population-based studies.

<i>reviewed)</i>	primary care experiencing long COVID-related symptoms 4 weeks after COVID-19 infection	registered with GP practices (March 2020–October 2022)	of health records (underreporting likely due to underreporting of symptoms in medical records)	the survey period	2022
UK Office for National Statistics (2023b)	Self-reported as experiencing persisting COVID-19 symptoms 4 weeks after infection	221,130 randomly sampled respondents in private households, weighted to represent UK population	Weighted survey (self-reported long COVID conditions) (not corrected for COVID-negative control groups)	1.7% of UK population affected on average over 2021. 2.9% of UK population affected on average over 2022. 3% of UK population affected in January 2023	7.6 million (1.7%) affected on average over 2021. 13 million (2.9%) affected on average over 2022. 13.4 million (3%) affected early 2023.
Santé Publique France (2022)	Self-reported as experiencing persisting COVID-19 symptoms 3–18 months after infection	27,537 voluntarily participating adults in France (March–April 2022)	Survey (self-reported long COVID conditions)	4% among survey participants in spring 2022	17.9 million (4%) early 2022
Santé publique France (2023)	Self-reported as experiencing persisting COVID-19 symptoms for 3 months or more	10,615 randomly sampled adults in France (September–November 2022), phone interview	Phone survey (self-reported long COVID conditions) (not corrected for COVID-negative control groups)	4% estimated rate in overall population, based on survey responses	17.9 million (4%) late 2022

Note: Study designs using a matched control group make findings more robust. Highlighted cells show extrapolations, based on calculations of the authors. For the extrapolation to the EU, a population size of 447.7 million is used and cumulative COVID-19 infections for EU27 are assumed to be around 180 million (OWID, 2023). The presented studies use varying symptom clusters to define long COVID conditions.

TENTATIVE ASSESSMENT OF THE LABOUR MARKET IMPACT OF LONG COVID IN THE EU

Estimating the labour market impact of long COVID in the EU is a complex exercise, complicated by high remaining uncertainty on long COVID incidence/prevalence, duration, severity, and the variety of impacts on individuals. In what follows, a back-of-the-envelope calculation is presented to get a broad idea of the magnitude of the impact. For reasons of transparency, all underlying assumptions are made explicit.

The scope of this exercise is to assess the EU labour market impact of long COVID in 2021–22. By relying on direct estimates of prevalence, we circumvent problems related to combining data on COVID-19 infections (and correctly accounting for underreporting) and long COVID duration. At the same time, even estimates on long COVID prevalence remain fraught with uncertainty. As a way forward, we therefore consider the estimate based on the UK ONS survey (on average 1.7% in 2021, and 2.9% for 2022).

With a population size of 447 million (all age groups), this implies that on average, around 7.6 million people in the EU would have been experiencing long COVID, at any point in time over 2021. The corresponding figure for 2022 is 13 million.

The impact on labour supply is calculated as the impact on the active population (aged 15+), which stood at 214 million at baseline, before the pandemic (2019). The 2019 figure is chosen as baseline as in 2020 and 2021 the pandemic had a strong impact on activity rates. Indeed, people who are out of job and are not looking for a job are recorded as inactive in European labour statistics. Due to the pandemic, many people lost their jobs, while job search and new recruitment were complicated by lockdown policies, which also affected childcare and education institutions. Health conditions (own illness, care responsibilities) and perceived health risks likely also played a role in reducing job search. By 2022, activity rates strongly rebounded and the active population exceeded the pre-pandemic level. Using the 2019 figure as a baseline helps keeping the analysis tractable, even if it means that changes in activity rates that are purely due to demographic shifts (more people retiring than young people entering the labour market, dynamics in migration) are neglected.¹⁰

As a separate prevalence for the working age group is not consistently available in the UK ONS survey, we adopt the conservative assumption that the prevalence of long COVID is similar for the working age population, and for the active population, as for the general population.¹¹ Assuming an EU labour supply of around 214 million, it results that in 2021, around 3.6 million previously active individuals would have been affected by long COVID in the EU; and 6.2 million in 2022.

Long COVID can have a negative impact on ability to work of those suffering from the disease. Depending on the severity of the symptoms, workers may see their performance at work impacted (lower productivity), but they can also be forced to reduce working hours, or to stop working altogether.

Productive labour supply reductions presented in this analysis are to be interpreted as any labour-related factors that would lead to a reduction in individual labour input, reflecting a combination of (i) a reduction in employment (external margin of labour supply adjustment); (ii) a reduction in hours worked (internal margin of labour supply adjustment); and (iii) reduced performance during work. In other words, in our analysis, we do not differentiate to what extent the reduction in productive labour supply is due to each of these channels, and we treat reductions in reduced performance at work in the same way as reductions in individual labour supply. We also do not differentiate between individuals dropping out of work by going on sick leave or by dropping out of the labour force all together. These simplifications should not be consequential for our main variable of interest, which is the reduction in aggregate labour supply.

There are relatively few studies available so far that provide estimations of the impact of long COVID on individuals' capacity to work. Those studies that exist, provide widely varying estimations. Survey data from the UK suggest that for most of the affected individuals, the negative labour market impact of long COVID lasts at least three, but less than six months (Waters & Wernham, 2022). Yet, for some individuals, the labour market impacts are clearly more persistent. For instance, Kerksieck et al. (2023) found that people who self-reported long COVID symptoms had a significantly reduced ability to work 12 months post diagnosis. Among those that had not recovered, higher levels of impairment were associated with lower work ability including ability to undertake physically and intellectually demanding tasks. 1.6% of those with self-reported long COVID symptoms left the active population. K. Fischer et al. (2022) find a persistent negative impact of around 5% on the performance of athletes lasting at least seven months after initial infection – something that has not been found after other respiratory infections. Insurance data from the US suggest that of those workers who claimed compensation for missed days at work or for medical treatment related to COVID-19 for at least 60 days, around 1/5 is still not able to return to work after one year (NYSIF, 2023).

To address the high degree of uncertainty with respect to the impact of long COVID on affected workers, we present a set of different scenarios, drawing on available research.

A first scenario draws on a study that uses UK data from 2021 and suggest that 10% of long COVID patients stop working by going on sick leave (Waters and Wernham, 2022). A second scenario draws on results by Ham (2022), who documents that among individuals with long COVID, 26% report their work is affected by long COVID, and these work on average 50% fewer hours, resulting in an impact per worker with long COVID of 13%. Finally, in a third scenario we draw on results from the Santé Publique France survey from 2022, which

¹⁰ It should be noted that this approach excludes the impact of long COVID on reducing potential entries into the workforce, such as for instance young people who were prevented to enter the workforce due to long COVID.

¹¹ See the section on Differences across sectors and population groups for more details on differences in impacts between age groups.

finds that, among those people who self-reported having long COVID, 60% reported that their symptoms adversely affected their day-to-day activities at least to some extent and out of these, half (30%) reported that their ability to undertake day-to-day activities had been strongly affected (Santé Publique France, 2023). We assume for those whose day-to-day activities are adversely but not strongly affected (30% of workers with long COVID), a reduction in productive labour supply by 10%, and for those whose activities are limited a lot (another 30% of workers with long COVID), a reduction in productive labour supply by 50%, resulting in an overall reduction of 18% for workers with long COVID, which could be either due to reduced hours or employment, or due to reduced performance at work. Estimates based on the UK ONS study would also suggest impacts in this range (around 15%), with 77% of affected people reporting that their symptoms affected their activities adversely and among these, one quarter reporting that their ability to undertake their daily activities had been “limited a lot”.

With these assumptions, we find that the estimated negative impact on labour supply ranges between 0.2% and 0.3% in 2021 and between 0.3% and 0.5% in 2022. This range includes, near its lower bound, the magnitude suggested for the US by Abraham and Rendell (2023, see Box 1). With the assumption that the labour elasticity of the potential output level is equal to the labour income share, often estimated to be around 65%, this translates into an output loss of 0.1–0.2% in 2021 and of 0.2–0.3% in 2022 due to long COVID. Figure 1 and Figure 2 below present the results of the calculation for the different scenarios of reduction in productive labour supply of affected individuals.

Box 1: Labour market implications of long COVID in the US

A much-discussed paper by the Brookings Institute estimated the labour market impact of long COVID for the US (Bach, 2022). The estimates were based on data from the Census Bureau, collected through its Household Pulse Survey (HPS), which gave researchers a better understanding of the prevalence of long COVID.¹² The main findings from the study are:

- Around 16% of the working age population in the US reported to have had long COVID at some point in time prior to the survey in June–July 2022. Assuming that 50% have recovered, the paper assessed that a share of 8% of the working population would remain affected, equalling around 16 million Americans aged 18 to 65 as of August 2022.
- An estimated 2 to 4 million of these patients would be out of work due to long COVID (around 0.6–1.2% of the US population).
- The annual cost of the resulting lost wages alone would be around \$170 billion a year (and potentially as high as \$230 billion).

Given the methodological limitations of the study, the provided figures could have an upward bias.¹³ A more recent Brookings Paper estimates that long COVID has rather reduced the labour force by around 700 000 people (around 0.3 ppt) (Abraham and Rendell, 2023).

¹² The Census Bureau added four questions about long COVID to its Household Pulse Survey.

¹³ The estimates of labour force participation and hours of work rely on three separate surveys, two of which relying on samples that were recruited online in long COVID support groups (as well as in a broader audience). This likely induces a selection bias, with the representativeness not corresponding to the long COVID estimates from the Household Pulse Survey. As a result, the estimates are likely an upper bound to the true number of people out of work due to long COVID.

Figure 1 Tentative assessment of the impact on aggregate labour supply, for different scenarios of the reduction in productive labour supply for affected individuals

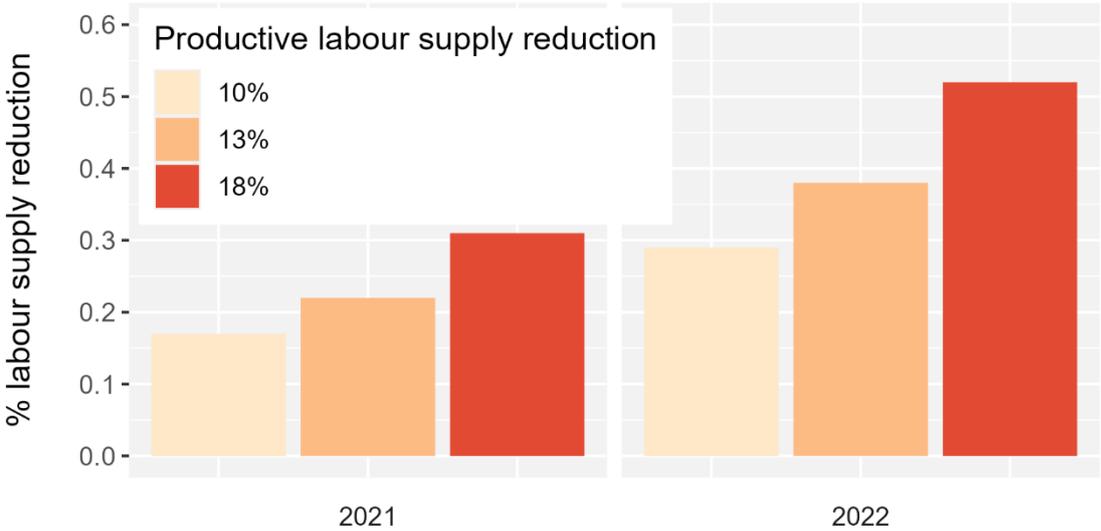
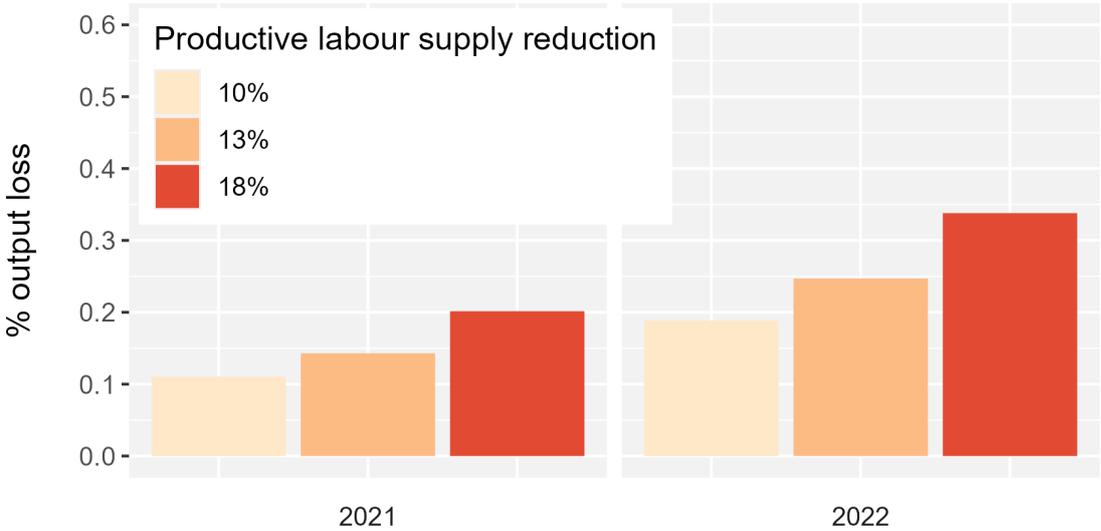


Figure 2 Tentative assessment of the impact on aggregate potential output, for different scenarios of the reduction in productive labour supply for affected individuals



POSSIBLE IMPACT OF LONG COVID AS OBSERVED IN EU LABOUR MARKET DATA

This section triangulates the estimation of the previous section with recent EU labour market survey data. Available labour market data suggest a mixed picture when it comes to the impact of long COVID. On the one hand, observed activity and employment rates in the EU recovered to historically high levels in 2022 after the COVID-19-related recession, in spite of strong headwinds.¹⁴ On the other hand, other indicators suggest that in 2022, health-related issues (COVID-19-related or of other origin) contributed

¹⁴ The number of people 'seeking a job but not available to work' (i.e., jobless people who do not qualify as unemployed because of their limited availability to start a new job) also returned to pre-pandemic levels in the EU (see Kiss et al., 2022).

more than in previous years to a reduction in labour supply. Admittedly, the impact of long COVID on the labour market could be hidden by other factors. It may also still be too early to assess the impact thoroughly, with data for 2023 still incomplete.

EU27 data on the self-perceived long-standing limitations in usual activities due to health problems (reported as some or severe limitations, for persons aged 16-64) present an increase between 2019 and 2022 (from 16.8% to 18.6%) (Figure 3). This represents an increase in the long-term disability level in the population, breaking the previous descending trend since 2014. Its timing makes it very likely that long COVID is one of the contributing reasons.

Several Member States have seen a marked increase in sick leave days between 2021 and 2022, sometimes reaching an all-time high. Notably, ECB (2023) reports that sick leave days increased by 10-30% between 2021 and 2022 in the four major euro area economies (Germany, Italy, Spain and France). Increased sick leave could have also contributed to the long-term trend of declining average hours worked per week and per employee in the EU (ECB, 2023). Official data from Germany suggest that employees reported sick for on average 15 working days, up from 11 in 2021 (which was already affected by the pandemic). Similarly, in the Netherlands, sick leave is at historically high levels and seems to have grown above the long-term trend since the beginning of the pandemic (CBS, 2023). Long COVID is likely to have contributed to these observations, even if acute COVID-19 and other diseases have also played a role. Absences due to long COVID are typically longer than those due to acute COVID-19 and seasonal respiratory diseases, thus having a disproportionate impact on average days of sick leave.¹⁵

At the same time, EU Labour Force Survey data on general absences from work do not show a significant structural break or upward shift so far (Figure 4). Persons can be absent from work due to a number of reasons, among which holidays, own illness, and temporary lay-offs. The data for the EU present a peak in 2020, and higher rates in the direct aftermath of the pandemic. Likely contributing reasons are the extensive use of short-time work and related schemes, and higher rates of sick leave as a direct reflection of the health impact of the pandemic. Towards the second half of 2022, the proportion of absences seems to revert to previous trends, which were already sloping slightly upwards, especially for women (see e.g. Antczak and Miszczyńska (2021) for a broader review of causes of the rising trend in sickness absenteeism in Europe).¹⁶

Figure 5 shows that the number of workers leaving their job for unemployment or inactivity due to illness/disability in EU27 dropped strongly during the first year of COVID-19 (from 154 thousand in 2019 to 91 thousand in 2020). The number increased again to levels beyond pre-pandemic levels in 2021 and increased further in 2022. When expressed as a proportion of all job leavers, the dynamics remain similar, suggesting that the changes are not driven by the overall number of job leavers: the overall number came down in 2022 while the number of job leavers for illness reasons increased. The vast majority of job leavers for health-related reasons move into inactivity rather than unemployment.¹⁷

¹⁵ For example, Destatis (2023), the German Federal Statistical Office, suggests an important role of major waves of influenza and colds, although, due to the low testing levels for COVID, flu and RSV, it is difficult to differentiate between the three viruses based on short-term symptoms alone. Schnabel (2023), as well as absences due to COVID itself, brings up the additional issue of rising mental health issues in the aftermath of the pandemic, which could also (but need not) be related to long COVID. WHO (2022c) also suggests that changes to the circulation patterns of common seasonal respiratory pathogens have intensified their circulation during the 2022/2023 winter.

¹⁶ Absences from work are in line with or below pre-pandemic trends for Germany by 2023, although preliminary data shows that record levels of sick leave are still reported in Germany for the first half of 2023 (IGES, 2023), which could imply that absences from work are an imperfect proxy for sick leave.

¹⁷ For example, in 2022, 14% of job leavers for health-related reasons left their job to unemployment and 56% to inactivity because of their own illness or disability; 30% left their job to inactivity because of care responsibilities.

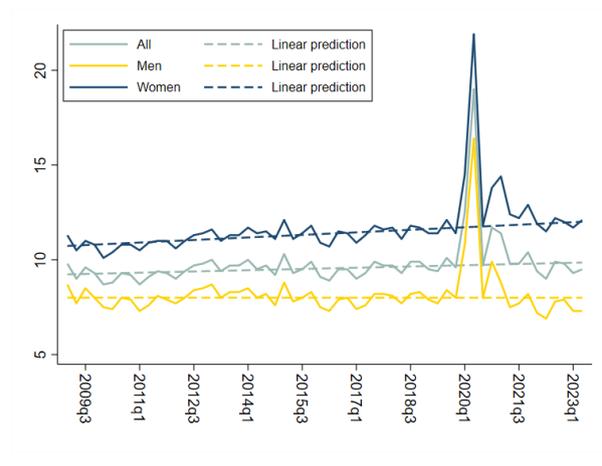
The impact of long COVID on this increase remains unclear. Overall, the number of recent job leavers for reasons of illness or disability has been on the rise since 2010. The ageing of the work force, the scaling down of early retirement schemes and more generally the deferral of retirement across Europe may contribute, alongside initial COVID-19 infection, long COVID, and other diseases.

Figure 3 Self-perceived long-standing health limitations, EU27, Y16-64, % population



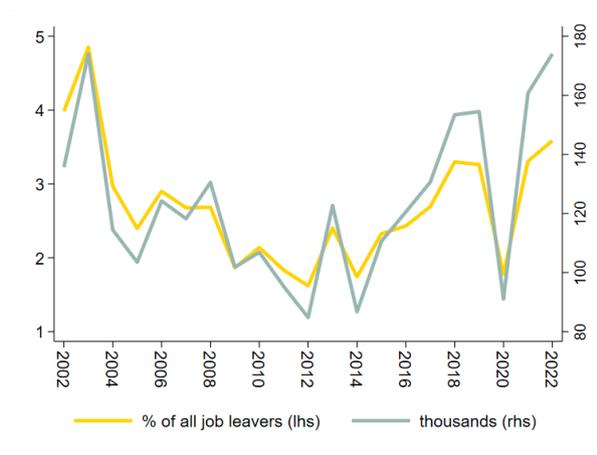
Note : Data represent the proportion of individuals reporting ‘some’ or ‘severe’ limitations in usual activities due to health problems
 Source: EU-SILC [Eurostat variable hlth_silc_06], https://ec.europa.eu/eurostat/web/products-datasets/-/hlth_silc_06

Figure 4 Total absences from work, EU27, Y20-64, % employment



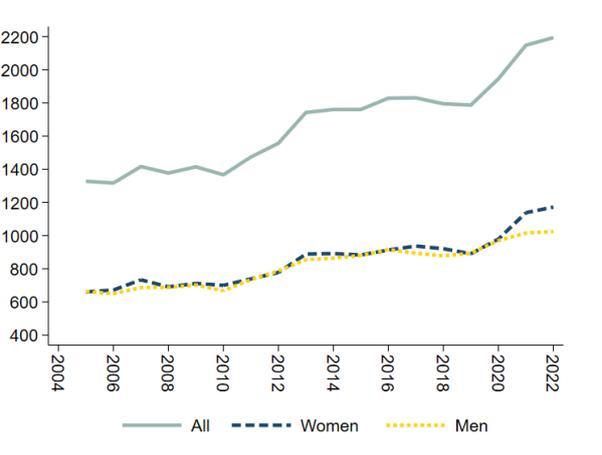
Note: Data are seasonally but not calendar adjusted. Linear predictions reflect an extrapolation of pre-COVID-19 trends (up to 2019q4) by group. Reasons for absences include holidays, illness, and temporary lay-offs; where a formal attachment to the job is maintained. 2021 presents a structural break due to a change in the definition of formal job attachment.
 Source: LFS [Eurostat variable lfsi_abt_q], https://ec.europa.eu/eurostat/web/products-datasets/-/lfsi_abt_q

Figure 5 Recent job leavers due to illness or disability, EU27



Note: 2021 presents a break in the data (according to Eurostat). Recent job leavers are people who left their jobs in the last 3 months, and are currently not in employment.
 Source: DG ECFIN calculations based on Eurostat special extraction from the EU Labour Force Survey.

Figure 6 Inactive due to illness or disability, EU27, Y20-64, thousands



Note: 2021 presents a break in the data (according to Eurostat).
 Source: LFS [Eurostat variables lfsa_igaww and lfsa_igar], https://ec.europa.eu/eurostat/web/products-datasets/-/lfsa_igaww, https://ec.europa.eu/eurostat/web/products-datasets/-/lfsa_igar

The number of working age people who are inactive because of an illness or a disability saw a marked increase of 151,000 in 2020, a further increase of 228,000 in 2021, and a further increase of 37,000 in 2022, after a long period of stability since 2013 (Figure 6). Long COVID is likely to have been a contributing reason. Note, meanwhile, that the cases of long COVID which would be captured by this indicator are likely to be only those whose daily activities are severely affected, which represent a small subset of the total population affected by long COVID. Along similar lines, the proportion of those who work part-time due to illness and disability has also increased faster than would be expected according to past trends since the start of the pandemic.

All in all, the possible role of long COVID in the rising trend in sick leave, disability and activity-limiting health factors, warrants careful monitoring going forward, due to its potential impact on labour supply and labour productivity, and on public finances through increased pensions, health care and long-term care expenditure.

DIFFERENCES ACROSS SECTORS AND POPULATION GROUPS

Long COVID has been found to have heterogenous effects on the population at large, and thus on the workforce. Research consistently finds that women are more strongly affected than men (see e.g. Wulf et al., 2022; UK ONS, 2023; SPF, 2023). With regard to age, the picture is less clear. While some studies suggest the incidence of long COVID is higher in old age (Bull-Otterson et al., 2022; Notarte et al., 2022; Michelen et al., 2021; Chen et al., 2022; NYSIF 2023), others suggest it is higher in working age (e.g. Sigfrid et al., 2021; Jeffrey et al., 2023) or find mixed results (Subramanian et al., 2022). SPF (2023) finds that long COVID is more prevalent among people below the age of 65. According to the UK's Office of National Statistics, self-reported long COVID is more common in those aged 35 to 69 years, with a peak between 50-69. Living in deprived areas or suffering from other activity-limiting health conditions or disabilities have also been identified as aggravating factors (UK ONS, 2023).

Many long COVID patients acquired the condition through occupational exposure (UK APPGC, 2022) and the European Commission recommends Member States to recognise COVID-19 as occupational disease if acquired during work under certain conditions (European Commission, 2023). Accordingly, the impact of long COVID on the labour force is likely to differ by sector. Generally, workers in 'essential' jobs (which continued to work during the pandemic) with a high exposure to physical contact have been more likely to contract COVID-19. With high pressure to continue work during the pandemic, many of them might also have little opportunity to recover fully before returning to work.

Workers in health care and long-term care would indeed be expected to be among those with the largest negative effects of long COVID, since they have been exposed most to COVID-19 (EXPH, 2022). Next to the high exposure to physical contact and sick individuals, both long-term care and many health care professions are dominated by women, who are more likely to develop long COVID. According to the UK ONS Survey (UK ONS, 2023), people working in the health and long-term care sectors were respectively the 2nd and 1st highest professional groups (out of 14 groups) in terms of long COVID prevalence. Similarly, NYSIF (2023) data suggest a particular high incidence of long COVID among workers in enforcement and healthcare services.

Estimates from the UK suggest that 1.8 million man-days were lost to healthcare workers with long COVID from March 2020 to September 2021 across the NHS in England (UK APPGC, 2022), and 1.3 million days from October 2021 to October 2022 (UK APPGC, 2023). Given high training requirements, the supply of health care workers tends to be relatively inelastic, making it particularly difficult to replace these workers in the short-term.

These challenges for the health care sector exacerbate existing challenges, such as those relating to population ageing, which increases the demand for health workers while reducing the supply of young labour market entrants. Also, in some EU countries and regions, low wages of health care workers have discouraged graduates' entry into the field and supported mobility and migration to other regions with better working conditions (WHO, 2022b).

There are indications that long-term care workers have been particularly affected by staff shortages since the beginning of the pandemic (Frogner et al. 2022). The relatively high prevalence rates of long COVID are likely to exacerbate previously existing problems of staff shortages and low retention rates (OECD, 2020).

Another sector that is expected to be affected disproportionately by long COVID is the education sector. Although young people usually experienced milder COVID-19 infections, physical contact in groups led to a fast spread of the virus in educational settings.¹⁸ Teachers represent a profession with increased occupational risk for long COVID through their contact over long periods of time with many students in classrooms that often suffer from poor Indoor Air Quality (IAQ) (Pulimeno et al., 2020).

According to the UK ONS Survey (UK ONS, 2023), people working in the educational sector were the 5th highest professional group (out of 14 groups) in terms of long COVID prevalence. This could potentially exacerbate existing teacher shortages, reported in many EU Member States. Evidence on prevalence and severity of long COVID in children and adolescents remains limited, with diverging numbers reported in existing studies (EXPH, 2022). While the prevalence among children could be lower than among adults, cognitive impairment, school absenteeism and even teacher absenteeism caused by long COVID can have long-term consequences for affected individuals, such as on educational outcomes and labour market participation (Maldonado et al., 2024).

LIMITATIONS AND CAVEATS

The analysis presented in the previous sections considers only the economic impact of long COVID through its impact on labour supply. Other potential costs of long COVID are therefore not covered. They include expenditure on social security and other benefits, and the costs arising from the demand for health care¹⁹ and long-term care (driven by the increase in disability reported above). Furthermore, the combined winter spike of COVID and seasonal respiratory diseases with altered circulation patterns puts a high pressure on health care systems, to which long COVID is added (WHO, 2022c). The delay of care has, next to the human cost of adverse patient outcomes due to lack of treatment, an economic cost in terms of escalating other conditions that become more expensive to treat (Wagner, 2022). Given the predominant role of the public sector in financing health care and long-term care systems in the EU, non-negligible fiscal impacts are plausible.

Determining the number of long COVID cases is subject to methodological challenges. Existing studies use varying definitions of the disease and practices of clinical diagnosis are not yet mainstreamed. In the absence of control and pre-treatment surveys before the illness, no causal effects can be identified, as one cannot exclude that the symptoms existed before, would have existed independently of COVID or were only exacerbated. Studies that are based on self-reported survey data have some inherent limitations. First, there can be misreporting on the diagnosis, as many long COVID symptoms are non-specific. Second, self-selection bias can lead to over-estimation while healthy respondent bias can lead to underestimation. Projection of national results to the EU level is hampered by differences in healthcare systems, social welfare systems, vaccination, treatment, circulation, and variants. Better access to health care and sick leave may reduce the development of long COVID.

Considerable uncertainty also remains at the level of the labour market impact of long COVID. A first aspect is that our assessment of the impact on labour outcomes is based on surveys, such as EU-SILC and the LFS, which are likely to miss those most severely affected by long COVID, as they are sent only

¹⁸ Evidence from Italy showed that, before the availability of vaccines, students, teachers and non-teaching staff of schools had a significantly higher incidence of COVID-19 than the general population (see Lattanzio, 2023).

¹⁹ The annual costs of providing health care to someone with long COVID can quadruple their previous annual health care costs according to evidence from the UK (Mu et al., 2023).

to private homes and not to institutional care facilities, where patients could for instance be staying for rehabilitation or long-term care. Additionally, these surveys could also suffer from healthy respondent bias, as the symptoms that make people unable to work fully may reduce their availability to respond to surveys. It is likely that the labour market implications are heterogeneous across Member States, health systems, sectors, and different subgroups of the population. Better access to sick leave during long COVID allows for longer employment breaks providing more time for recovery, reducing labour supply more in the short run, while lack of access to sick leave could negatively affect overall productivity due to lower performance and less effective recovery of patients, with potentially more extensive impacts in the medium to long run.

As testing of COVID becomes increasingly restricted, in particular for the working-age population (WHO, 2023), it is likely that diagnosing long COVID will become more difficult too. Therefore, the burden of long COVID would still be felt but it would be more difficult to estimate its impacts accurately, at least until diagnostic tools based on biomarkers are available.

Finally, this analysis focuses on the impact of persistence of long COVID symptoms but does not include the impact of other adverse outcomes that may be caused by long COVID. Beyond symptomatic long COVID, there are other long-term impacts of COVID-19 infection that are likely to have an impact on mortality, health status, ability to perform work and productivity. A growing literature finds that even mild COVID-19 infections can be linked to increased morbidity and mortality through increased risk of conditions that include cardiovascular illness (Zuin et al., 2023); Wan et al., 2023), diabetes (Xie & Al-Aly, 2022; Harding et al., 2022), neurological disorders including stroke (Xu et al., 2022; Taquet et al., 2022), and gastrointestinal disorders (Xu et al., 2023). Further research is necessary to determine the impact of this increase in overall population mortality and morbidity on the economy, the labour market, and on public finances.

CONCLUSIONS

The first cases of long COVID were documented in May 2020. Since then, a rich literature has developed examining its causes and symptoms. To date, however, there have been relatively few estimates of its economic impact, in particular at EU level. This brief pulls together the available evidence to provide a tentative estimate of the effect of long COVID on EU labour market supply and examines select labour market indicators to assess the evidence so far.

The magnitude of the impact of long COVID on the labour supply is difficult to determine with precision. Our estimates suggest a prevalence of long COVID cases of around 1.7% of the EU population in 2021 and 2.9% in 2022, resulting in a negative impact on labour supply of 0.2-0.3% in 2021 and 0.3-0.5% in 2022. These figures imply that long COVID could have caused an output loss of 0.1-0.2% in 2021 and 0.2-0.3% in 2022. This effect is not homogenous across the economy and appears to more strongly affect women as well as the health care, long-term care and education sectors.

While there remains considerable uncertainty regarding the future evolution of COVID-19 and long COVID numbers, available data suggest that long COVID prevalence peaked in 2022 and then dropped and stabilised at a lower but still significant level. Beyond 2023, the outlook will depend on the interaction between the number of infections and the accumulated immunity from vaccination and previous infections. Pharmaceutical innovations such as treatments and better vaccines, but also public interventions (e.g. on indoor air quality) can potentially reduce this burden.

In conclusion, these results and the high level of uncertainty suggest that the impact of long COVID on the labour supply and the economy should be carefully monitored going forward. More research is needed on the prevalence of long COVID and its debilitating symptoms, including how they impact the labour market. Beyond the labour market, more research on the other economic costs of long COVID would be necessary, including on their potential fiscal implications.

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