Being on the Frontline? Immigrant Workers in Europe and the COVID–19 Pandemic

Francesco Fasani
Queen Mary University of London, CEPR, CReAM and IZA

Jacopo Mazza*
European Commission Joint Research Centre

April 8, 2021

Abstract

We provide a first timely assessment on the labour market impact of COVID–19 on immigrant workers in Europe. We propose a novel measure of individual exposure to employment risk that combines information on four occupation characteristics: the role of workers' occupations in the response to the pandemic, the contractual protection they enjoy, the possibility of performing their job from home and the resilience of the industry in which they are employed. We show that our measure of employment risk closely predicts actual employment losses observed in European countries in 2020. Our measure allows comparing relative employment risk across population groups as well as identifying individual covariates that are associated to higher exposure to risk. We find that: i) migrants – and Extra EU migrants in particular – are exposed to a higher risk of unemployment than native workers, even within industries and occupations; ii) young and low educated migrants are those most exposed; iii) female workers face harsher consequences from the pandemic than men. According to our estimates, more than 9.3 million immigrants in the EU14+UK area are exposed to a high risk of becoming unemployed in the COVID–19 recession; 1.3 million of them are facing a very high risk.

JEL Codes: F22, J61, J20
Keywords: employment risk, COVID–19, key occupations.

*Corresponding author at the KCMD, European Commission Joint Research Centre, Via Enrico Fermi, 2749, 21027 Ispra (VA), Italy. We thank Peter Backus, Matias Cortes and Tommaso Frattini for helpful comments. Computer programs are available on request. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the European Commission or of any other person associated with the European Commission.

1 Introduction

The costs of recession are rarely, if ever, equally distributed across the population (Hoynes, Miller and Schaller, 2012). Early evidence on the labour market impact of the COVID–19 suggests that this recession is anything but different. A growing body of evidence is showing that pandemic–induced job losses are concentrated among low–wage industries and occupations, young workers, the low educated, women and ethnic minorities.[1] Inequalities in the pandemic effects are not limited to unemployment risk. Minorities and other vulnerable groups of workers are over–represented in occupations exposed to higher risk of contagion (Basso, Boeri, Caiumi and Paccagnella, 2020), they are suffering from severe deterioration in mental health (Proto and Quintana-Domeque, 2020) and their excess mortality is particularly high (Platt and Warwick, 2020). Policy interventions can counteract the inequality–enhancing effects of the pandemic, as shown in Cortes and Forsythe (2020a) for the U.S., but to be effective these actions need to be targeted at those in need. Understanding who will be most harshly affected by the economic consequences of the COVID–19 crisis is then of primary importance.

Unsurprisingly, the detrimental economic impact of the pandemic is more severe for those whose labour market participation is relatively vulnerable and whose savings and wealth are inadequate to weather the effects of a lasting recession. Migrant workers possess all these characteristics, yet little attention has been devoted to understanding the peculiar effects this recession is having on them. We fill this gap in the burgeoning literature on the labour market effects of the COVID–19 pandemic, by providing a first timely assessment of how the pandemic crisis is impacting the employment prospects of immigrant workers in Europe.[2] Further, we contribute to this early body of evidence by proposing a novel measure of employment risk – which combines the distinction between essential and non–essential occupations with other indicators that are widely discussed in this literature – and by testing its predictive power on actual employment losses recorded in Europe in 2020. Our measure allows comparing relative employment risk across population groups as well as identifying individual covariates that are associated to higher exposure to risk. Although the focus of this paper is on migrant workers, the approach we develop can be immediately extended to any other category of workers.

Several reasons would lead us to expect migrants to face especially dire prospects in the midst of the COVID–19 pandemic. As relative new–entrants in the labour market who typically face linguistic and institutional barriers to access occupations, migrants are generally more likely to have non–standard or informal contract, shorter job tenure and low–skilled occupations than comparable natives (Kerr and Kerr, 2011; de la Rica, Glitz and Ortega,

[1] See, among others: Cortes and Forsythe (2020b); Couch, Fairlie and Xu (2020); Alon, Doepke, Olmstead-Rumsey and Tertilt (2020); Hupkau and Petrongolo (2020); Adams-Prassl, Boneva, Golin and Rauh (2020); Farre, Fawaz, Gonzalez and Graves (2020).

[2] This paper builds on earlier evidence discussed in Fasani and Mazza (2020a) and Fasani and Mazza (2020b).

2015). The combination of all these factors render their employment status particularly sensitive to business cycle fluctuations, increasing their vulnerability during economic downturns (Dustmann, Glitz and Vogel, 2010; Orrenius and Zavodny, 2010). Immigrants are also more concentrated in low–pay jobs than natives with similar characteristics: having relatively low earnings and transferring a large fraction of their income abroad through remittances, migrants typically have limited savings in host countries and are therefore poorly equipped to sustain long periods of unemployment. Further, migrants' residence status typically determines their entitlement to welfare state provisions and public health care, limiting their access with respect to natives (Avato, Koettl and Sabates-Wheeler, 2010). In addition, residence permits are often tied to their employment status: being laid off may force them to return home or remain illegally in the host country without any welfare coverage. Two factors may partly offset these weaknesses. First, migrants' higher mobility across areas may enable them to more effectively respond to local negative shocks than natives (Borjas, 2001; Cadena and Kovak, 2016). Second, migrants can typically rely on insurance from family abroad (Yang, 2011), a resource that can be extremely effective when shocks in host and source countries are uncorrelated. Both mechanisms, however, break down when the recession is at a global scale, like the ongoing one. The evidence on migrants' performance in the midst of the COVID–19 crisis is still extremely scarce. A notable exception is work by Borjas and Cassidy (2020) showing that immigrants in the US are experiencing a particularly severe decline in employment. They quantify that about a third of this relative decline is explained by migrant workers having jobs that are less "remotable" than natives and find that undocumented men were hit particularly hard by the pandemic, with their rate of job loss far exceeding the rate of job loss of legal immigrants. In the context of low– and middle–income countries (LMICs) such as Nepal and Bangladesh, Barker *et al.* (2020) observe that migrant households suffer a double fallout: their income dropped due to reduced migration of households members and fewer remittances, while their health hazard increased due to the return of members from national and international destination areas which were more affected by the pandemic. In Europe, harmonized microdata covering the continent since the COVID–19 outbreak have yet to be released. In a rapidly evolving and dramatic recession such as the ongoing one, this delay undermines the ability of policy–makers to intervene in a timely manner designing the appropriate interventions on the affected population, deepening the economic damages of the pandemic.

In this paper, we propose a measure of exposure to employment risk that relies on existing data to asses the risk of dismissal at the individual worker level. Our measure links specific characteristics of migrant workers' occupations – which are salient in the context of this unique crisis – to individual level data from one of the most recent waves of the European Labour Force Survey (EU–LFS 2018). The four dimensions that we identify as pivotal in predicting workers' employment risk in the current COVID–19 crisis are: i) *essentiality*; ii) *temporariness*; iii) *teleworkability* and iv) *industry resilience*. We first account for the distinction between *key* and *non–key* occupations that many governments introduced when imposing shutdown measures. Despite variation in definitions and enforcement across

countries, workers employed in key sectors and occupations could generally continue their activities, although with enhanced safety and health measures. Outside these key occupations, instead, workers and firms were subject to severe restrictions that often implied that workers had to stay at home while their workplaces were kept entirely or partially closed. The second dimension that we consider is the duration of employment contracts: having lower firing costs than workers on permanent contracts, fixed–term workers are the first ones to be laid off when negative shocks hit firms or sectors (Blanchard and Landier, 2002; Boeri and Garibaldi, 2007). Thirdly, we assess the degree of teleworkability of occupations, which has been rapidly identified as one the most important predictors of job loss in the COVID–19 crisis (Dingel and Neiman, 2020; Mongey, Pilossoph and Weinberg, 2020; Adams-Prassl, Boneva, Golin and Rauh, 2020). Finally, we factor in the additional uncertainty associated to differential exposure to the pandemic across industries. Following Pagano, Wagner and Zechner (2020), we evaluate resilience according to the degree of teamwork, interaction with customers and physical presence required by the occupations in each industry. In particular, we expect industries whose occupations require more physical interactions and presence to be more negatively affected by the social distancing measures and, thus, more negatively impacted by the crisis.

Our measure allows us to assign migrant workers in the EU14+UK area to four categories of employment risk: very high, high, moderate and low. In our framework, workers who are employed in non–key occupations, with temporary contracts, in jobs that require physical presence and in industries that are not resilient to the crisis, face the highest risk of being laid off. To validate our approach, we leverage available data on European labour market in 2020 at the aggregate level and show that our measure is able to explain a large part of the variation in the labour market contraction recently experienced by migrant workers in European countries. Remarkably, our measure of employment risk has no predictive power in the pre–pandemic period, when occupational dimensions such as teleworkability of tasks or the intensity of social interactions at the workplace were orthogonal to job stability. Considering the high goodness–of–fit of our measure for explaining the fallout of the pandemic on European labour markets, we argue that our approach could be employed for assessing the consequences of a protracted pandemic on the employment prospects of immigrants in Europe. We then analyse migrant–native gaps in employment risk and estimate that EU mobile and Extra–EU migrant workers are 7 and 11 percent more likely to belong to the high risk category than comparable natives. These gaps shrink for both migrant groups once we control for sorting into occupations and sectors, becoming not significantly different from zero for the former while being equal to 4 percent for the latter. When focusing on which individual covariates predict exposure, we identify young, low educated and Extra–EU workers as those most exposed to employment risk. As far as gender differences are concerned, we find that women tend to be employed in occupations and sectors that are less exposed to employment risk but face higher risk when compared to men employed in similar jobs and industries. We do not observe differences in gender gaps between native and migrants workers. Applying our measure of employment risk to the pool of foreign born workers who

were employed in the EU14+UK area before the pandemic, we estimate that approximately 1.3 million of migrants in the EU14+UK area are at *very high risk* of losing their jobs as a consequence in the pandemic–induced recession; this number swells to more than 9.3 million workers – approximately one third of the foreign born employed in the area – if we consider also those workers that we classify as being exposed to *high risk*.

In constructing our employment risk categories, we initially assume that key–workers are largely shielded from the labour market fallout of the crisis. The ability of our measure to closely predict actual employment losses of migrants in Europe implies that this is a reasonable assumption to make. Nevertheless, key workers are not completely immune to the detrimental effects of the pandemic crisis. In the last part of the paper, we focus on this group of workers and explore several dimensions of their potential vulnerability (i.e. contract duration, earnings, physical proximity on the job and teleworkability). We find that migrant workers tend to be more concentrated in key occupations and that migrant key–workers fare worse than comparable natives in all of the dimensions of vulnerability that we analyse. Together with our findings on non–key workers, these results strongly suggest that the COVID–19 recession poses a severe threat for migrant workers in Europe irrespective of whether they are employed in key or non–key occupations.

The paper unfolds as follows. Section 2 presents our data and briefly describes our methodology. Section 3 introduces our measure of employment risk for migrant workers and attributes them to different risk categories in our sample of European countries. Section 3.1 reports a validation exercise of our measure against the most recent aggregate data on employment losses in Europe and Section 3.2 estimates conditional migrant–native gap in the probability of being at risk. Further, Section 3.3 quantifies the number of migrant workers whose jobs are threatened by the pandemic. Section 4 describes the distribution of migrant key workers across countries and occupations and assess their labour market vulnerability relative to natives. Finally, Section 5 discusses some policy implications of our findings.

2 Data and Definitions

For our analysis, we use individual–level data from the 2018 wave of the EU Labour Force Survey (EU–LFS), a large household survey that combines and harmonizes micro–data from the Labour Force Surveys collected by national statistical institutes across all EU member states. We restrict the sample to employed workers aged 15–64 and distinguish two groups of migrant workers based on their country of birth: EU migrants (i.e. workers born in a EU Member State other than the one where they currently work and reside) and Extra–EU migrants (i.e. workers born outside of the Union). Further, we define as native anyone who was born in the current country of residence. We focus our analysis on the EU–14 countries and the UK, which jointly host the vast majority of migrant workers living in the European

Union.[3] Our sample includes 1,089,952 individuals, of which 933,516 (85.6%) are natives, 58,660 (5.3%) EU–mobile and the remaining 97,776 (8.9%) are Extra–EU workers.

We use the following definitions for the four dimensions of workers' vulnerability to the COVID–19 pandemic that we study in this paper:

1. *Key workers.* For the definition of key workers, we follow the Communication from the European Commission on Guidelines concerning the exercise of the free movement of workers during COVID–19 outbreak[4] supplemented with the Dutch definition of key workers.[5] We identify key workers based on ISCO–08 occupations at three digits, which is the most detailed classification available in the EU–LFS.[6]

2. *Temporary Workers.* The EU–LFS survey includes information on the type of employment contract that allows us to distinguish employees who are on a fixed–term contract from those with a permanent one.

3. *Teleworkability.* Our measure of *teleworkability* is taken from Dingel and Neiman (2020). This measure is based on responses to two Occupational Information Network (O*NET) surveys covering "work context" and "generalized work activities". The index runs from 0 to 100 and we use a threshold value of 60 to classify jobs above the cutoff as teleworkable and jobs below the cutoff as non–teleworkable. We then apply the cross–walk provided in the replication package by Dingel and Neiman (2020)[7] to merge the SOC classification of occupations provided by the Bureau of Labor Statistics (BLS) with the ISCO–08 classification available in the EU–LFS.[8]

4. *Industry resilience.* We borrow the definition of *industry resilience* from Pagano, Wagner and Zechner (2020) to characterize how negatively affected an industry can be by the ongoing crisis and by its future developments based on the characteristics of its pool of jobs. We define an industry as "resilient" if the number of jobs in that industry that are "affected" by the pandemic crisis (and by social distancing measures) is below the median of the national distribution, and "non–resilient" if it lies above. To identify "affected" occupations, we follow Koren and Peto (2020) and use three characteristics

[3] In 2019, the EU–28 area hosted approximately 55 million foreign born resident and over 90% of them lived in EU–14+UK countries. In Fasani and Mazza (2020b) we consider all 27 European Union countries and exclude the UK, which left the EU on the 31st of January, 2020.

[4] https://ec.europa.eu/social/main.jsp?langId=en&catId=89&furtherNews=yes&newsId=9630

[5] https://www.government.nl/topics/coronavirus-covid-19

[6] A full list of our definition of key profession is provided in the appendix Table A.3 and can be accessed at the repository https://github.com/jacopoto/fm-migrant-key-workers. Note that both the Commission's and the National's definitions often refer to a finer ESCO four digits classification. ESCO is the European implementation of ISCO and therefore the two classifications can be easily mapped into each other. Our definition is thus necessarily broader than the original one.

[7] https://github.com/jdingel/DingelNeiman-workathome

[8] In the same way, we construct a measure of physical proximity, that we discuss in Section 4.1.

of occupations that likely predict how negatively affected they will be by the persistence of social distancing measures: i) the level of teamwork required, ii) the intensity of contact with customers, and iii) the need for physical presence from the worker. The more interactions with colleagues and customers are required and the less teleworkable an occupation is, the more affected it will be by the pandemic, both in the short and in the medium–long run. We therefore construct an "affected" occupation index, which is a composite index of three sub–indices (teamwork, customer proximity and physical presence). The sub–indices take value one if the underlying measures are above given cutoff values, as in Koren and Peto (2020). Finally, the composite index takes value one if at least one of its sub–indices is equal to one. We modify the definition of industry resilience proposed in Pagano, Wagner and Zechner (2020) by taking into account the information on whether occupations are key or not. Since key workers are relatively protected from possible lay–offs during the pandemic, we account for their status by setting their index equal to zero. This implies that, differently from Pagano *et al.* (2020), industries with many "affected" workers could still be resilient if the share of key workers within the industry is sufficiently high.

3 The Employment Risk of Migrant Workers

We combine information on key occupations, temporariness of employment contracts, teleworkability of tasks and industry resilience – as defined in the previous section – to characterize the employment risk that migrant workers are facing during the pandemic crisis in the EU14+UK area and assign them to different risk categories.

We first identify workers employed in *key occupations* and treat them as a distinct risk category with respect to non–key workers. Key workers are at the front line of Europe's COVID–19 response, performing the crucial tasks of keeping European citizens healthy, safe and fed during the pandemic. The recognized importance of their functions largely shield their jobs from labour market contractions induced by social–distancing measures and by the ongoing recession (while potentially heightening their social interactions and thus their risk of contagion). Although in this first part of the analysis we treat them as a relatively employment risk–free group, in Section 4 we explore in more detail the characteristics of key workers, focusing in particular on their vulnerability relative to native workers in the same occupations.

As summarised in Table 1, we then assign *non–key workers* to four categories of employment risk:

1. *Very high*: this group includes workers who are vulnerable along all the four dimensions that we identify, i.e. workers employed in non–key occupations, with a temporary contract, whose work is not teleworkable and in an industry which is not resilient to

the pandemic.

2. *High*: we assign workers to this group if their jobs are not key and if at least two out of the other three conditions (temporary contract, non–teleworkable job, low–resilience industry) are satisfied.

3. *Moderate*: this group comprises workers who meet only one of the vulnerability conditions (i.e. are either temporary, their job is not teleworkable or their industry is not resilient)

4. *Low*: this latter group includes non–key workers who are not vulnerable along the other three dimensions (i.e. they have a permanent contract, a teleworkable occupation and are employed in a resilient industry)

Table 1: Classification of Non–Key Workers by Employment Risk Group

Job Characteristic:												
Permanent Contract	✓		✓	✓			✓					
Teleworkable Occupation	✓		✓			✓			✓			
Resilient Industry	✓				✓	✓					✓	
Risk category:	Low		Moderate				High				V. High	

Note: The table reports our criteria to assign workers to different employment risk categories. Key workers are excluded from this classification.

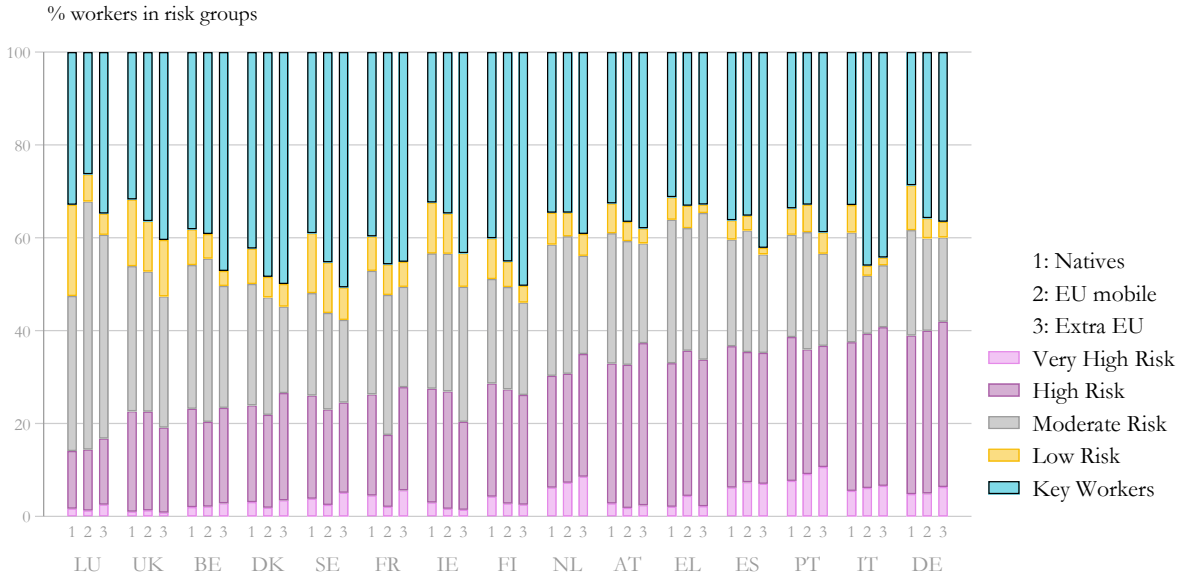
In Figure 1, we show how workers are distributed in the four employment risk categories across EU14+UK countries. We distinguish native, EU mobile and Extra EU workers (denoted in the graph with numbers 1, 2 and 3, respectively). Countries are ordered according to the total share of "*workers at risk*", that we define as the sum of the workers belonging to the two highest categories of risk (i.e. very high and high risk). On average, the share of workers at risk is 29.3% among natives and 28.2% and 29.7% for EU mobile and Extra–EU, respectively. Figure 1 shows that the share of "workers at risk" fluctuates widely across European countries, being around 20% of all employed workers in countries such as Luxembourg, the UK, Belgium and Denmark, while approaching (and even exceeding) 40% in Spain, Portugal, Germany and Italy. This cross–country heterogeneity is driven by large disparities in the concentration of workers in the different determinants of employment risk.[9] It is also worth noting that the share of migrants at high risk is large both in countries with a

[9]As Appendix Table A.1 show, among the four countries with the highest shares of workers "at risk", Spain, Portugal and Italy all have a share of temporary workers substantially above the EU14+UK average, while Germany has a disproportionately low share of workers employed in high resilience industries. Further, all four countries display a below–average share of workers in teleworkable occupations.

typically healthy labour market like Germany and in countries with a sluggish labour market like Italy and particularly Spain. This suggests a weak relationship between the fundamental strength of a labour market and its vulnerability to the pandemic–induced contraction.[10]

As far as foreign born workers are concerned, Figure 1 points to two important facts: in 8 out of the 15 EU14+UK countries, migrant workers – and Extra–EU migrants in particular – tend to be overrepresented with respect to natives among workers "at risk" (pink and purple bars in Figure 1) and they are also over–represented among key workers (turquoise bars). In the rest of the paper, we will closely analyse these patterns and investigate the position of migrants relative to natives in non–key occupations (section 3.2) and key occupations (section 4).

Figure 1: Share of Workers in Risk Groups, by Host Country and Origin



Note: The figure reports the distribution of employed workers across the five categories of employment risk we identified, by host country and origin area. The countries are ordered according to the sum of the shares of workers at very high and high risk.

[10]This conjecture is confirmed by looking at the regional breakdown of migrant workers at risk in Appendix Figure A.1. Indeed, if we consider Germany and Italy – two countries with marked regional inequalities and the two countries with the highest share of migrant workers at risk – the most vulnerable regions are some of the wealthiest such as Baden–Württerrnberg in Germany or Veneto, Emilia–Romagna and Lombardy in Italy. The lack of relationship between past unemployment rates and the employment risk specific to the pandemic is displayed in Appendix Figure A.2 where we plot the regional unemployment rate against the regional share of workers at high risk for EU migrants in panels A.2a and for extra EU migrants Panel A.2b.

3.1 Testing the Employment Risk Measure

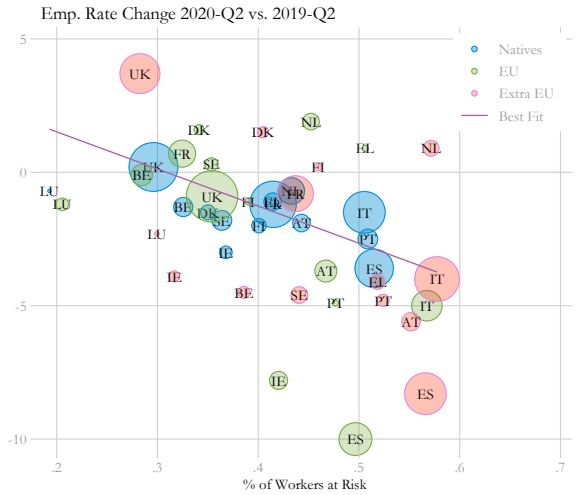
Before discussing further implications of our proposed measure of employment risk, we validate its predictive power against data on actual employment losses. In particular, in Figure 2 we assess how well our composite indicator captures the dynamics of the European labour markets observed in the months immediately following the first pandemic outbreak. In fact, although individual data covering this period are not yet accessible for the whole of Europe, aggregate data on labour markets outcomes at the country level and by origin are available.[11]

In Figure 2a, we plot the changes in employment rate between the second quarters of 2020 and of 2019 (vertical axis) against the percentage of workers in the high/very high risk group (horizontal axis) for each host country and origin group (native, EU mobile and Extra–EU migrants). The figure displays a clear negative relationship: the countries and origin groups for which we predict the largest shares of workers at risk of job loss actually experienced the sharpest drops in employment during the first wave of the pandemic. The second quarter of 2020 coincides with the peak of the first wave in Europe. The pandemic subsided in the third quarter leading to a relaxation of containment measures and a partial recovery of economic activity. The improvement reflects on how well our measure – which is designed to predict employment losses and not employment gains – correlates with recorded labour market dynamics. In Panel 2b, where we consider the changes in employment between the third quarters of 2020 and 2019, the line of best fit becomes flatter and countries are less concentrated around it than in Panel 2a.

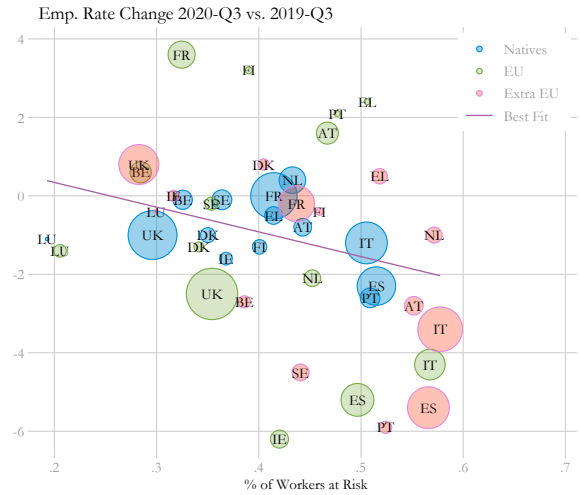
To probe our measure further, in Figure 2c we replicate the same graph, but we now use the change in employment rate observed between the third quarters of 2018 and 2019, hence before the pandemic even started. Since our measure of employment risk captures occupational features (essentiality, teleworkability and physical proximity) that are distinctively relevant only in the context of the current pandemic, we would not expect our measure to have predictive power in a pre–pandemic world in which those attributes had not direct bearing on the probability of being in employment. The flat line in Figure 2c confirms our conjecture, showing that before the COVID–19 outbreak our employment risk measure and actual changes in employment were totally uncorrelated. We also look at the relationship of our measure with recorded employment losses for women (panel a) and men (panel b) separately in Figure A.3. The figure shows that our measure is able to capture the recorded dynamic equally well across genders, although the slope of the relationship is steeper for female than male workers.

[11] Employment rate data are taken from Eurostat dataset LFSQ_ERGACOB, last accessed 10/03/2021. Data are available for all countries in our sample with the exception of Germany for which employment rates for 2020 by country of origin are missing.

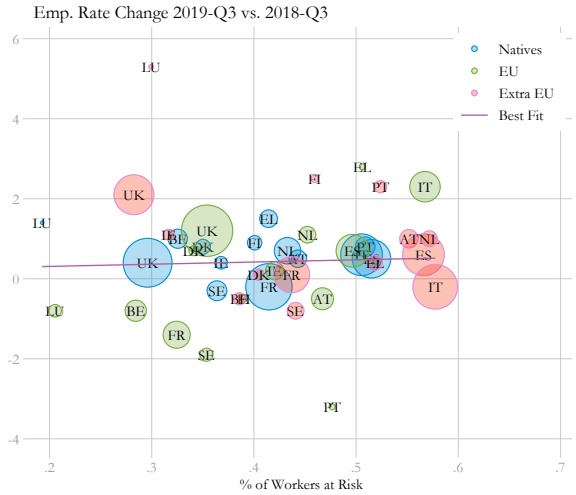
Figure 2: Employment Rate Changes and Workers at Risk



(a) **Post Pandemic (Q2 2020 – Q2 2019)**



(b) **Post–Pandemic (Q3 2020 – Q3 2019)**



(c) **Pre–Pandemic (Q3 2019 – Q3 2018)**

Note: The figure reports scatter plots of changes in employment rate (vertical axis) against the percentage of workers in the high/very high risk group (horizontal axis) disaggregated by host country and origin group (native, EU mobile and Extra EU migrants). Changes in employment rate are computed between the second quarters of 2020 and of 2019 in panel 2a, between the third quarters of 2019 and 2018 in panel 2b and between the third quarters of 2019 and 2018 in panel 2c. Markers' area is proportional to country's population aged 16 to 65 for each area of origin.

We test the relationship between the two variables more formally in Table 2, where we regress actual changes in employment rates on the share of workers at risk (i.e. those at high and very high risk). The estimation sample pools observations for fourteen host countries and three origin groups (native, EU mobile and Extra–EU workers), which are exactly the same data used for the scatter plots in Figure 2. We use pre–pandemic (Q3 2019–Q3 2018) changes in employment rate in columns 1–2 and post pandemic changes in the other columns (Q2 2020–Q2 2019 in columns 3–4 and Q3 2020–Q3 2019 in columns 5–6).

The estimates in columns 1–2 confirm that our employment risk measure does not predict employment changes before the onset of the pandemic: not only the coefficients on the *% of workers at risk* are not statistically significant, but the R^2 of the regression is at most 2 percent. The relationship becomes instead strongly significant in columns 3–4 of Table 2: a 10 percentage points increase in our measure of risk exposure for any given worker group is associated to a drop of approximately 14 percentage points in its employment rate in the second quarter of 2020 (relative to the same quarter in 2019). The coefficient barely changes when we include dummies for migrant groups (column 4). The estimate for our parameter of interest is significant at the 1% level and the R^2 is around 50 per cent in both regressions. It is remarkable how well our intuitive measure of employment risk is able to explain the employment rate changes observed in the aftermath of the first pandemic wave. The predictive power of our measure somehow declines when looking at employment changes in the third quarter of 2020 (with respect to the same quarter in the previous year; columns 5–6): the coefficient of interest is approximately half of the estimates in columns 3–4 and is marginally significant. Still, the R^2 remains relatively high, being at 0.27 in column 6. Results in Table 2 thus confirm that our exposure measure is able to capture the peculiar labour market dynamics induced by the social distancing measures adopted throughout the continent without being mechanically correlated to long run labour market performances in the countries analysed. The negative coefficients estimated on the "EU mobile" and "Extra EU" dummies reported in columns 4 and 6 imply that being in an occupation at risk may lead to larger employment losses for migrants than for natives, although none of the coefficients are significant.

In Appendix Table A.2, we replicate the same exercise but we now distinguish male and female workers – thus doubling the sample size – and add to the specification a female dummy (odd columns) and the interaction of the female dummy with migrant group dummies (even columns). When considering employment changes between the second quarters of 2020 and 2019 (column 3–4 in the table), we estimate a negative and significant coefficient on the female dummy which clearly points at women having suffered higher employment losses than men in the immediate aftermath of the first pandemic wave. According to our estimates, equal levels of exposure to risk translate into 1.3 percentage points larger employment losses for women than for men, roughly equivalent to a 10 percent larger effect. The non–statistically significant coefficients on the interaction terms of migrant status with the female dummy (see column 4 of Appendix Table A.2) further suggests that there are no differential gender gaps for migrants relative to native workers. Our data do not allow us to discern if these additional job losses are voluntary or involuntary separations, but they are in line with the emerging literature on the unequal labour market consequences of the pandemic across genders (Alon, Doepke, Olmstead-Rumsey and Tertilt, 2020; Farre, Fawaz, Gonzalez and Graves, 2020; Hupkau and Petrongolo, 2020).

Table 2: Realized Employment Losses and Exposure Measure

	Δ Empl. Q3 2019 vs. 2018		Δ Empl. Q2 2020 vs. 2019		Δ Empl. Q3 2020 vs. 2019	
	(1)	(2)	(3)	(4)	(5)	(6)
% of Workers at Risk	0.547	0.483	-13.918***	-13.811***	-6.296*	-5.986
	(0.636)	(0.731)	(2.934)	(3.075)	(3.056)	(3.358)
EU mobile		0.184		-1.601		-1.178
		(0.425)		(1.113)		(0.884)
Extra EU		0.189		-0.543		-0.962
		(0.441)		(1.333)		(0.843)
R^2	0.008	0.020	0.489	0.531	0.202	0.271
Obs.	42	42	42	42	42	42

Note: In this table, we regress changes in employment rates between the third quarter of 2019 and 2018 (columns 1–2), second quarter of 2020 and 2019 (columns 3–4) and third quarters of 2020 and 2019 (columns 5–6) on the share of workers at risk (high and very high risk) and other controls (area of origin). We pool observations by host country and area of origin (native, EU mobile and Extra–EU workers). Germany is not included in the sample because data on employment rates for 2020 by country of birth are not available. All regressions are weighted using countries' population in 2019. Robust standard errors in parentheses. ***, ** and * denote statistical significance at the 99.9, 99 and 95%, respectively.

Whether employment risks translates into actual layoffs is, among other factors, influenced by the severity of the pandemic in each country and the different policies adopted to oppose it. Appendix Figure A.4 confirms this intuition. In the figure, we plot the recorded change in GDP between the second quarters of 2019 and 2020 (vertical axis) against the percentage of workers at high/very high risk (horizontal axis) in each country. Arguably, GDP changes are heavily influenced by the severity of the pandemic and can be used as a proxy for its intensity. Four of the countries hardest hit by the pandemic – France, Italy, Spain and the U.K. – are also the countries which experienced the most severe drops in GDP during the first wave, but the job market consequences in these countries differ substantially (as shown in Figure 2). Workers in Italy and, particularly, in Spain – two of the countries with the highest share of workers at risk, according to our measure – have suffered far larger employment losses than workers in France and the U.K., where we estimate a percentage of workers at risk which is approximately 50% lower.[12]

[12]Germany, instead, has managed to control the severity of the contagion: lock down measures have been less strict and German GDP has contracted far less. For this reason, even if the share of workers at risk in Germany is the highest in our pool of countries, we would not expect the German labour market to contract as heavily. Unfortunately, data on German labour market for Q2 of 2020 are still not available.

3.2 Migrant–Native Gaps in Employment Risk for Non–Key Workers

In this Section, we analyse the migrant–native gap in the probability of being at risk of becoming employed among non–essential workers. We define the outcome as an indicator variable taking value one if the worker belongs to either the *very high* or the *high* risk category (see Section 3) and we estimate the following linear probability model (LPM):

$$y_i = \alpha_i + \beta X_i + \gamma EU_i + \theta EXTRA_i + \psi_c + \epsilon_i \quad (1)$$

where: y_i is the indicator variable for being at risk; X_i is a vector of individual controls (gender, age, education); the dummies EU_i and $EXTRA_i$ identify EU and Extra–EU migrant workers, respectively; ψ_c are country of residence fixed effects; ϵ_i is an idiosyncratic shock. In further specifications, we include a full set of occupation and industry dummies. We restrict the estimation sample to workers employed in non–essential occupations (approximately 608 thousand observations): the average share of workers at risk in this sample is approximately 50% (54% for men and 44% for women).

We report estimates from the baseline specification in column 1 of Table 3. In columns 2-3 and 5-6, we sequentially include occupation and industry fixed effects, while in columns 4-6 we add interaction terms of a female dummy with migrant group dummies (EU_i and $EXTRA_i$). According to the estimated coefficients in column 1, migrant workers are significantly more exposed to employment risk than natives. In particular, EU mobile and Extra EU workers are 3.6 and 5.7 percentage points more likely to belong to the high or very high risk category than natives with similar characteristics. These coefficients correspond to a 7 per cent for EU mobile and 11 per cent for Extra EU higher probability of being at risk with respect to the baseline probability of native men (which is 54% in our sample). The negative and significant estimated coefficient on the female dummy, instead, implies that women face a 10 per cent lower probability (minus 5 percentage points) with respect to native men of being at risk. Our findings change in columns 2 and 3 of Table 3, when we include occupation and industry dummies. Accounting for workers' sorting into jobs and sectors considerably reduces the estimated gaps for migrants relative to natives: the coefficient for EU mobile workers becomes a precisely estimated zero, while the coefficient for Extra EU workers remains strongly significant although its magnitude is halved (2.2 percentage points, or 4 per cent higher probability of being at risk than comparable native workers). Taking into account sorting changes the direction of the gender gap in exposure: the estimated coefficient on the female dummy in column 3 becomes positive (and it is still statistically significant), implying that women are 1.4 percentage points (or 2.5 percent) more likely to be at risk than men who are employed in similar occupations and industries. Our results, therefore, suggest that women are sorted into jobs and sectors that are less exposed to employment risk but face higher risk once this sorting is taken into account. The higher exposure to risk interacts with women's higher chances of dismissal for any given exposure to risk level – which we have discussed in Section 3.1 (see Appendix Table A.2) – further depressing their

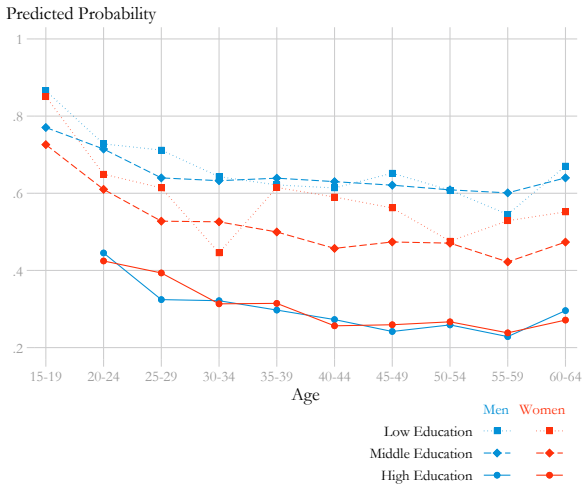
Table 3: Probability of Being at Risk

	(1)	(2)	(3)	(4)	(5)	(6)
EU mobile	0.037***	-0.012**	-0.001	0.044***	-0.011*	0.005
	(0.005)	(0.004)	(0.004)	(0.007)	(0.005)	(0.005)
Extra EU	0.057***	0.007*	0.022***	0.059***	0.007	0.025***
	(0.004)	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)
Female × EU mobile				-0.016	-0.002	-0.013
				(0.010)	(0.008)	(0.007)
Female × Extra EU				-0.005	-0.001	-0.007
				(0.008)	(0.007)	(0.006)
Female	-0.051***	0.003	0.014***	-0.049***	0.003	0.015***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Country FE	✓	✓	✓	✓	✓	✓
Occupation FE		✓	✓		✓	✓
Industry FE			✓			✓
Age FE & Educ. FE	✓	✓	✓	✓	✓	✓
R^2	0.147	0.545	0.624	0.147	0.545	0.624
Obs.	607,828	607,828	607,828	607,828	607,828	607,828

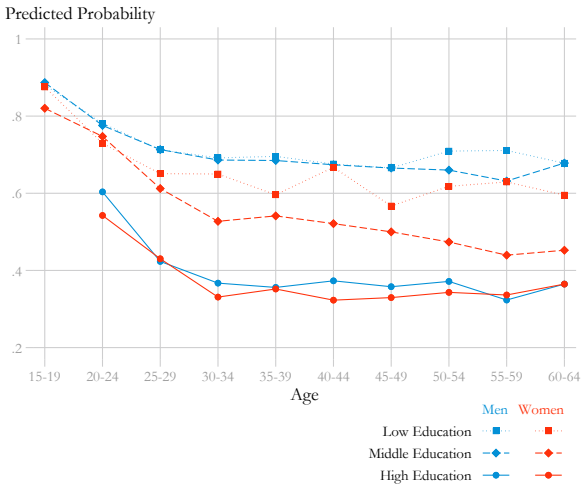
Note: In this table, we regress an indicator variable for being in the high risk or the very high risk category on origin group dummies, gender and a full set of fixed effects (age, education, host country, occupation, industry). All regressions are weighted using person weights from the LFS. Robust standard errors in parentheses: ***, ** and * denote statistical significance at the 99.9, 99 and 95%, respectively.

employment prospects. In columns 4–6 of Table 3, we test for differential gender gaps in exposure to risk among migrants relative to natives by interacting the female dummy with migrant group dummies. The estimated coefficients on these interaction terms are all fairly precisely estimated zeros, suggesting that the gender gaps (conditional and not conditional on sorting) are similar for native and migrant workers. The inclusion of these additional controls only marginally alters all other estimates.

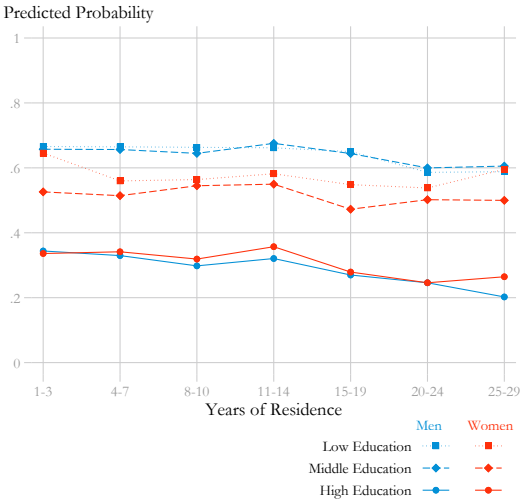
Figure 3: Probability of Being at (High/Very High) Risk



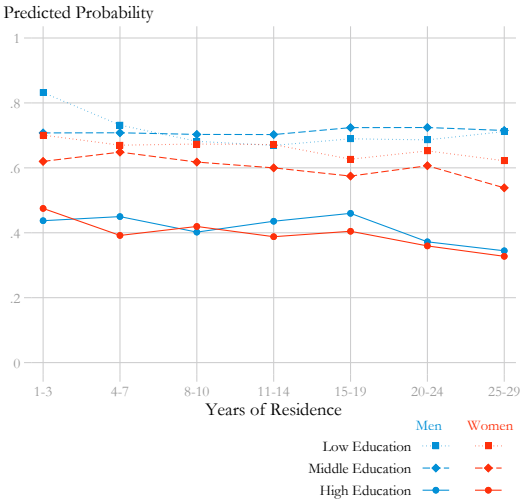
(a) EU Mobile, by Age



(b) Extra EU, by Age



(c) EU Mobile, by Years of Residence



(d) Extra EU, by Years of Residence

Note: The table reports the predicted probabilities estimated from the model described in equation (1) of being at high risk of employment loss by sex, education, age (Panel 3a for EU Mobiles and Panel 3b for Extra EU migrants) and years of residence in the host country (Panel 3c for EU mobile and Panel 3d for Extra EU migrants). Apart from the variables shown, the estimated model includes country fixed effects.

In Figure 3, we describe how the probability of exposure to employment risk differs across socio–demographic groups among migrants. We estimate the baseline model described in equation (1) (i.e. not controlling for sorting into occupations and sectors) and report the

predicted probabilities of being at risk of employment loss by sex, education, age (Panel 3a for EU Mobiles and Panel 3b for Extra EU migrants) and years of residence in the host country (Panel 3c for EU mobile and Panel 3d for Extra EU migrants). Looking at the Figure, several elements stand out. First, irrespective of origin, sex and education, the employment risk decreases with age, especially after 30. Second, irrespective of origin, age and sex, highly educated migrants are less at risk. Third, irrespective of origin age and sex, low or medium educated workers are those more at risk of unemployment. Fourth, Extra EU migrants suffer from higher risk at any age for both sexes and at every educational level. The same pattern holds if instead of looking at age groups, we look at length of stay as we do in the bottom two panels of the figure. The migrants who are more at risk of loosing their jobs during the pandemic are the youngest and with low education. This finding is hardly surprising, but it is worrisome for the long–term consequences of the pandemic as early experiences in the labour market have long lasting consequences for future outcomes as a growing literature in labour economics shows (Beaudry and DiNardo, 1991; Gibbons and Waldman, 2006; Davis and von Wachter, 2011; Hagedorn and Manovskii, 2013).

3.3 Quantifying Migrant Workers at Risk in Europe

In Table 4, we use data from Eurostat on foreign born employed workers residing in each EU14+UK country in 2019 (i.e. before the pandemic started), together with our estimates of the share of migrants workers at risk of being laid off to quantify how many immigrants are currently facing high risk of becoming unemployed in Europe. According to our calculations, there are approximately 3.1 million EU mobile workers in employment in EU14+UK countries who are at risk of becoming unemployed due to the pandemic, accounting for roughly 30% of the 10.2 million EU mobile workers who were employed in the region before the pandemic started. Among these workers at risk, 395 thousand face a very high risk of being laid off. As far as Extra–EU migrants are concerned, more than 6.1 million workers may become unemployed due to the pandemic, 32.7% of the 18.9 million individuals born in a non-EU country that were employed in EU14+UK countries before pandemic. Almost a million of them (974 thousand) fall in the very high risk category. These figures point at a total population of over 9.3 million foreign born workers – slightly less than one third of their total employment in the EU14+UK area – that are employed in jobs and sectors that may be severely affected by the pandemic–induced crisis. For more than 1.3 million of them the risk is extremely high.

In order to get a better sense of the size of these populations at risk and to gauge the likelihood that their labour market status will actually turn into unemployment in the near future, we can contrast our estimates for the number of employed workers at risk with the actual employment losses that migrant workers experienced in EU14+UK countries after the first pandemic wave. Figure 4 reports a scatter plot, by host country and migrant origin group, of changes in employment (2020–Q2 relative to 2019–Q2; vertical axis) versus the

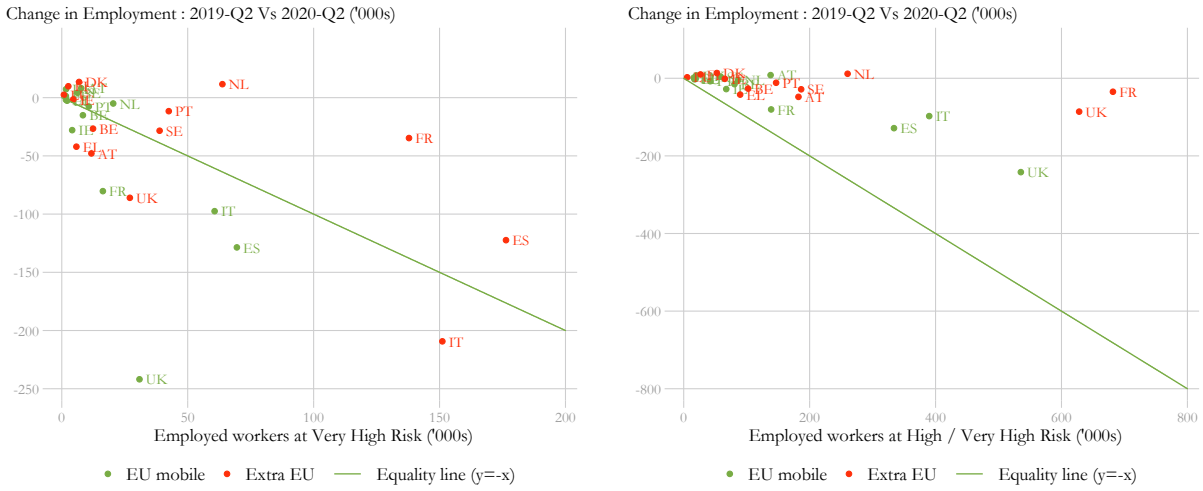
Table 4: Employed Workers at Risk, by Host Country and Migrant Group

	EU mobile				Extra EU			
	% at risk	Total employed ('000s)	At risk ('000s)	at very high risk ('000s)	% at risk	Total employed ('000s)	At risk ('000s)	at very high risk ('000s)
AT	*32.6*	422.7	138.0	7.7	*37.3*	488.6	182.3	11.8
BE	*20.3*	396.2	80.6	8.4	*23.4*	437.6	102.3	12.4
DE	*39.9*	3,099.8	1,239.1	153.7	*41.9*	4,617.5	1,935.6	292.2
DK	*21.8*	90.8	19.9	1.7	*26.6*	198.4	52.7	6.9
EL	*35.7*	48.0	17.1	2.1	*33.8*	265.7	89.7	5.8
ES	*35.3*	943.6	334.0	69.5	*35.2*	2,509.3	883.4	176.4
FI	*27.4*	58.4	16.0	1.6	*26.2*	102.2	26.7	2.6
FR	*17.5*	791.4	138.9	16.3	*27.8*	2,450.1	681.7	137.9
IE	*26.9*	250.8	67.6	4.1	*20.4*	320.3	65.2	4.6
IT	*39.3*	991.8	389.9	60.7	*40.7*	2,296.7	935.5	151.1
LU	*14.4*	131.1	18.9	1.7	*16.8*	32.9	5.5	0.8
NL	*30.7*	281.5	86.5	20.4	*35.0*	744.6	260.3	63.8
PT	*36.0*	117.5	42.3	10.7	*36.7*	399.6	146.7	42.5
SE	*23.0*	254.8	58.7	6.3	*24.5*	761.0	186.6	38.8
UK	*22.6*	2,373.4	535.4	30.9	*19.1*	3,282.9	628.1	27.0
Total	*31.0*	10,251.7	3,182.7	395.9	*32.7*	18,907.2	6,182.2	974.5

Note: The table reports for EU mobile (left panel) and Extra EU workers (right panel), and for each host country in the EU14+UK area, the share of workers at risk (i.e. the sum of the shares of workers at very high and high risk), the total number of employed workers (measured in 2019; from Eurostat database), the number of employed workers at risk (equal to the share at risk times total employment) and the number of employed workers at very high risk (equal to the share at very high risk times total employment).

number of employed workers at very high risk (panel 4a) and at high or very high risk (panel 4b) of becoming unemployed (horizontal axis). In each panel, the continuous straight line is the (negative) equality line ($y = -x$) and allows to immediately compare the relative size of actual employment losses and estimated populations at risk. Panel 4a clearly shows that realized employment losses during the first half of 2020 are very similar in magnitude to the number of workers that our measure predicts to face a very high risk of lay–off due to the pandemic. In many instances the points in the graph lie below the line, implying that employment losses recorded immediately after the first wave of the pandemic have already exceeded the number of workers that we considered at very high risk, suggesting that this category captures reasonably well the short–run effects of the pandemic. In Italy, for instance, we estimate that 150 thousand Extra–EU workers and 60 thousand EU mobile ones belong to the highest risk category (see Table 4); we observe employment losses of 210 and 100 thousand, respectively. Similarly, in Spain our measure pointed at 180 thousand Extra–EU workers and 70 thousand EU mobile migrants at very high risk and employment for these two groups fell by roughly 120 thousand units each. In panel 4b of Figure 4, instead, all points lie well above the (negative) equality line, implying that realized employment losses in the first two quarters of 2020 are still substantially smaller that the cumulative number of employed workers that we consider at risk (i.e. facing high or very high employment risk). As the pandemic crisis persists, however, it seems reasonable to expect the points to gradually approach the line, as more and more workers will lose their jobs.

Figure 4: Changes in Migrants' Employment and Number of Employed Workers at Risk, by Country and Origin



(a) Employed workers at very high risk

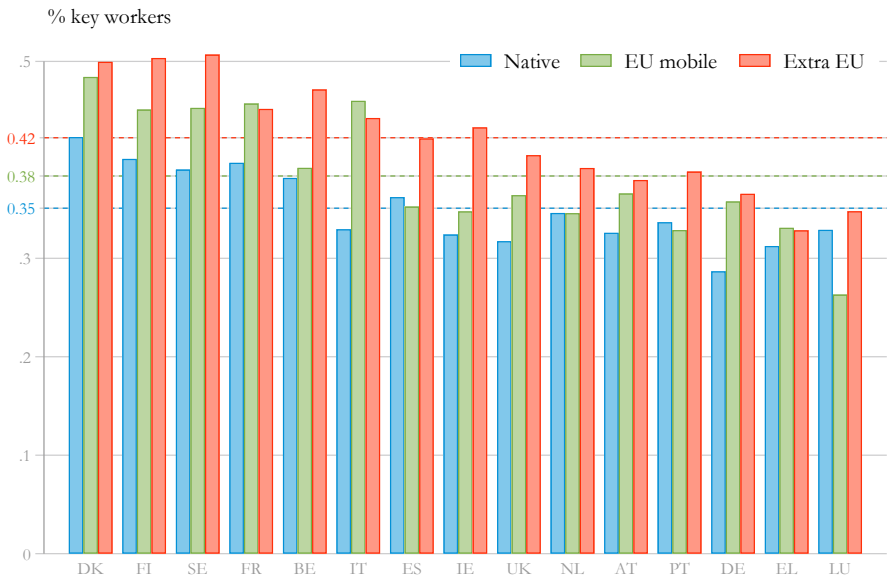
(b) Employed workers at risk

Note: The figures report a scatter plot of changes in employment (2020–Q2 relative to 2019–Q2) versus the number of employed workers at very high risk (upper panel) and at high risk (lower panel) of becoming unemployed. The continuous straight line is the negative equality line ($y = -x$).

4 The Vulnerability of Migrant Key Workers

In constructing the employment risk categories described in Section 3, we have assumed that key–workers are shielded from the labour market contraction induced by the pandemic crisis. This is a reasonable assumption, since the widely recognized importance of these occupations in the response to the pandemic has generally protected them from both restrictive measures and spontaneous drops in demand. Nevertheless, key workers are not completely immune to the detrimental effects of the pandemic crisis. In the last part of the paper, we therefore focus on this particularly important group of workers. Using the definition discussed in Section 2, we first describe how many migrants are employed in key–occupations in the EU14+UK area. In Section 4.1, we then explore different dimensions of their potential vulnerability (i.e. contract duration, earnings, physical proximity on the job and teleworkability) with respect to comparable natives.

Figure 5: Share of Employment in Key Occupations, by Host Country and Origin

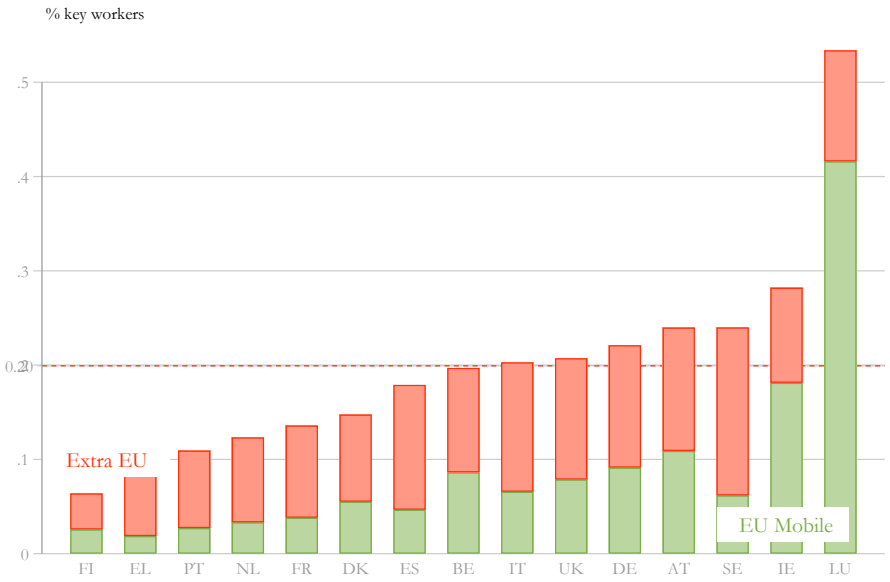


Note: Each bar represents the share of key workers within each origin in each host country. The dashed lines represent the EU14+UK average for each group: natives (35%), EU mobile (38%) and Extra–EU (42%).

For each country in the EU14+UK area, Figure 5 shows the shares of employment in key occupations for each of the three groups that we consider in this paper: natives (blue bars), EU mobile workers (green bars) and Extra–EU workers (red bars). Notably, in the vast majority of the EU14+UK countries migrants of both origins tend to be relatively more concentrated in key occupations than natives. According to our definitions and estimates, on average approximately 35% of native workers are in essential occupations, increasing to 38% and 42% among EU and Extra–EU migrants, respectively (see dashed lines in Figure 5). The share of key workers by origin displays considerable variation both across countries and origin.

Figure 6 reports the percentage of total employment in key occupations that is accounted for by migrant workers in each EU14+UK country. On average, one key worker out of five (20%) is a foreign born worker in the EU14+UK area. Since immigrants account for 15.8% of employed workers in the area (EU mobile migrants account for 5.9% and Extra–EU for 9.9%), they are clearly over–represented among key occupations. These figures are remarkably similar to estimates available for the U.S. which suggest that foreign born workers account for 19% of the U.S. workers in front–line key industries while making up approximately 17% of the employed workforce (Gelatt, 2020). We observe wide variation across countries in the share of immigrant key workers, being at about 5% in Finland and Greece, fluctuating around 20% in countries such as Italy, Belgium, Germany, Sweden, the

Figure 6: Share of Immigrants among Key Workers, by Country



Note: The bars report the percentage of immigrants over total key workers in each country.

U.K. and Austria and reaching 26% and 53% in Ireland and Luxembourg, respectively. In most countries, the share of Extra–EU key workers is larger than the EU mobile one.

Finally, Figure 7 looks at the presence of migrant workers in key occupations, separating high and low qualifications based on the median level of education of the workers employed in each ISCO 2–digits occupation.[13] The graph highlights how heavily some key occupations rely on migrant workers. If foreign born workers account for 20% of all key workers in our sample of countries (see Figure 6), in many key occupations we observe shares which are substantially higher. Notably, all the key occupations where migrants are over–represented are low qualified ones. For example, more than a third of cleaners and helpers, more than a quarter of labourers in mining and construction sectors, stationary plant and machine operators and one in five workers in food processing, personal care and personal services, are migrants. Extra–EU citizens alone account for more than 25% of cleaners and helpers, 17% of mining and construction workers and 14% of personal care workers. The figure also reports the gender composition of the migrant labour force within key occupations. As expected, women account for the majority of cleaners and helpers, personal care workers and teachers, while labourers in mining and constructions, drivers and mobile plant operators or ICT professionals are mostly men.

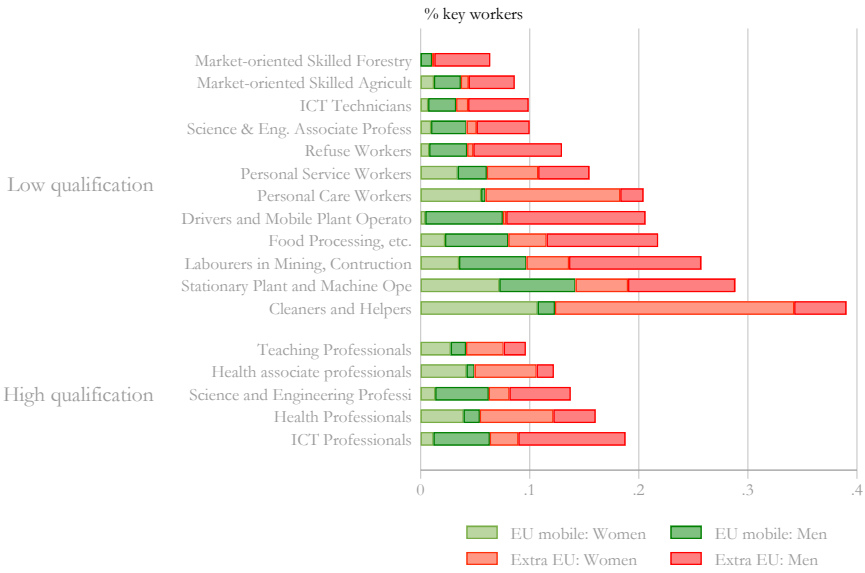
[13]We define high skilled occupations all those occupations whose workforce median educational level is above ISCED level 3, while low skilled occupations are those whose workforce median level of education is equal or below that.

Table 5: Key Workers: Migrant–Native Gaps in Job Attributes

	Temp. Contr. (14.4%)			Earnings Above Median (27.6%)			Proximity (49%)		Teleworkability (38.6%)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
EU mobile	0.034***	0.028***	0.029***	-0.053***	-0.013	-0.011	-0.071***	-0.054***	-0.065***	-0.034***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.010)	(0.011)	(0.007)	(0.006)
Extra EU	0.072***	0.064***	0.063***	-0.088***	-0.041***	-0.040***	-0.016*	-0.014*	-0.063***	-0.026***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.007)	(0.006)	(0.004)
Female × EU mobile	-0.005	-0.002	0.003	-0.042***	-0.021*	-0.018	-0.008	0.012	-0.042***	-0.006
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.013)	(0.013)	(0.009)	(0.007)
Female × Extra EU	-0.032***	-0.026**	-0.018*	-0.001	0.022**	0.028***	-0.068***	-0.037***	-0.036***	-0.009
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.010)	(0.009)	(0.007)	(0.005)
Female	0.038***	0.006	0.003	-0.182***	-0.110***	-0.105***	0.097***	0.022***	-0.011***	-0.036***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)
Country FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Occupation FE		✓	✓		✓	✓				
Industry FE			✓			✓		✓		✓
Age FE & Educ. FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R^2	0.135	0.144	0.147	0.350	0.404	0.409	0.074	0.330	0.283	0.601
Obs.	332,110	332,110	330,436	332,110	332,110	330,436	332,110	330,436	332,110	330,436

Note: The Table reports LPM estimates of binary outcomes for occupational characteristics on individual controls and fixed effects. The outcome variables are: i) having a temporary contract (col. 1–3); ii) being in the top half of the earning distribution (col. 4–6); iii) being in an occupation that requires physical proximity (i.e. the index of physical proximity is above the cutoff value of 60; col. 7–8); iv) being in an occupation that is teleworkable (i.e. the index of teleworkability is above the cutoff value of 60; col. 9–10). All regressions are weighted using person weights from the LFS. Robust standard errors in parentheses: ***, ** and * denote statistical significance at the 99.9, 99 and 95%, respectively. Sample means for each of the four outcomes are reported in the column headings in parenthesis.

Figure 7: Share of Immigrants among Key Workers, by Gender and Occupation



Note: The bars report the percentage of immigrants over total key workers (by area of origin and gender) for each occupation.

4.1 Migrant–Native Gap in Key Workers' Vulnerability

The fact that migrants tend to be more concentrated in key occupations relative to natives – as shown in Figure 5 – is a factor that may reduce their overall risk of becoming unemployed, potentially counteracting the relatively higher exposure in non–essential occupations that we documented in Section 3. Even within key occupations, however, migrants may still be in a more disadvantaged situation with respect to native workers with similar characteristics.

In this Section, we evaluate the relative vulnerability of migrant key–workers along four attributes of their jobs: i) whether they are employed on a temporary contract, ii) the wage they earn, iii) the physical proximity to colleagues or clients on the workplace and iv) the possibility to perform their tasks remotely from home. While the first two outcomes measure the economic uncertainty workers may face, the latter two variables proxy for the health hazard they are exposed to. We define the following binary outcomes: i) having a temporary contract; ii) being above the median of the national earning distribution;[14] iii) being in an occupation that requires physical proximity (i.e. the index of physical proximity is above the cutoff value of 60); iv) being in an occupation that is teleworkable (i.e. the index of teleworkability is above the cutoff value of 60). For each of these outcomes, we estimate

[14]The probability of being in the top half of the earning distribution is calculated on the full sample that includes both key and non–key workers while the percentage reported in Table 5 refers to key workers only. Our calculations show that the median earnings for key workers are lower than for non–key workers.

the same Linear Probability Model specification that we use to assess the migrant–native gap in employment risk for non–key workers (see equation (1) in Section 3.2).

In Table 5, we report our results for the probability of having a temporary contract (columns 1–3), being in the top half of the earning distribution (columns 4–6), being in a job where the physical proximity is above the median (column 7 and 8) and being in a teleworkable job (column 9 and 10). For reference, we report the sample mean for each of these outcome in parentheses in the column headings. For the temporary contract and earning outcomes we estimate the baseline specification that only controls for individual characteristics and country FE (columns 1 and 4) and two additional specifications where we also include occupation and industry fixed effects. Since the proximity and teleworkability indices vary only at occupational level, we cannot include occupation fixed effects when looking at these two outcomes and we are therefore presenting the baseline specification and one including industry fixed effects only. Our estimates show that migrant key workers, especially the extra EU ones, are more insecure in their jobs and are paid less than their native counterparts (columns 1–6). In the baseline specification, EU male migrants are 3.4 percentage points more likely to be in temporary employment and 5.3 p.p less likely to earn wages in the top half of the income distribution. For Extra EU migrants the gaps are 7.2 and 8.8 p.p. respectively. These gaps tend to shrink – with the exception of teleworkability – once we condition on occupation and industry fixed effects. The evidence on differential gender gaps for women is not clear–cut. Most of the coefficients on the interaction term for EU mobile workers are not significant, while the coefficients on the interaction term for Extra EU are mostly significant and tend to have opposite sign with respect to the female dummy, suggesting that gender gaps are narrower among the latter migrant group than in the native population.

5 Concluding Remarks

More than other areas, Europe has been hit hard by the first wave of the COVID–19 pandemic. Facing the prospect of seeing their health system overwhelmed, most governments resorted to partial or total lockdown of their economies. These measures played an important role in curbing the spread of the virus, but the costs exacted in terms of employment losses on European economies are still to be quantified, as are their distributional impacts.

In the absence of harmonized micro–data covering the continent since the outbreak of the pandemic, drawing on emerging literature, in this paper we propose a novel measure of exposure to employment risk that can be used to assess the risk of dismissal at the individual level for workers employed in non–essential occupations. We test the accuracy of our indicator against the already available macro data on European labour markets for the second and third quarters of 2020, showing that it is able to capture remarkably well the observed employment losses and the distinct nature of this economic crisis. We find large differences in the size of workforce at high risk of dismissal in our sample of countries. With this measure, we are able to focus on the employment consequences of the pandemic on migrant workers.

We find that migrants are exposed to a substantially higher risk of job loss than comparable natives, although the gaps become smaller when we compare migrants and natives in the same occupations and industries. We calculate that up to 9 million migrants are currently at high risk of dismissal (1.3 million of which at very high risk) and we determine where these workers at risk are located. We also find that among migrants, those at higher risk are the youngest and least educated men, a group that might carry the scars of this recession for years to come. We then consider essential occupations and find that migrant workers are overrepresented among these jobs. This may be good news, as occupations that are deemed essential are certainly less affected by social distancing measures and forced shutdowns. Key workers, however, are potentially more exposed to health hazard. Moreover, when comparing migrants with similar natives in key occupations, we find that the former are significantly more vulnerable than the latter along several dimensions. The overall picture we draw is that of a migrant workforce which is on the frontline of this pandemic crisis both because migrant workers are providing essential services to hosting societies and because they are more exposed to its harmful effects.

The evidence produced in this paper calls for policy actions targeted at migrant workers that should possibly differentiate according to whether they have been defined as key or non–key workers. The concentration of migrant workers in fixed–term contracts that we document, for instance, points at interventions on employers' incentives – via reduced taxation or subsidies – to renew these contracts and retain their workers. Migrants' lower earnings suggest the need for policy action on income support schemes, which may take the form of widening migrants' access to existing welfare programs as well as of creating new schemes that specifically target foreign workers. Finally, migrants' exposure to the contagion and to health hazard calls for interventions that remove – at least temporarily – existing barriers to full health care access for non–citizens. Not only migrants' welfare is at stake here, but it is also in the interest of hosting societies to create the conditions for migrant workers to keep contributing to the solution of the ongoing crisis and to the future recovery. The urgency of implementing measures to support migrant workers during the pandemic crisis has been advocated by organizations such as the World Bank (2020b), the OECD (2020) and the Overseas Development Institute (ODI).[15] Of particular concern are also the detrimental repercussions on migrant flows origin areas: according to the latest World Bank estimates (World Bank, 2020a) remittance flows to low– and middle–income countries (LMICs) are projected to decline by 7.2 per cent (minus $ 40 billion) in 2020, followed by a further decline of 7.5 per cent (minus $ 40 billion) in 2021. The pandemic may also offer a possibility of identifying weak spots in current migration policies and thinking about improvements and solutions in the medium–long run. For example, Fernandez-Reino, Sumption and Vargas-Silva (2020) estimate that 40–50 per cent of current foreign born workers employed in key occupations in the UK would not qualify for a working visa according to the new migration rules that the British government is planning to introduce after having left the EU. The

[15]See the ODI's initiative on "Migrants' contribution to the COVID–19 response" at: https://www.odi.org/migrant-key-workers-covid-19/.

widespread emphasis in the migration policy debate on attracting high–skilled migrants may need some re–thinking since the ongoing crisis has shown that migrants are playing a key role also in so–called low–skilled occupations.

References

Adams-Prassl, A., Boneva, T., Golin, M. and Rauh, C. (2020). 'Inequality in the impact of the coronavirus shock: Evidence from real time surveys', *Journal of Public Economics*, vol. 189, p. 104245, ISSN 0047-2727, doi:https://doi.org/10.1016/j.jpubeco.2020.104245.

Alon, T., Doepke, M., Olmstead-Rumsey, J. and Tertilt, M. (2020). 'The impact of covid-19 on gender equality', National Bureau of Economic Research, doi:10.3386/w26947.

Avato, J., Koettl, J. and Sabates-Wheeler, R. (2010). 'Social Security Regimes, Global Estimates, and Good Practices: The Status of Social Protection for International Migrants', *World Development*, vol. 38(4), pp. 455–466.

Barker, N., Davis, C.A., López-Peña, P., Mitchell, H., Mobarak, A.M., Naguib, K., Reimão, M.E., Shenoy, A. and Vernot, C. (2020). 'Migration and the labour market impacts of covid-19', UNU-WIDER.

Basso, G., Boeri, T., Caiumi, A. and Paccagnella, M. (2020). 'The new hazardous jobs and worker reallocation', OECD.

Beaudry, P. and DiNardo, J. (1991). 'The effect of implicit contracts on the movement of wages over the business cycle: Evidence from micro data', *Journal of Political Economy*, vol. 99(4), pp. 665–88.

Blanchard, O. and Landier, A. (2002). 'The Perverse Effects of Partial Labour Market Reform: Fixed-Term Contracts in France', *The Economic Journal*, vol. 112(480), pp. F214–F244.

Boeri, T. and Garibaldi, P. (2007). 'Two tier reforms of employment protection: A honeymoon effect?', *Economic Journal*, vol. 117(521), pp. F357–F385.

Borjas, G.J. (2001). 'Does Immigration Grease the Wheels of the Labor Market?', *Brookings Papers on Economic Activity*, vol. 32(1), pp. 69–134.

Borjas, G.J. and Cassidy, H. (2020). 'The Adverse Effect of the COVID-19 Labor Market Shock on Immigrant Employment', National Bureau of Economic Research, Inc.

Cadena, B.C. and Kovak, B.K. (2016). 'Immigrants equilibrate local labor markets: Evidence from the great recession', *American Economic Journal: Applied Economics*, vol. 8(1), pp. 257–90.

Cortes, G.M. and Forsythe, E. (2020a). 'Impacts of the covid-19 pandemic and the cares act on earnings and inequality', Institute of Labor Economics (IZA).

Cortes, G.M. and Forsythe, E.C. (2020b). 'The heterogeneous labor market impacts of the covid-19 pandemic.', Upjohn Institute for Employment Research.

Couch, K.A., Fairlie, R.W. and Xu, H. (2020). 'Early evidence of the impacts of covid-19 on minority unemployment', *Journal of Public Economics*, p. 104287, ISSN 0047-2727, doi:https://doi.org/10.1016/j.jpubeco.2020.104287.

Davis, S.J. and von Wachter, T.M. (2011). 'Recessions and the cost of job loss', *Brookings Papers on Economic Activity*, vol. 43(2 (Fall)), pp. 1–72.

de la Rica, S., Glitz, A. and Ortega, F. (2015). 'Chapter 24 - immigration in europe: Trends, policies, and empirical evidence', in (B. R. Chiswick and P. W. Miller, eds.), *Handbook of the Economics of International Migration*, pp. 1303 – 1362, vol. 1 of *Handbook of the Economics of International Migration*, North-Holland.

Dingel, J. and Neiman, B. (2020). 'How many jobs can be done at home?', Becker Friedman Institute.

Dustmann, C., Glitz, A. and Vogel, T. (2010). 'Employment, wages, and the economic cycle: Differences between immigrants and natives', *European Economic Review*, vol. 54(1), pp. 1–17.

Farre, L., Fawaz, Y., Gonzalez, L. and Graves, J. (2020). 'How the COVID-19 Lockdown Affected Gender Inequality in Paid and Unpaid Work in Spain', Institute of Labor Economics (IZA).

Fasani, F. and Mazza, J. (2020a). 'A Vulnerable Workforce: Migrant Workers in the COVID-19 Pandemic', Publications Office of the European Union.

Fasani, F. and Mazza, J. (2020b). 'Immigrant Key Workers: Their Contribution to Europe's COVID-19 Response', Institute of Labor Economics (IZA).

Fernandez-Reino, M., Sumption, M. and Vargas-Silva, C. (2020). 'From Low-Skilled to Key Workers: The Implications of Emergencies for Immigration Policy', *Oxford Review of Economic Policy*.

Gelatt, J. (2020). 'Immigrant Workers. Vital to the U.S. COVID-19 Response, Disproportionately Vulnerable', Migration Policy Institute (MPI).

Gibbons, R. and Waldman, M. (2006). 'Enriching a theory of wage and promotion dynamics inside firms', *Journal of Labor Economics*, vol. 24(1), pp. 59–108.

Hagedorn, M. and Manovskii, I. (2013). 'Job selection and wages over the business cycle', *American Economic Review*, vol. 103(2), pp. 771–803.

Hoynes, H., Miller, D.L. and Schaller, J. (2012). 'Who suffers during recessions?', *Journal of Economic Perspectives*, vol. 26(3), pp. 27–48.

Hupkau, C. and Petrongolo, B. (2020). 'Work, care and gender during the Covid-19 crisis', Centre for Economic Performance, LSE.

Kerr, S.P. and Kerr, W.R. (2011). 'Economic Impacts of Immigration: A Survey', *Finnish Economic Papers*, vol. 24(1), pp. 1–32.

Koren, M. and Peto, R. (2020). 'Business disruptions from social distancing', mimeo.

Mongey, S., Pilossoph, L. and Weinberg, A. (2020). 'Which workers bear the burden of social distancing policies?', National Bureau of Economic Research, doi:10.3386/w27085.

OECD (2020). 'What is the impact of the COVID-19 pandemic on immigrants and their children?', OECD.

Orrenius, P. and Zavodny, M. (2010). 'Mexican immigrant employment outcomes over the business cycle', *American Economic Review*, vol. 100(2), pp. 316–20.

Pagano, M., Wagner, C. and Zechner, J. (2020). 'Disaster resilience and asset prices', CEPR.

Platt, L. and Warwick, R. (2020). 'Covid-19 and ethnic inequalities in england and wales', *Fiscal Studies*, vol. 41(2), pp. 259–289.

Proto, E. and Quintana-Domeque, C. (2020). 'COVID-19 and Mental Health Deterioration among BAME Groups in the UK', Institute of Labor Economics (IZA).

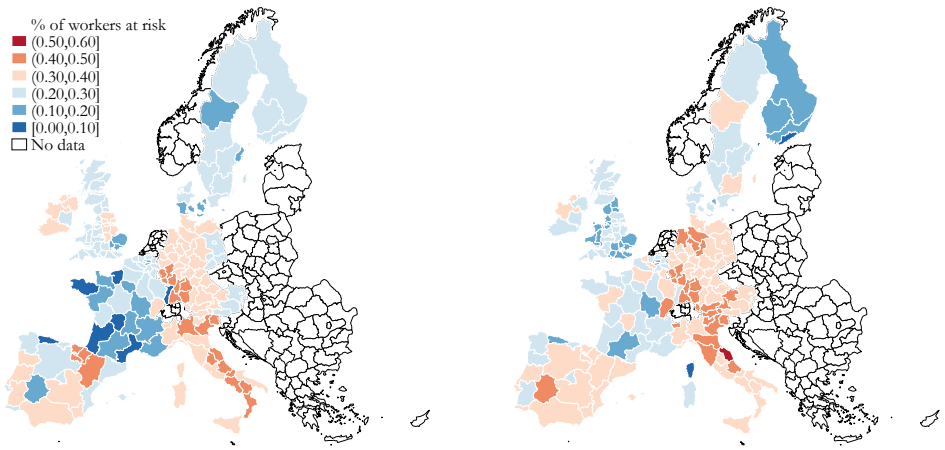
World Bank (2020a). 'Phase II: COVID-19 Crisis through a Migration Lens', World Bank.

World Bank (2020b). 'Potential responses to the covid-19 outbreak in support of migrant workers', World Bank.

Yang, D. (2011). 'Migrant Remittances', *Journal of Economic Perspectives*, vol. 25(3), pp. 129–152.

Appendix A Appendix Figures

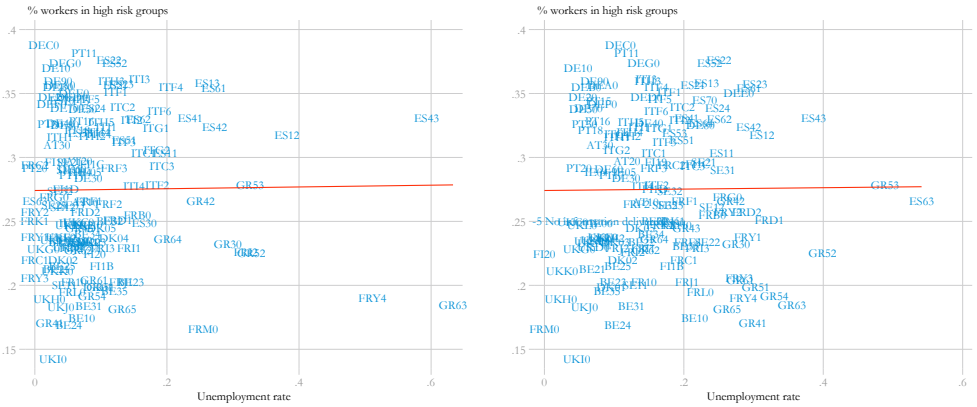
Figure A.1: Workers at high risk of job loss, by region and origin



(a) EU Mobile (b) Extra EU

Note: Information on NUTS–2 regions in the EU–LFS is absent for Greece and The Netherlands. Panel A.1a shows the share of EU workers at very high risk of losing their job for each NUTS–2 region while Panel A.1b show the same share for extra EU migrants.

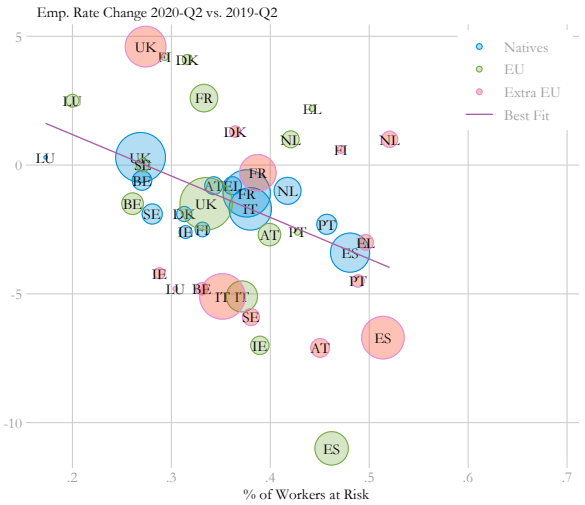
Figure A.2: Regional labour markets and workers at high risk



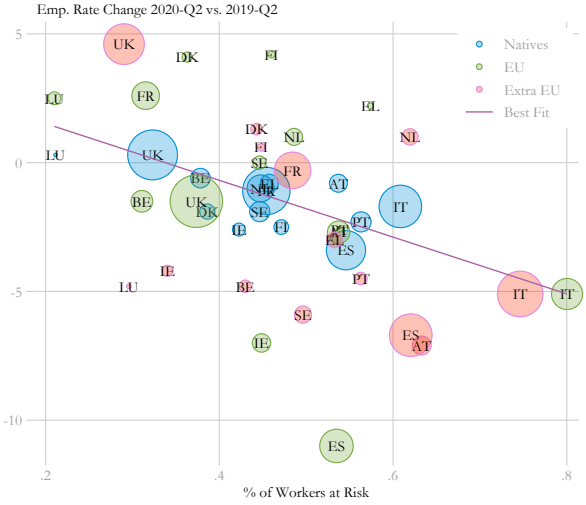
(a) EU Mobile (b) Extra EU

Note: Panels A.2a and A.2b plot the regional unemployment rate against the share of EU and extra EU workers at high risk, respectively. Lines of best fit in red.

Figure A.3: Risk Measure and Employment Rate Changes – Post Pandemic; by Gender



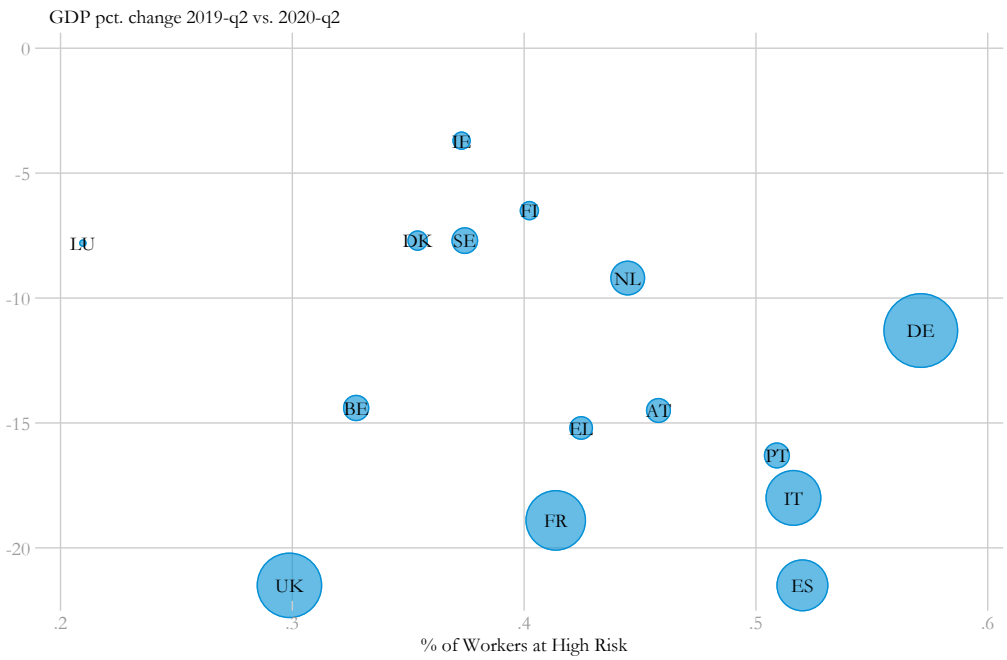
(a) Women



(b) Men

Note: The figure reports scatter plots of changes in employment rate (vertical axis) against the percentage of workers in the high/very high risk group (horizontal axis), disaggregated by host country, origin group (native, EU mobile and Extra–EU migrants) and gender. Area of marker proportional to country's population aged 16 to 65 for each origin.

Figure A.4: Risk Measure vs. GDP Change in Q2 2020



Note: The figure reports the scatter plot of the recorded change in GDP between the second quarters of 2019 and 2020 (vertical axis) against the percentage of workers at high/very high risk (horizontal axis) in each country. Area of marker proportional to country's population aged 16 to 65.

Appendix B Appendix Tables

Table A.1: Share of Workers for Each Component of Exposure Measure, by Country

	Key Workers	Temp. Contracts	High Resilience	Teleworkable
AT	.37	.09	.39	.36
BE	.42	.09	.53	.41
DE	.32	.13	.26	.36
DK	.45	.11	.51	.42
ES	.4	.26	.50	.32
FI	.43	.17	.50	.40
FR	.43	.17	.46	.38
EL	.44	.11	.51	.33
IE	.37	.10	.49	.39
IT	.39	.17	.42	.34
LU	.32	.10	.49	.52
NL	.38	.21	.43	.41
PT	.36	.22	.42	.34
SE	.42	.16	.51	.44
UK	.36	.05	.55	.44
Total	.39	.14	.47	.39

Note: The table reports the share of workers in each country for each of the four components of the risk exposure measure: key occupations, temporary contracts, industry resilience and teleworkability.

Table A.2: Realized Employment Losses and Exposure Measure, by Sex

	Δ Empl. Q3 2019 vs. 2018		Δ Empl. Q2 2020 vs. 2019		Δ Empl. Q3 2020 vs. 2019	
	(1)	(2)	(3)	(4)	(5)	(6)
% of Workers at Risk	0.352	0.444	-12.611***	-12.546***	-5.574***	-5.362***
	(0.589)	(0.611)	(2.311)	(2.428)	(1.430)	(1.527)
Females	0.037	0.046	-1.325***	-1.287***	-0.586	-0.550
	(0.209)	(0.223)	(0.268)	(0.269)	(0.310)	(0.328)
EU mobile		0.628		-1.664		-0.389
		(0.354)		(1.251)		(0.644)
Extra EU		-0.223		-0.196		-0.616
		(0.587)		(1.235)		(1.078)
EU mobile × Female		-0.001		0.035		0.015
		(0.509)		(1.803)		(0.981)
Extra EU × Female		0.023		-0.658		-0.281
		(0.795)		(1.958)		(1.642)
R^2	0.003	0.055	0.430	0.474	0.213	0.240
Obs.	84	84	84	84	84	84

Note: In this table, we regress changes in employment rates between the third quarter of 2019 and 2018 (columns 1–2), second quarter of 2020 and 2019 (columns 3–4) and third quarters of 2020 and 2019 (columns 5–6) on the share of workers at risk (high and very high risk) and other controls (origin group and sex). We pool observations by host country and origin group (native, EU mobile and Extra–EU workers). Germany is not included in the sample because data on employment rates for 2020 by country of birth are not available. All regressions are weighted using countries' population in 2019. Robust standard errors in parentheses. ***, ** and * denote statistical significance at the 99.9, 99 and 95%, respectively.

Appendix C Key Occupations: Definition and Shares

Table A.3: Key Workers Occupations

ISCO–08 2 digits	**ISCO–08 3 digits**
Science and Engineering Prof.	Life science professionals Engineering professionals
Health Professionals	Health professionals Medical doctors Nursing and midwifery Traditional and compl. medicine Paramedical practitioners Other health professions
Teaching Professionals	University and higher education teachers Vocational education teachers Secondary education teachers Primary school and early childhood teachers Other teaching professionals
ICT Professionals	Information and communication technology Software and applications developers Database and network professionals
Science & Eng. Associate prof.	Sci. and engineering assoc. professionals Physical and engineer science technicians Mining, manufacturing and constructions Process control technicians Life science technicians Ship and aircraft controllers and technicians
Health associate professionals	Medical and pharmaceutical technicians Nursing and midwifery
ICT Technicians	Information and communications technicians ICT operations and user support technicians Telecommunications and broadcasting technicians
Personal Service Workers	Travel attendants, conductors and guides Other personal services workers
Personal Care Workers	Personal care workers Child care workers and teachers' aides Personal care workers in health services
Market–oriented Skilled Agricultural Workers	Market–oriented skill agricultural workers Market gardeners and crop growers Animal producers Mixed crop and animal producers
Market–oriented Skilled Forestry Fishery	Fishery workers, hunters and trappers
Food Processing, etc.	Food processing and related trades workers
Stationary Plant and Machine Operators	Food and related products machine operators
Drivers and Mobile Plant Operators	Locomotive engine drivers Car, van and motorcycle drivers Heavy truck and bus drivers Ships' deck crews
Cleaners and Helpers	Domestic, hotel and office cleaners and helpers Vehicle, window, laundry and other cleaning

	workers
Labourers in Mining, Construction, Manufacturing	Transport and storage labourers
Refuse Workers	Refuse Workers