II. Short- and long-run determinants of labour shortages

By Alfonso Arpaia and Anita Halasz

Abstract: *With the swift economic recovery in 2021, labour shortages re-emerged quickly. The lack of labour was reported in several industries, especially the labour-intensive ones. This is not a new phenomenon, as high shortages were reported already in 2019, and their decline during the pandemic was only temporary. After the start of Russia's invasion of Ukraine, labour shortages in the EU kept rising, especially in services, with some signs of lessening towards the end of 2022 as the economy slowed. This suggests that the economic cycle plays a strong role in driving up labour shortages. The cross-country and cross-sectoral patterns of labour shortages during the recovery have followed pre-pandemic patterns, suggesting that besides cyclical drivers, long-term factors constraining the supply of labour, such as the ageing of the population, are also influence labour shortages. In addition to demographic changes, other drivers include skills shortages driven by the digital and green transitions and other ongoing structural changes, changes to the patterns of labour mobility, migration and poor working conditions in some sectors and occupations. Regarding skills shortages, the availability of digital skills is of particular relevance for labour shortages. Policies tackling the structural causes of labour shortages are necessary to ensure that growth prospects are not hampered in the medium and long term. In particular, these policies should support labour market transitions to improve the efficiency of job matching and anticipate potential skills imbalances stemming from the two transitions. Policies that support labour market participation and reallocation can help reduce shortages. In addition, labour mobility and migration policies can also help reduce skill shortages. Yet movement of labour around the EU may just redistribute shortages among Member States, as scarcity in certain occupations is widespread. EU policies support a broad range of policies that can be used to reduce labour shortages, in particular under the European Pillar of Social Rights Action Plan and the European Semester and EU instruments such as the Recovery and Resilience Facility, the European Social Fund Plus and Invest EU.*

II.1. Introduction [21]

Labour shortages exist when employers cannot find the workers needed to fill vacancies. This occurs when the demand for labour exceeds the available supply for a given skill set, at the particular level of wages and working conditions, at a specific location, and point in time [22]. It is useful to distinguish quantitative from qualitative shortages [23]. In quantitative shortages, the total supply of labour (i.e., for all sectors and occupations) is below the total demand for labour. Qualitative shortages occur if labour demand exceeds labour supply in a specific sector, occupation, or at a specific skill level. Skill shortages are a major driver of qualitative labour shortages. Seasonal patterns (e.g., in services or agriculture) or geographical imbalances between labour demand and supply can also drive labour shortages.

Evidence demonstrates that the level of labour shortages in the EU has been rising over the last decade. The European Business and Consumer Surveys (EU-BCS) collect quarterly data from employers in manufacturing, services, and construction, asking whether labour shortages are a major factor limiting their production [24]. According to the EU-BCS, shortages reached a peak at the end of the past decade. The increasing trend was interrupted by the pandemic, but it has reappeared forcefully since. Labour shortages have appeared increasingly on the policy agenda, amid concerns by policy makers and employers/trade unions about their effects on employment and economic growth [25].

This section focuses on the determinants of labour shortages and discusses the implications for policies. It is structured as follows. First, it provides an overview of ongoing trends and developments

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[21] An extended version of this paper has been published the 2022 Labour Market and Wage Developments in Europe report published by DG Employment, Social Affairs and Inclusion. The report contains further analysis on the impact of labour shortages on wages and on the links between the inflow of displaced persons from Ukraine and labour shortages.

[22] Barnow, Trutko and Piatak, 2013.

[23] Dafne Reymen & Maarten Gerard & Paul de Beer & Anja Meierkord & Marii Paskov & Valentina di Stasio & Vicki Donlevy & Ian Atkinson & Agnieszka Makulec & Ulrike Famira-Mühlberger & Hedwig Lutz, 2015. "Labour Market Shortages in the European Union," WIFO Studies, WIFO, number 58151.

[24] Services exclude wholesale and retail trade.

[25] Persistent qualitative labour shortages delay the adoption of new technologies and the opportunities provided by the green and digital transitions. Quantitative labour shortages, especially if combined with supply chain issues, can temper economic activity.

in labour shortages across the EU Member States. Second, it analyses the influence of the short- and long-term determinants of labour shortages, also based on findings from regression analysis.

II.2. Trends and developments in labour shortages and mismatches

Graph II.1: **Change in the vacancy-unemployment ratio from 2019 Q3 to 2022 Q3 (%)**
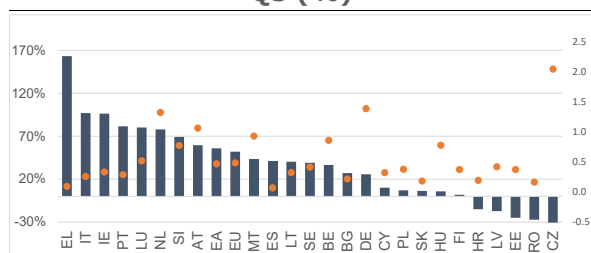
The blue bars represent the percentage change in the vacancy-unemployment ratio between 2019 Q3 ans 2022 Q3 (lhs). The red dots (rhs) represent the value in 2022 Q3.

**Source:** Own calculations, Eurostat. Job vacancy data are not available for DK and FR.

Before the pandemic, labour shortages had been increasing and reached a historical peak in the euro area [26]. Between 2013 to 2019, when the euro area employment rate was rising from 67.6% to 72.5%, there was in parallel an increase in labour shortages according to several indicators. The proportion of businesses indicating that labour was a factor limiting production increased fivefold in construction, quadrupled in manufacturing and more than doubled in the service sector. Similarly, the job vacancy rate in the euro area, a measure of the unmet demand for labour rose over the same period to 2.2%, its highest value since 2006 [27]. In 2020, containment measures linked to the pandemic and the resulting economic disruptions led to a decline in labour shortages in almost all Member States as many firms withdrew their job openings.

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[26] The rise in labour shortages in manufacturing and construction was larger for the median euro-area country than for the median non euro-area country; for services there is no difference.

[27] A *job vacancy* is defined as a paid post that is newly created, unoccupied, or about to become vacant: for which the employer is taking active steps and is prepared to take further steps to find a suitable candidate from outside the company concerned and which the employer intends to fill either immediately or within a specific period of time. The job vacancy rate is defined as the number of job vacancies as a percentage of the total number of occupied posts and the total number of vacancies.

The economic recovery from the Covid-19 pandemic has been characterised by a steep rise in labour shortages. Data from the EU-BCS show that labour shortages in the euro area rose faster in industry and construction, while in services, which were more severely hit by the lockdowns, they increased more slowly (Graph II.2). However, by the end of 2021, shortages exceeded their pre-pandemic levels on average in all three macro-sectors and remained very high thereafter. Evidence of widespread shortages across the EU is also suggested by the vacancy-to-unemployment-ratio, a standard indicator of labour market tightness. The number of vacancies per unemployed person increased from the first quarter of 2020 to the first of 2022 in most euro area countries (Graph II.1). In 2022, the job vacancy rate in the euro area hovered around 3%; this is about 1.7 pps above the average of the 2006-16 period. At the end of 2022, there were two job openings for every unemployed person in the EU; this is the highest rate since 2005.

Graph II.2: **Labour shortages in the EU by sector and country**
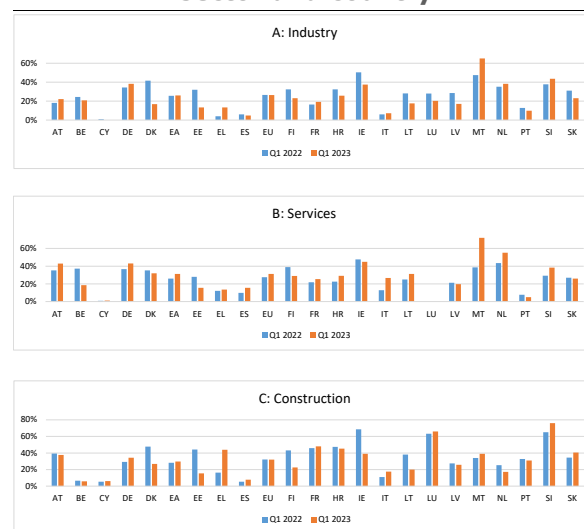
(1) Y axis: the % of employers who report that the availability of labour is a factor limiting production.
(2) In the EU-BCS the 'services' category excludes wholesale and retail trade and public services.
Source: European Commission, EU-BCS

During the recovery, labour shortages continued to increase, in parallel with significant decreases in unemployment. The decline in unemployment followed the rise in shortages with a slight lag, as is usual during recoveries. This suggests that the process linking unemployed people with vacant posts (i.e. the efficiency of labour market matching)

did not deteriorate during the pandemic [28]. Both the macroeconomic skills mismatch [29] and the occupational mismatch indicator show that the increase in the imbalance between demand and supply of labour during the pandemic was only temporary (Graph II.3) [30].

Graph II.3: **The evolution of macroeconomic skills and occupational mismatch in the EU (2005Q1 – 2022Q2)**
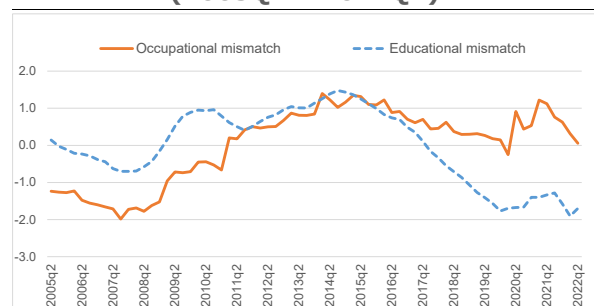
(1) Data are standardised by their mean and standard deviation over the period.
Source: Own calculations based on Eurostat, LFS.

In parallel with rising labour shortages before the pandemic [31], firms have also reported skills shortages. According to the Eurofound European Company Survey, in 2019 there were 24 Member States that had more than 20% of companies

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[28] Kiss A., et al, (2022) reaches the same conclusion. Kiss, A. A. Turrini and A. Vandeplas "Slack and Tightness: Making Sense of Post COVID-19 Labour Market Developments in the EU", DG ECFIN Discussion Paper 178.

[29] Kiss, A., and A. Vandeplas, (2015) "Measuring skills mismatch. DG EMPL Analytical webnote, 7, 2015"

[30] Mismatch indicators measure the discrepancy between the skills of the population and the skills required by the labour market. The occupational mismatch measures the dispersion across nine occupational groups of the employment share relative to the population share. Since the population by occupation is not available, it is assumed that the population with skill level i is distributed proportionally to the share of employment in each occupation with a specific skill level i on total employment with skill level i. With this assumption, the occupational mismatch is equivalent to a measure of dispersion of the employment rates by skills relative to total employment rate with double weights. These weights represent the population share of the skill groups and the employment share of the occupational groups with that specific skill level. In symbols

$$\sum_{j=1}^{9} \left| \sum_i \left(\frac{O_i}{O_T} - \frac{P_i}{P_T} \right) \frac{O_{ji}}{O_i} \right| = \sum_{j=1}^{9} \left| \sum_i \frac{e_i - e_T}{e_T} \frac{P_i}{P_T} \frac{O_{ji}}{O_i} \right|$$

Where O_{ji} is the employment in occupation j for skill group i. P_i is the population with skill i; and e_i is the employment rate of skill group i. and

$$\sum_{j=1}^{9} \sum_i \frac{P_i}{P_T} \frac{O_{ji}}{O_i} = 1$$

Thus, the mismatch reflects not only the weight of specific skills, but the distribution of occupation conditional on a specific skill. See Box 3.1 in Chapter 3 of the Labour Market and Wage Developments in Europe: Annual Review 2022.

[31] Similar evidence is not available for the recovery after the pandemic.

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indicating that over 60% of their newly recruited employees did not have the required skills for their jobs (Graph II.4).
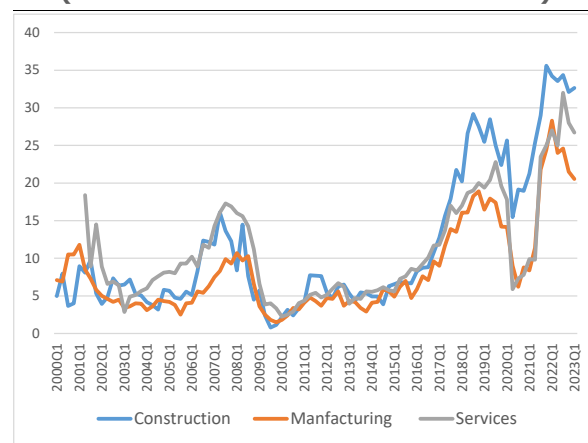
Graph II.4: **Share of managers indicating that 60% or more of their newly recruited employees did not have the required skills (2019)**
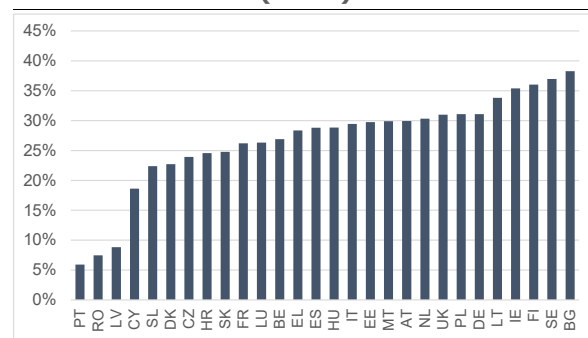
Source: Own calculations, based on the European Company Survey, Eurofound.

Skills shortages measured this way were higher in construction (39%) and smaller in manufacturing (28%) and services (22%). Across the EU the share of employers who reported in 2019 to have difficulties finding workers with the required skills ranged from about 10% in Denmark to 46% in Romania. Furthermore, smaller companies appeared to have more difficulties to find workers with the right skills as compared to larger establishments.

Graph II.5: **Labour shortages by sector (median across euro area countries)**

Source: EU-BCS

Preliminary evidence suggests that next to the business cycle, structural factors may have been driving labour shortages. Between 2013 and 2019, their rise was particularly steep, and the pandemic has only temporarily interrupted this trend (Graph

II.5). Moreover, across countries and sectors, the levels of shortages in the recovery shows a strong positive correlation with their pre-pandemic levels, suggesting that the processes which had been shaping shortages before the pandemic were continuing to drive them. The similar occupational shortages across the EU, and the evidence of widespread skills shortages also point to the presence of potential common underlying structural factors. All this justifies a closer look at the respective roles of cyclical and structural factors in driving labour shortages

II.3. Short- and long-term determinants of labour shortages

The unmet demand for labour can reflect both cyclical developments and long-term (structural) factors. In the short-term, fluctuations in labour shortages may derive from shifts in the demand for labour over the business cycle. These shifts depend on how firms' hiring policies are influenced by developments in the expected economic outlook. For instance, in the early stages of a recovery, vacancies tend to increase as firms open positions to expand production as the recovery consolidates. Frictions in the process of matching vacant jobs with jobseekers then lead to a temporary increase in the unmet demand for labour.

Long-term trends may also create persistent imbalances between demand for and supply of labour, increasing the level of unfilled vacancies. Long-term drivers of labour shortages may derive from (i) a decline in the labour force related to ageing, (ii) skill-biased technological progress, iii) skill shortages linked to the structural and organisational changes, such as those triggered by the digital and green transitions and the impact of the pandemic, (iv) the influence of labour mobility and migration, and (v) poor working conditions, which make people refrain from accepting some jobs [32].

Ageing can influence labour shortage through its impact on the size and composition of the labour force. The combination of demographic change and rapid technological change can generate labour shortages as older workers tend to have skills that do not match those required by technologies, such

as those required by the two transitions. On the demand side, ageing increases the demand for specific goods and services requested by older workers (e.g. health and leisure).

The effect of technological progress is a priori ambiguous. Labour-saving technologies tend to reduce the labour per unit of capital, lowering the unmet demand for labour at a given wage. However, new technologies may also complement some specific skills, which can generate skill-biased demand shifts [33]. Some technologies substitute certain tasks, making obsolete many routine task-intensive (not necessarily manual) occupations. As discussed later, the effect of these contributing factors can differ across sectors, owing to the different skill and age structure of the working age population and the prominence of routine-based occupations.

The cyclical and the structural determinants of labour shortages interact with each other. The economic business cycle, through its influence on labour market flows, affects matching and productivity. The employment of low-qualified workers tends to be more sensitive to the economic business cycle than the employment of the high-qualified. Recessions reduce the unfilled demand for labour and have a *cleansing* effect by removing lower-quality matches. During downturns, labour shortages may drop by less when the average level of education of the workforce is high. On the other hand, mismatches, increase during a recession because firms post fewer vacancies and jobseekers reallocate toward more productive jobs more slowly. If low-quality jobs are created during a recession (*sullying effect)* the gap between over- and under-education increases, exacerbating mismatches [34].

Employers typically encounter more challenges in recruiting the "right" workers at times of strong economic growth. In upturns, if high productivity firms expand more, and hire workers away from firms with lower productivity, productivity may rise [35]. At the same time, amid labour shortages,

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[32] While working conditions are likely to have an influence on labour and skills shortages, data that would allow to quantify their influence are lacking.

[33] Acemoglu, D., and D.H. Autor, (2011) "Skills, Tasks and Technologies: Implications for Employment and Earnings". In Handbook of Labor Economics, ed. D. Card and O. Ashenfelter, Vol. 4, Part B, 1043–1171. Amsterdam: Elsevier

[34] Baley, Figueredo and Ulbright, (2022) "Mismatch Cycles" Journal of Political Economy, November, Vol 130, No111.

[35] Haltiwanger, J.C. – Hyatt, H.R. – Mcentarfer, E. – Staiger, M. (2021): Cyclical worker flows: cleansing versus sullying. National Bureau of Economic Research Working Paper 28802.

this process may be disrupted, and the quality of matches may be worse than in a situation without shortages. Empirical evidence supports the view that employers adjust wages upwards and/or recruitment standards (such as minimum qualification levels for hiring) downwards during economic upturns when job applicants become scarcer [36].

The effect of short- and long-term determinants on labour shortages is estimated using a panel regression over the period 2000Q1-2022Q2. The dependent variable is the share of firms in manufacturing, construction and services indicating that labour is a factor limiting production – from the EU Business and Consumer Survey. The explanatory variables are the deviation of sectoral value added from trend, the trend in sectoral labour productivity, the share of the low skilled in employment, the age dependency ratio and employment in low routine intensive occupations relative to high routine intensive occupations [37]. To allow for robust inference with sufficient degrees of freedom, estimation is performed on a panel of EU countries. Since labour shortages across EU countries exhibit persistent differences possibly attributable to country-specific factors which may not be captured by available statistics, country fixed effects are included [38]. In a macro panel, time period effects are introduced to account for the common evolution of the dependent variable [39]. To capture the synchronisation of the EU cycle, we introduce dummies in the regression period [40]. Thus, the

response of labour shortages to a change in the dependent variables has to be interpreted as the average effect across countries, controlling for individual and time heterogeneity [41].

II.3.1. Role of the business cycle in driving shortages

Tables II.1-II.2 show the results of the estimation of the determinants of labour shortages. Across all specifications, i.e. including also for the long-term drivers of labour shortages (columns (1) to (7) of Tables II.1 and II.2), cyclical shifts are accompanied by a change in the number of employers that consider labour a factor limiting production. This suggests that, during recoveries, firms are not able to expand their activities as they wish because they lack key labour resources. A complementary explanation is that when the economy expands, employers look for additional labour resources in anticipation of further increases in demand. This implies that the number of firms that perceive labour as a factor limiting production rises before job openings are effectively published.

The available data do not allow us to verify this second explanation. Yet, the fact that the volatility of the *factors limiting production* is almost twice that of the *job vacancy rate* hints at the possible relevance of this explanation. Moreover, across all specifications labour shortages are more responsive to the cyclical component of value added in services than in manufacturing or construction (Graph II.6). This may reflect not only the cyclicality of demand in services, but also the relatively higher share of non-permanent contracts in services.

Other short-term pandemic-related factors (not captured in the regression) might have shaped labour shortages in the recovery besides the

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[36] Devereux, P. J. (2002), "Occupational upgrading and the business cycle", Labour, Issue 16, No. 3, pp. 423-452; ; Büttner, T., P. Jacobebbinghaus, and J. Ludsteck (2010), "Occupational Upgrading and the Business Cycle in West Germany", *Economics*, Vol. 4, No.1.

[37] The BCS does not cover wholesale and retail trade. The sectoral value added is obtained by aggregating the National Account data by A*10 industry. Trends are obtained by applying the Hodrick-Prescott filter with smoothing parameter equal to 1600. For an explanation of the occupational mismatch and of the index of routine task intensity see Chapter 3 of the DG Employment and Social Affairs publication 'Labour Market and Wage Developments in Europe 2022".

[38] This means that the country specific mean over time is subtracted from both the dependent and the explanatory variables. The fixed effect estimation does not explain the variability between countries because the country specific means are subtracted. The explanatory value of the within estimator is derived from the co-movements of the dependent variable around its country specific mean with the independent variables around their country-specific means.

[39] For example, Islam (1995) uses dummies to capture common trends in TFP. Islam, N. (1995) Growth empirics: a panel data approach. Quarterly Journal of Economics 110(4): 1127–1170.

[40] Just as fixed effects models require regressors' variation over time within each country, a time fixed effect requires regressors'

variation over units within each time period. (Wooldridge 2012, "Introductory econometrics" Chapter 14 "Advanced panel data methods" 5th Edition, South Western Cengage Learning Ed. This has implications for our preferred specification when we introduce variables such as the age dependency ratio that change slowly over time and share a common trend.

[41] The model allows us to eliminate biases from unobservables that change over time but are constant over countries and it controls for factors that differ across countries but are constant over time. The model with country and time fixed effects (the 'two-way fixed effect estimator') identifies the parameters only through the gap between (i) labour shortages demeaned by the country specific average and (ii) the common time specific component and the explanatory variables expressed as well as deviation from their country-specific average and their time-specific components. This means that it wipes out the effect of any individual or time-invariant variables

increase in demand. In 2021, due to remaining border restrictions and selective lockdown, intra-EU mobility remained low, causing vacancies in certain sectors to remain unfilled. For instance, in Member States such as Greece, the harvesting and planting season was disrupted in 2020, as seasonal workers could not reach their destinations due to travel restrictions.

Graph II.6: **The response of labour shortages to the cyclical component of value added**
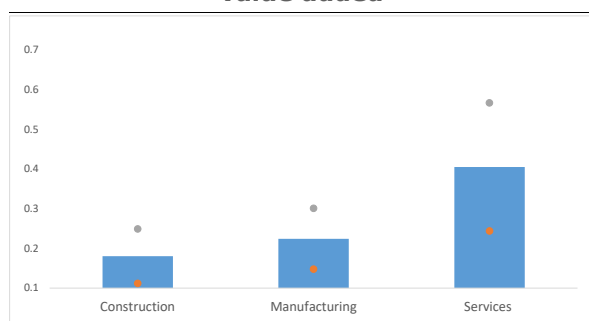
(1)   The chart shows the average of the significant coefficients of specifications 1-4 in Tables II.1-II.2. The estimates of column (7) are not included as they refer to a shorter sample period. The dots indicate the 95% interval confidence.
**Source:** Own calculations

Moreover, the gradual phasing-out of some containment measures and policy support might also have temporarily reduced job-to-job transitions. Finally, health concerns kept people from returning to work; this concerned mostly the high-contact sectors and occupations for which telework is not possible (such as for example hospitality and retail).

II.3.2. Role of long-term trends in driving shortages

Turning to the role of structural variables, labour productivity has a differentiated effect across sectors. As a sector becomes more efficient, in principle one would expect that the number of workers needed for a given level of demand decreases. However, with skill-biased technological change, the increase in productivity can be accompanied by a shift in employment towards high-skilled workers and, with wage rigidity, this can in turn raise labour shortages and skills mismatches. The regression analysis finds a positive effect of trend sectoral productivity on labour shortages in manufacturing, but not in construction or services (Graph II.7 and columns 2 to 6 of Tables II.1 and II.2). This is consistent with the literature suggesting that skill-biased technical

progress plays a role in skill-intensive sectors. On the other hand, the increase in labour productivity in construction, most likely as a consequence of labour-saving technologies, reduces, *holding the other variables constant*, the unmet demand for labour in these sectors ([42]).

Graph II.7: **Response of labour shortages to labour productivity**
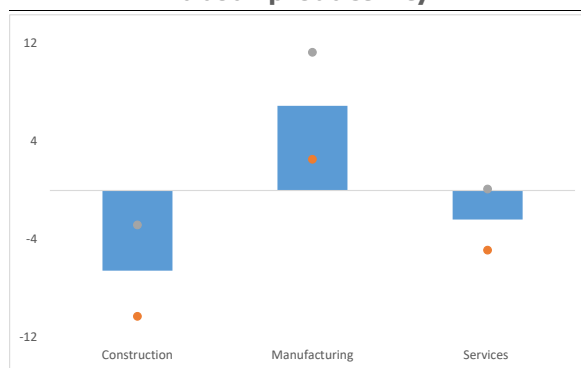
(1) The chart shows the average of the significant coefficients of specifications 1-4 in Tables II.1-II.2. The estimates in column 7 are not included as they refer to a shorter sample period. The dots indicate the 95% interval confidence.
Source: Own calculations

The availability of a skilled workforce can reduce the extent of labour shortages in all sectors. At the macroeconomic level, the decline in the share of the low-skilled improves the average skill level of the workforce. Our estimates (columns 1 to 5 of Tables II.1 and II.2) suggest that the improvement in the workforce's level of education reduces labour shortages, more in construction and services than in manufacturing (Graph II.8) ([43]).

There can be different explanations for this finding. Construction is a sector with a large share

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([42]) In the long-term, changes in the structure of specialisation within the EU may modify inter- and intra- industry trade flows, thereby varying the skill structure of labour demand. Labour shortages are likely to emerge if labour supply adjusts slowly to these changes. This, possibility is left for further analysis.

([43]) The decision to hire people with a certain level of education in response to labour shortages might make the employment share of low skilled endogenous. For this reason, the share of low skilled in the working population is used as alternative indicator of skilled workforce. This does not change substantially the results. The hump shaped effect of labour productivity on labour shortages by sector remains valid; yet the effect on labour shortages in manufacturing is not statistically significant. A drop in low skilled employment reduced labour shortages more in construction than in manufacturing or services. The Wooldridge test of strict exogeneity (Wooldridge 2002 pp 298) shows that in all specifications the share of low skilled in total employment is strictly exogenous. Wooldridge, J. M. (2002), "Econometric Analysis of Cross Section and Panel Data" MIT Press.

of low-skilled workers [44]; yet, it requires some of the most highly skilled workers because projects within the industry are diverse and range from less complex to the most complex ones such as nuclear power plants or oil refineries and large utilities [45].

Graph II.8: **The response of labour shortages to the share of low skilled**
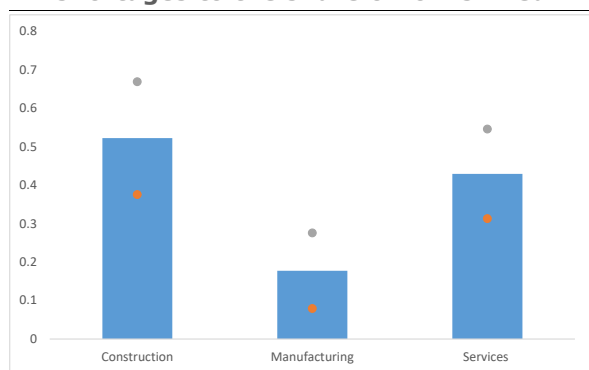
(1) The chart shows the average of the significant coefficients representing the response of labour shortages to the cyclical component of value added. The estimates in column 7 are not included in the average as they refer to a shorter sample period.
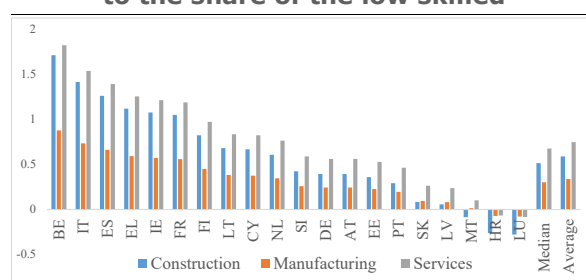*Source:* Own calculations based on Table II.1

Furthermore, construction is at the forefront of the green transition, which creates additional training needs for workers in this sector across all skill levels, and additional labour demand for higher skills in relation to improvements in energy efficiency and the use of renewable energy. The green transition is also creating additional indirect labour demand in the service sector, for professional services, which require a higher level of skills [46]. In addition, digitalisation is likely to boost demand for skilled labour in both construction and services and a reduction in the share of the low-educated might reduce the number of unfilled vacancies. Second, the reduction in the share of low-skilled workers has occurred in parallel with an increase in labour market concentration. The prevalence of low wages

may induce relatively more skilled workers to no longer accept low-paying jobs [47].

Assuming that the effect of the share of the low skilled on labour shortages is the same across countries imposes a homogeneity restriction on countries that in reality have labour market institutions and policies with different capacities to deal with occupational mismatches. Consequently, a change in the share of low-skilled employment might lead to different responses in terms of labour shortage according to the predominant level of occupational mismatch. This effect can be particularly relevant in the short run as institutional constraints make it more difficult to adapt policies. This suggests that we should stop considering the interaction between the occupational mismatch and the share of low skilled as an additional explanatory variable [48].

Graph II.9: **Country-specific estimates of the response in terms of labour shortage to the share of the low skilled**

(1) The country-specific estimates are based on specification 5 in Tables II.1-II.2 and are computed as in footnote (28).
Source: Own calculations

Following, Haque et al., the effect of the share of the low skilled is assumed fixed over time but it is allowed to vary across countries with the average occupational mismatch [49]. Results (column (5) of

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[44] In construction, industry and services (excluding wholesale and retail trade), the share of low-skilled in sectoral employment was in 2020 respectively 30%, 22% and 14%. Over the last ten years this share dropped more in construction (by7 pps) than in industry (6 pps) or services (5pps).

[45] B. Brucker Juricic, M. Galic, S. Marenjak (2021) "Review of the Construction Labour Demand and Shortages in the EU".

[46] CEDEFOP (2021): The green employment and skills transformation. Insights from a European Green Deal skills forecast scenario.

[47] OECD (2022) finds that labour market concentration, one of the key determinants of monopsony power, is pervasive in a wide range of OECD countries; that more concentrated markets result in lower wages and that after one year into the COVID-19 pandemic, concentration was 10% higher. OECD (2022) "Monopsony and concentration in the labour market" Chapter 3 of Employment Outlook.

[48] Neglecting the slope heterogeneity leads to inconsistent estimates when the response to a dependent variable varies across countries (Pesaran, 2015 "Time Series and Panel Data Econometrics" OUP).

[49] In symbols, in the regression $y_{it} = \alpha_i + \mu_t + \beta_i x_{it} + u_{it}$ the slope β_i varies with the average mismatch $\beta_i = \gamma_0 + \gamma_1 * \overline{mism_i}$ This implies that in addition to the share of low skilled there is the interaction with the average mismatch. Haque N.U., M.H. Pesaran, and S. Sharma (2000)" Neglected heterogeneity and dynamics in cross-country savings regressions" IMF WP/1999/128.

Table II.1: **Long- and short-term determinants of labour shortages**

	Construction								Manufacturing							
	1	2	3	4	5	5a	6	7	1	2	3	4	5	5a	6	7
Value added cyclical component	0.18***	0.18***	0.18***	0.18***	0.20***	0.20***	0.17***	0.44***	0.24***	0.22***	0.21***	0.22***	0.25***	0.24***	0.23***	0.60***
	(5.1)	(5.0)	(5.2)	(5.3)	(5.7)	(5.7)	(2.96)	(8.2)	(6.3)	(6.5)	(5.4)	(5.6)	(6.1)	(6.1)	(3.5)	(7.8)
Labour productivity trend		-1.8	-5.3***	-7.8***	-6.6***	-8.9***	-16.1***			9.7***	7.5***	6.4***	7.0**	1.8	43.0***	
		(-1.1)	(-3.0)	(-3.8)	(-2.6)	(-3.9)	(-2.3)			(5.7)	(3.4)	(2.8)	(2.1)	(0.7)	(7.8)	
Share of low skilled			0.5***	0.5***	0.4***	-0.05	0.7***				0.2***	0.2***	0.1***	-0.02	0.03	
			(6.8)	(7.1)	(6.6)	(-0.7)	(4.8)				(3.4)	(3.6)	(2.8)	(-0.3)	(0.11)	
Occupational Mismatch						-2.0***								-1.3***		
						(-10.7)								(-9.3)		
Share of low skilled*occupational mismatch				0.03***		0.08***						0.01***		0.05***		
				(4.8)		(11.2)						(3.6)		(9.7)		
Age dependency ratio				-0.5***	-0.4***		0.4	1.1***				-0.09	0.09		1.00	0.9***
				(-6.64)	(-3.76)		(1.4)	(6.2)				(-1.25)	(1.1)		(3.3)	(6.9)
Probability of employment in low RTI occupations relative to high RTI occupations (lagged)							0.02								0.043	
							(0.6)								(1.60)	
Country fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Period effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Observations	2172	2166	2123	2123	1847	1847	693	2172	2247	2241	2196	2196	1881	1881	691	2247
R-squared- adjusted	0.7	0.7	0.71	0.71	0.73	0.74	0.83	0.53	0.69	0.69	0.7	0.7	0.73	0.74	0.85	0.54

(1) Estimation: fixed-effects OLS with robust t-statistics in parentheses. Sample period: 2000q1-2022q2. *,**,*** stand for statistical significance at the 10%, 5% and 1% level. Age dependency ratio: population 0 to 19 years and 60 years or over, to population 20 to 59 years. RTI stands for routine task intensity.
Source: Own calculations

Tables II.1 and II.2) suggest that for all sectors the response to a change in the share of the low skilled differs significantly across countries, depending on their *average degree of mismatch*. The country-specific estimates reported in Graph II.9 suggest that a decline in the share of low skilled has a larger effect on labour shortages in countries where the mismatch is high. In addition, they confirm the hump shape response of labour shortages obtained with specifications 1 to 4, which assume a homogenous response across countries.

When the occupational mismatch is introduced as a standalone variable (equation 5), in addition to the share of the low skilled and the interaction term between the two, it turns out that its coefficient is negative while the share of the low skilled is statistically significant only in services. This suggests that a reduction in the occupational mismatch in one country (relative to its common EU-wide component) rises labour shortages in the same country (always relative to the EU-wide common component). This effect is to some extent offset by a reduction in the share of the low skilled, as hinted at by the positive coefficient of the interaction between the two variables.

As digitalisation becomes pervasive, the lack of digital skills may also cause labour shortages ([50]).

While the lack of digital skills might lead to labour shortages in expanding non-routine task

Table II.2: **Long- and short-term determinants of labour shortages**

	Services							
	1	2	3	4	5	5a	6	7
Value added cyclical component	0.40***	0.40***	0.40***	0.41***	0.42***	0.42***	0.98***	1.1***
	(5.8)	(5.8)	(5.8)	(4.6)	(4.6)	(4.8)	(3.6)	(10.4)
Labour productivity trend		1.5	-4.1***	-4.4***	-6.2***	-10.8***	-19.1	
		(0.9)	(-2.7)	(-2.6)	(-3.6)	(-5.3)	(-1.3)	
Share of low skilled			0.4***	0.4***	0.5***	0.29***	-0.3	
			(9.4)	(9.6)	(8.9)	(4.4)	(-1.2)	
Occupational Mismatch						-1.1***		
						(-8.5)		
Share of low skilled*occupational mismatch				0.02***		0.04***		
				(4.07)		(8.6)		
Age dependency ratio				-0.07	-0.07		1.3***	1.2***
				(-0.7)	(-0.72)		(6.1)	(11.5)
Probability of employment in low RTI occupations relative to high RTI occupations (lagged)							0.02	
							(0.67)	
Country fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Period effects	Y	Y	Y	Y	Y	Y	N	N
Observations	1814	1809	1800	1800	1754	1681	691	1814
R-squared- adjusted	0.72	0.73	0.74	0.74	0.74	0.75	0.75	0.61

(1) Estimation: fixed-effects OLS with robust t-statistics in parentheses. Sample period: 2000q1-2022q2. *,**,*** stand for statistical significance at the 10%, 5% and 1% level. Age dependency ratio: population 0 to 19 years and 60 years or over, to population 20 to 59 years. RTI stands for routine task intensity.
Source: Own calculations

occupations, it may be irrelevant for routine-task occupations that are predicted to decline. The available data are too short for robust inference of the impact of digital literacy on labour shortages ([51]). Cross-section regressions suggest that there is a significant negative correlation across countries between the share of individuals with at least basic digital skills and the labour shortages in manufacturing and construction (for the latter only

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[50] Information on online job postings, available since 2018, show a strong increase for a wide range of digital occupations. OECD (2022) "Skills for the Digital Transition. Assessing recent trends using big data".

[51] Eurostat data on digital skills is available from 2015 to 2021 (but no data for 2018 and 2020).

if the sample excludes the pandemic recession and subsequent recovery) [52].

For services, there is a positive correlation between digital literacy and labour shortages, which might reflect the rising labour demand in services as a consequence of the increase in the digital capabilities of the population.

The old-age dependency ratio (the ratio between the number of persons aged 65 and over and the number of persons aged between 15 and 64) increased in the EU from 26.3% in 2010 to 32.5% in 2021. [53] When the estimate is made with both period and country fixed effects, an increase in the old-age dependency rate reduces labour shortages only in construction, while its effect is not statistically significant in manufacturing and services. However, the results are strongly influenced by the presence of the time fixed effects, which capture unobservable components common across countries but that change over time. Indeed, with period fixed effects, we cannot include any explanatory variables that have a constant difference over time for each country; the period fixed-effects absorb all time-constant effects [54]. This is the case with the age dependency ratio, which is available only on an annual basis and we assume it remains constant within each year [55]. For this reason, when we include the age dependency ratio, our preferred specification is without fixed effect. The sign of the coefficient of the dependency ratio turns positive and significant in panel estimate only with country fixed effects. This provides indirect evidence that ageing is a common component that drives labour shortages. [56] Ageing implies an increase in the inactivity rate and a decline in the working age population, which reduces the size of labour

supply [57]. In parallel, it increases consumption and changes it towards specific goods and services such as housing and health care [58].

The estimates have been conducted splitting the sample in periods where the change in the cyclically adjusted value added is either positive or negative (Graph II.10). The results confirm the sign of estimates for the full sample. Yet, labour shortages in construction and services are more responsive to the cycle when the economy expands. Only for labour shortages in construction and manufacturing the share of low skilled has a stronger effect during recoveries than during recessions. In construction and services, the effect of trend productivity is statistically significant only during recoveries, while rising productivity trend soften the drop of labour shortages in manufacturing during recessions.

Graph II.10: **Response of labour shortages to selected variables during expansions and recessions**
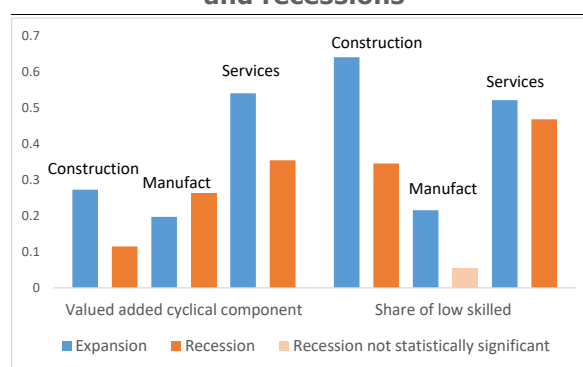
Source: Own calculations

Graph II.11, based on specification (6) of the regression analysis, tries to identify the cyclical and structural determinants of labour shortages. It shows that swings in the business cycle accounted for a large share of the fluctuations in labour shortages during the pandemic recession and the subsequent recovery. The contribution of the cycle is particularly significant in the case of construction and services. In manufacturing, the widespread use

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[52] For manufacturing, the relationship is still significant and negative for the pre-pandemic period.

[53] When the dependency ratio increases the size of the workforce declines

[54] The same would be true if a linear time trend is introduced in place of the period dummies.

[55] A pooled regression of the dependency ratio on period dummies gives an R2 of 15% while for labour productivity this is less than 2%. Graph II.12 in the Annex shows that the age dependency ratio is high correlated with the period effects in the equation without a dependency ratio (Equation 3 of Tables II.1-II.2)

[56] In a cross-section estimate, about 10% of the differences across countries in the dependency ratio are explained by time-fixed effects; for labour productivity, the time-fixed effect does not explain differences across countries; for the share of the low-skilled, less than 6% of the differences by country are due to common factors.

[57] According to the life-cycle model, aggregate consumption rises when the share of elderly people in the population increases. Moreover, older workers enjoy a more stable employment relationship which reduces uncertainty about their incomes which in turn keeps up consumption and labour demand.

[58] Ageing-related changes in the population structure also affect the labour component of potential output via differences in age-specific participation rates. Nerlich, C. and Schroth, J.(2018), "The economic impact of population ageing and pension reforms", Economic Bulletin, Issue 1, ECB

Graph II.11: **Contribution of short- and long-term drivers to labour shortages by sector**

Manufacturing

Construction

Services
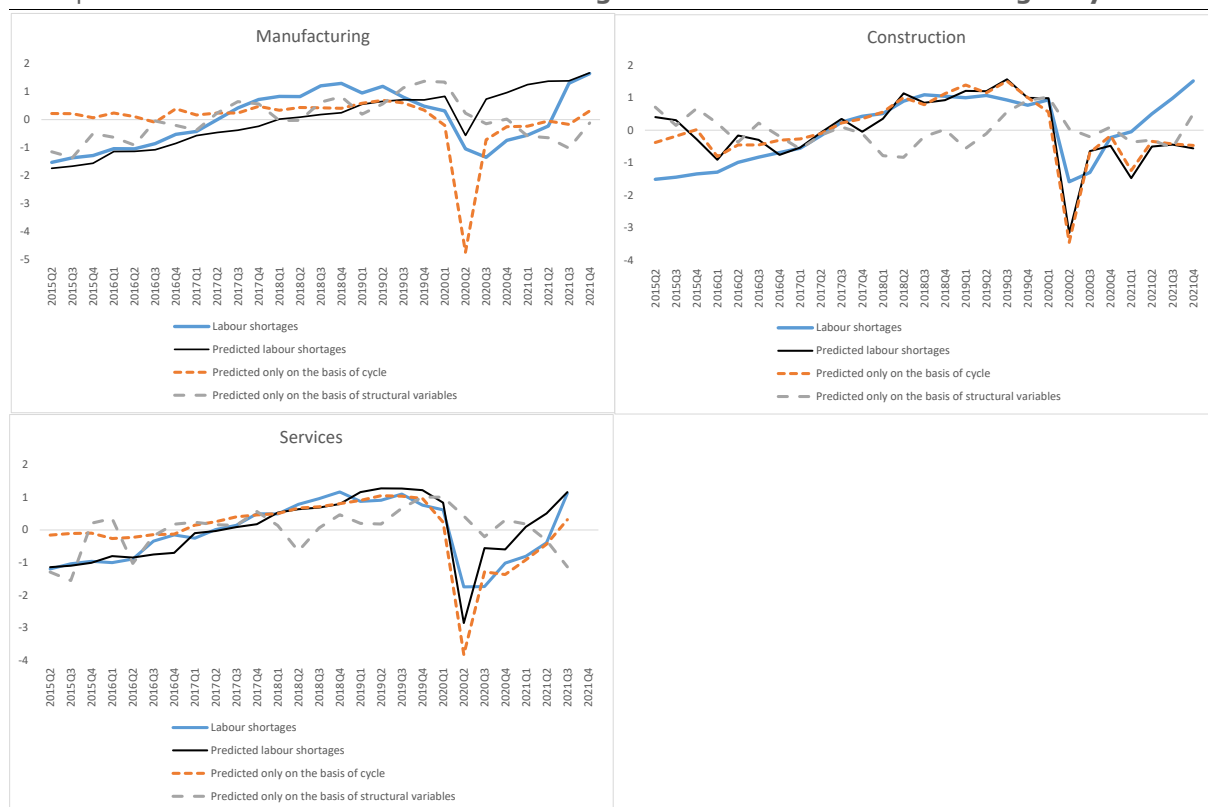
(1) The chart shows the mean contribution of different factors estimated from column 6. Estimates are based on a panel of EU countries. The cycle does not include the time fixed effects. The predicted data are is based on the estimated coefficients, excluding fixed effects. Standardised data.
Source: Own calculations

of short-time work schemes during the pandemic recession preserved employment relationships, making employers' hiring plan relatively more shielded from the business cycle [59]. The rise of labour shortages in the recovery was partly due to the strong increase in demand after the end of the Covid-19 related lockdown. This expansion arrived after a downturn in which short-time work schemes allowed firms to maintain their firm-specific human capital, which was clearly in their interest after a period of intense labour shortages leading up to the pandemic. The post-pandemic surge in labour demand was fast, and the rise in vacancies preceded a drop in unemployment and labour market slack. Compared to industry, the contraction of value added in services and construction was more prolonged, which

contributed to moderate labour shortages throughout the early stages of the recovery.

The labour shortages predicted on the basis of structural variables is a gauge of the unmet demand for labour that would prevail over the longer-term assuming that temporary demand shocks fade away. Before the pandemic, most of the increase in labour shortages was related to structural factors, in particular ageing and the decline in the share of the low skilled in employment. Long-term productivity developments also contributed to the increase in labour shortages, notably in manufacturing [60].

In the long-term, labour mobility can reduce the amount of labour shortages. However, as many of the most widespread and most severe occupational shortages are common across Member States, [61]

[59] Drahokoupil, J. and T. Müller (2021) "Job retention schemes in Europe" ETUI, Working Paper 7. For Germany, the share of employees benefiting from short-time work schemes was the highest in manufacturing. In wholesale and retail trade, the share of workers in short-time work schemes was the second highest; however, the wholesale and retail trade sub-sector is excluded from the definition of services in the Business and Consumer Survey data used to measure the labour shortages.

[60] The EU old-age dependency ratio (population 0 to 19 years and 60 years or over to population 20 to 59 years) was below 80 until 2010; in 2021 it was around 91% and is expected to increase according to the population projection. Similarly, the share of the low skilled in the EU dropped from 26% of 2005 to 16% of 2021.

[61] McGrath (2021)

panel estimates with country-fixed effects would not identify the relationship between labour shortages and labour mobility. A cross-section regression looks at this relationship across countries. The results in Table II.3 suggest that countries with respectively high intra-EU mobility and migration have low labour shortages in construction and manufacturing.

In services, only a high share of the non-EU population is associated with low labour shortages. The lack of correlation between labour shortages and mobility in cross-section regression is suggestive of the linguistic barriers and difficulty of getting qualifications recognised being more constraining in services than in construction and manufacturing [62]. Conversely, migrant population is more likely employed in low-skilled jobs with few barriers of entry because these requirements are less constraining [63].

Table II.3: **Effects of mobility and migration on labour shortages in a cross-section**

	Construction	Manufacturing	Services
Value added cyclical component	0.14*	0.17*	0.04
	(1.62)	(1.69)	(0.17)
Share of EU population except reporting country on total poulation of reporting country	-0.14***	-0.18***	0.08
	(-2.7)	(-4.7)	(0.6)
Share of non EU population on total population of reporting country	-1.44***	-1.30***	-0.66***
	(-10.3)	(-12.7)	(-5.9)
Country fixed effect	N	N	N
Period effects	Y	Y	Y
Observations	1301	1307	1209
R-squared- adjusted	0.30	0.31	0.25

Source: Own calculations based on Business and Consumer Survey and Eurostat Labour Force Survey.

II.3.3. Influence of the pandemic on the long-term drivers of shortages

The pandemic has accelerated some pre-existing trends, potentially contributing to a rise in labour shortages. First, it increased the demand for information and communication technologies. Second, its effects on consumers' preferences and labour supply have proven persistent in some sectors. In services, notably high-contact occupations, part of the workforce may have

reconsidered returning to their previous jobs, due to concerns of contracting the virus and uncertainties of business continuity where there were recurrent lockdowns. These new developments added to the problem of low wages in some service sub-sectors, further reducing their attractiveness [64]. Activity in manufacturing has also been less resilient in some Member States (including Germany), reducing the related labour demand and contributing to labour reallocation to other activities. Once employed in a new activity, employees are less likely to return to their previous occupations [65].

The pandemic is likely to have exacerbated poor working conditions in some occupations and created new demands for job quality in others. Worsening working conditions in health care reduced the supply of labour that was already previously insufficient [66]. They drove health care workers out of their profession for example in Denmark and Croatia. During lockdowns, when activities in the hospitality sector (hotels, restaurants and catering) were interrupted, some of the employees in the sector switched jobs, and in the recovery, they were not attracted to return, also due to poor working conditions, as well as the available opportunities elsewhere in Europe's tight labour markets. Poor working conditions have also been reported in the IT sector in Spain, where ICT specialists often lack upskilling or reskilling opportunities, and in Germany, where IT specialists reported challenges in terms of work intensity [67].

Yet the *Great resignation*, in which employees quit their jobs in search of job quality and flexibility and better work-life balance, has received significant attention in the US but has not so far affected a sizeable part of the workforce in the EU. This

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[62] In the EU Business and Consumer Survey, the service sector excludes wholesale and retail trade.
[63] This is consistent with the evidence provided by the European Labour Authority on the share of workers with a migrant background.

[64] Due to travel restriction and closures of restaurants and bars, parts of the labour force have been driven out of the hospitality sector in Belgium, Denmark, Italy, Sweden or the Netherlands.
[65] In the Italian hospitality sector (hotel, restaurants), the increased uncertainty about the possibility of work during the pandemic has incentivised workers to search for occupations in other sectors. This caused a shortage of staff after the restriction were lifted. Source: Country reports in the 2022 thematic review by the European Centre of Expertise (ECE) in the field of labour law, employment and labour market policies, entitled 'Skills shortages and structural changes in the labour market during the Covid-19 pandemic and in the context of the digital and green transition'.
[66] Eurofound (July 2021), Tackling labour shortages in EU Member States | Eurofound (europa.eu)
[67] E.g., in IT, a larger share of employees than in other types of services perceive that the tasks they were given were often or very often not doable within the given time frame. Source: ECE Thematic Review 2022, op. cit.

trend has been reported only in some sectors and Member States, for example in the construction sector in Italy [68]. Altogether, the movement of workers out of occupations and sectors with poor working conditions may contribute to increasing skills imbalances, although to a limited degree [69].

II.4. Conclusions

To a large extent, the current labour shortages are not new. Their patterns closely follow those of the pre-pandemic period and have significant structural drivers. These include ageing, the influence of skills shortages and mismatches, the ongoing digital and green transitions, migration and poor working conditions in some sectors and occupations.

While the pandemic reduced labour shortages due to its negative cyclical economic impact, it accelerated digitalisation and, created new pressures for reallocation by influencing consumers' and employees' preferences; thereby, it increased the likelihood for skills mismatches triggered by transitions between sectors. By reducing labour mobility and migration, the pandemic also caused a decline in the labour supply. Furthermore, it worsened working conditions in some sectors.

Persistent labour shortages may have several negative economic consequences. They can lead to employers being required to hire workers with significant skills gaps, or leave vacancies unfilled for protracted periods, which can in turn negatively affect labour productivity, hamper innovation capacity and adaptation to technological developments [70]. Countries with labour and skills shortages may become less attractive for innovation and investment in R&D, which may negatively affect productivity and their competitiveness. Skill shortages can contribute to skills mismatch if employers are unable to find the skills they need and end up recruiting workers who

are under-skilled for a specific job [71]. Lack of workers in specific occupations could worsen the quality of the services provided, most prominently in health care. At the individual level, labour shortages can represent an opportunity for improvements in wages and working conditions. At the same time, employees may also face higher work intensity and work-life balance conflicts.

Currently, the ongoing green transition can also trigger a pressure towards reallocation in the labour market. The speed and effectiveness of this depends on the adaptability of the skills of workers. The green transition increases demand for digital, technical and transferrable skills [72]. Structural weaknesses in the adult learning systems in most Member States risk slowing down this adaptation. Skills mismatches triggered by the twin green and digital transition can lead to longer unemployment spells and eventually higher structural unemployment, slowing down the transition itself. These factors might increase labour shortages and these risks should be anticipated and addressed by policies. The implementation of the Recovery and Resilience Plans and of the cohesion policy funds, including the European Social Fund Plus and the Just Transition Fund, will boost labour demand in some sectors including the green and digital ones; it will also provide support for up- and re-skilling and for increasing the labour supply via active labour market policies. On the other hand, robotisation and AI are likely to reduce labour demand for different occupations, and the current high level of labour shortages may accelerate this process.

At the current juncture, the European economy is affected by high food and energy prices and inflation. The current economic downturn, although milder than previously expected, may dampen labour shortages in some sectors and countries, especially in industry. The inflow of displaced people from Ukraine has the potential to increase the labour supply and help somewhat ease shortages in sectors with the lowest barriers to skills transferability, such as services if these persons are integrated in the labour market. In line with the activation of the Temporary Protection Directive by the Council on 4 March, a broad

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[68] Yet many of the people voluntarily quitting their job in 2021 are postponed resignations, due to the freezing of the labour market during the pandemic. See Banca d'Italia (2021) "Il mercato del lavoro dati e analisi" N6.

[69] The great resignation may also contribute to the desirable increase in job quality. Employers will need to offer better working conditions and possibly benefits, beyond wages, to attract and keep their workers.

[70] Brunello, G. – Wruuck, P. (2019): Skill Shortages and Skill Mismatch in Europe: A Review of the Literature. Journal of Economic Surveys, 2021, 35 (4), 1145-1167.

[71] Desjardins, R. and Rubenson, K. (2011): An Analysis of Skill Mismatch using Direct Measures of Skills, OECD Education Working Papers n.63, Paris.

[72] CEDEFOP (2021), "The green employment and skills transformation. Insights from a European Green Deal skills forecast scenario."

range of measures (language and training policies, access to education, care and healthcare services, targeted labour market measures such as profiling, counselling, and employment subsidies and measures to prevent undeclared work) could support the integration of displaced persons from Ukraine into the labour market of their host societies. Improved policy coordination between the different policy domains affecting labour shortages (activation policies, education and training, mobility and migration policies) could contribute to better addressing this macroeconomic challenge. Policies should continue to address the underlying drivers of labour shortages, regardless of whether an economic downturn temporarily alleviates them. This can ensure that in the short run, the positive impact of shortages on wages and working conditions prevails and that in the medium to long run, shortages do not constrain innovation and growth prospects.

Policies at the national level can effectively address the main causes of labour shortages. Activation policies could reduce both shortages and potential wage pressures, thereby contributing to price stability. Skills policies could address the main root causes of labour shortages, with the contribution of migration policies. There is scope to step up policies supporting transitions in the labour market and promoting quality of work. Labour mobility can help address labour shortages to some extent, including to cope with the consequences of an ageing workforce and in combination with measures that keep older people in the labour force. As regards migration, the Commission's recently proposed Skills and Talent package provides the framework for supportive national policies to attract talent, which can ensure an effective right to mobility for non-EU nationals and simplify admission procedures for all workers from non-EU countries. Improvements in the recognition of professional qualifications could support labour mobility filling labour shortages across the EU.

Most national actions to address the structural causes of labour shortages will have a delayed impact. This is the case especially for policies that target the labour market relevance of initial education and training. Yet it is important to implement both policies with a short-term impact (such as PES actions to improve matching, migration policies or short training courses) along with structural policies with a long-term impact on

labour shortages, including structural policies affecting the provision of adult learning.

Graph II.12: **Period effects in equation without age dependency ratio, and age dependency ratio (data standardised by detracting means and dividing by the standard error)**
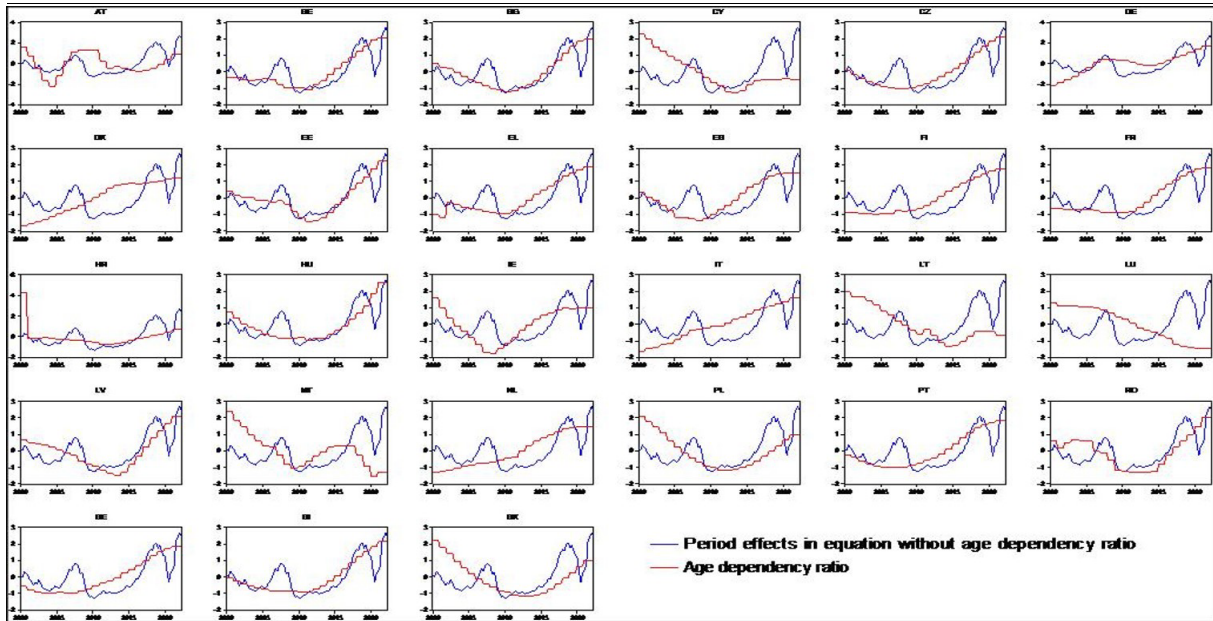
(1) The chart shows the period effects for equation 3 for manufacturing in Table II.1 and the age dependency ratio. For the equation of labour shortages for construction and services a similar relation is observed.
Source: Source: Own calculations based on period effects of regression 3 in Table II.1