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Occupational Hazards

Migrants and the Economic and Health Risks of COVID-19 in Western Europe

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Abstract

This paper investigates the economic and health risks arising from the COVID-19 pandemic for migrant workers in the European Union. It first assesses migrants' economic and health vulnerabilities using ex ante measures based on both supply and demand shocks. The analysis finds that immigrants were more vulnerable than native-born workers to both income- and health-related risks, and that this greater exposure stems from the occupations in which migrant workers are concentrated. Migrants work to a greater degree than native-born citizens in occupations that are less amenable to teleworking arrangements, and in economic sectors that experienced greater reductions in demand during the pandemic. This has led to an increase in both their income and employment risks. The paper shows that individual characteristics, such as educational attainment, age, and geographical location, fail to explain the native-migrant gap in exposure to economic and health risks posed by the pandemic. Limited language ability, the concentration of migrants in jobs with labor shortages among native-born workers, and a reliance on immigrant networks to find jobs all appear to play significant roles in migrants' exposure to pandemic-related risks. Finally, the paper finds that actual job losses in 2020, the first year of the pandemic, are highly correlated with ex-ante vulnerabilities: immigrant workers experienced significantly higher rates of job losses, which partly originates from their greater concentration in non-teleworkable jobs. Ex-ante vulnerabilities, however, only explain part of the migrant-native gap in job losses that followed the pandemic and being an immigrant still imposes additional risks.

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1. Introduction

COVID-19 exerted unforeseen and sudden pressures on the labor markets across the world, leading unemployment rates to rise and wages to fall. Even in high-income, Western European countries with extensive social safety nets, large swaths of the labor force were negatively affected. Workers in many different occupations and sectors faced significant disruptions as governments imposed various lockdown measures, restricting mobility, and closing non-essential businesses to slow down the spread of the epidemic. Furthermore, the sudden decline in overall economic activity set off a chain reaction of earnings losses and downsizing in transportation, tourism, direct retail, and related sectors both upstream and downstream. Relatively large government stimulus packages and increases in demand in other sectors, such as health care and internet retail, failed to compensate for these losses. Because workers sort into different types of jobs according to their comparative advantages, educational backgrounds, and social networks (Patel and Vella, 2013; World Bank, 2018), the upheaval of the pandemic rendered some workers more vulnerable to these various shocks simply by virtue of the work they do.

This paper focuses on the labor market and health ramifications of the pandemic for a specific group of workers: immigrants in the European Union (EU). We show that immigrant workers were uniquely vulnerable to pandemic-related shocks, and that their heightened vulnerability is the result of the greater concentration in occupations that, by the nature of the work involved, proved to pose greater health and income risks. We show that the risks were greater among immigrants from certain countries, and that certain factors – such as limited language skills, a reliance on immigrant networks to find employment, and a tendency for immigrants to fill jobs that have shortages of native-born workers –likely played a role in this increased concentration in higher-risk work. The evidence of impacts on actual labor market outcomes in 2020, the first year of the pandemic, shows that migrant workers in high-risk occupations were significantly more likely to lose their jobs.

Income losses have welfare repercussions for workers, and the ramifications can be especially severe for migrant workers. Many migrants lack access to social protection programs in destination countries (Avato, Koettl, and Sabates-Wheeler 2010); access to such support often depends on maintaining a job, or on having a permanent rather than temporary immigration status. Indeed, the loss of a job can threaten a migrant's ability to remain in the destination country. Income losses for migrants can have large ripple effects across the world, especially in poorer origin countries where remittances from workers abroad form a large share of the GDP. Migrants' remittances to their families in their home countries provide vital income support to many households, especially the poorest; receipt of such remittances has been associated with better health and education outcomes and lower poverty rates (Amuedo-Dorantes and Pozo 2010; World Bank, 2018).

On the labor supply side, we construct three different metrics of ex-ante vulnerabilities to the COVID-19 pandemic: (i) a measure of the share of jobs that are not amenable to telework; (ii) a measure of jobs that were not deemed essential by European governments; and (iii) a measure of income risk that combines these two measures. On the labor demand side, the paper measures economic exposure by using estimates of changes in consumption of goods and services across

sectors. The analysis of supply and demand shocks provides insights on the extent that a worker is in jeopardy to losing a job or facing a reduction in hours or wages, depending on his or her age, occupation, or level of education; it also examines the degree to which certain workers are in jobs that entailed higher health risks both because they could not carry out their work from home, and because their work required extensive face-to-face interactions. This is the case for those who work in many essential services, such as health care and education.

The paper finds that migrants in the EU were particularly vulnerable to both income- and health-related risks. The greater exposure stems from the characteristics of the occupations in which migrant workers tend to be employed. Prior to the pandemic, migrants tended to work to a greater degree in occupations with lower amenability to telework, and more likely to be exposed to demand shocks. The concentration of migrants in these occupations led them to face greater income risks when the pandemic hit. Furthermore, migrants were employed in occupations that were more likely to require face-to-face interactions, increasing their exposure to health risks too.

We also show, however, that exposure to these pandemic-related risks varies widely among migrants themselves, depending on which part of the world they emigrate from. Migrants from other high-income countries that are members of the Organization for Economic Co-operation and Development (OECD) (in Western Europe, North America or East Asia) are *less* vulnerable than the native workers; by contrast, migrants from other specific locations – relatively new EU member states (such as Poland and Hungary), Eastern Europe, the Middle East and Sub-Saharan Africa – are significantly *more* vulnerable than native workers.

In the final section of the paper, we examine labor market outcomes in 2020, the first year of the pandemic. We find that ex-ante measures of vulnerability strongly correlate with actual job losses during the pandemic: non-essential or non-telework jobs were significantly more impacted, though teleworkability of an occupation seems to matter more. Non-teleworkable jobs were lost at significantly higher rates in 2020, but the association between non-teleworkability and actual job loss is even stronger for migrant workers. The larger share of migrants in more vulnerable occupations partially explains the more acute employment losses they faced in 2020. In other words, the pandemic exacerbates the differences between migrants and native workers as well as between telework and non-teleworkable jobs, where, as a result, migrants in non-telework jobs took the brunt of the job losses in 2020. Ex-ante vulnerabilities, however, only explain part of the migrant-native gap in job losses that followed the pandemic and being an immigrant still imposes additional risks.

Migrants tend to fill specific labor-market gaps according to their age, skills, and education levels; however, these differences in demographic profiles explain only a small part of the diverging occupational choices between native-born and migrant workers – and, hence, between the different levels of risk exposure that we document. We examine three additional factors that may contribute to the patterns we find. First, migrants' skills and human capital are transferred in imperfect ways when they seek work in destination countries' labor markets. Migrant workers face barriers that stem from their own language skills, and from the difficulty that destination countries have in recognizing foreign credentials. As a result, migrants tend to select into different occupations, which differ vertically (the occupations require lower levels of education) or horizontally (i.e., the

occupations require the same education levels but entail different types of tasks). These jobs tend to be less amenable to work-from-home options and more likely to be strongly hit by the pandemic-related supply restrictions (Mongey, Pilossoph and Weinberg, 2020). Second, migrants rely on networks of preceding waves of friends, families, and diasporas to find jobs when they arrive. This process creates a path dependency in the selection into specific occupations and perpetuates the occupational divide. Finally, migrants are more likely to be employed in dynamic occupations with higher employment turnover which leads to higher vulnerability.

Our paper contributes to several strands of literature in economics and other disciplines. First, it adds to the growing literature on the employment and labor market consequences of the COVID-19 pandemic. Most papers thus far have explored the overall labor-market impacts in high-income countries (Adams-Pressel et al., 2020a; Adams-Pressel et al., 2020b; Bartik et al., 2020; Cortes and Forsythe 2020; Rojas et al., 2020). Related studies have explored the impact on different groups within the labor force (Albanesi and Kim, 2021; Mongey et al., 2020; Alon et al., 2021).[1] The emerging pattern is that the groups of workers who were already vulnerable to income and employment risks prior to the pandemic are also the ones most negatively impacted from COVID-19-related shocks. The literature thus far shows that employment risks associated with COVID-19 have disproportionately affected low-wage and less-educated workers (Rio Chanona et al., 2020; Mongey, Pilossoph and Weinberg, 2020). Similarly, Garrote-Sanchez et al. (2020) find that the pandemic exacerbated inequality in the labor market, especially in richer countries where better-paid and better-educated workers were almost fully insulated from the shock.

We focus on migrant workers, who represent an under-examined category of workers within the literature that has analyzed the labor-markets impacts of the pandemic thus far. A handful of studies have looked at this group, finding that immigrant workers tended to be more exposed to the negative labor market consequences of the pandemic (Boeri et al. 2020; Borjas and Casidi, 2020; Fassani and Mazza, 2020a; Fasani and Mazza, 2020b; Yasenov, 2020). However, the drivers of increased exposure among migrant workers have yet to be analyzed in detail. In contrast to previous contributions, this paper provides a detailed descriptive analysis of the potential drivers of the higher economic and health risks faced by migrants during the pandemic. It also examines actual job losses that followed the pandemic by migrant status, in addition to ex-ante measures of vulnerability to the pandemic. We focus on migrant workers in the EU, one of the main destinations for immigrants; the region hosts some 60 million of the world's estimated 272 million immigrant workers. By taking advantage of the harmonized labor-force data available for multiple destination countries in Europe, we examine potential drivers at a granular level, taking into account migrants' personal characteristics, occupations, and origin countries.

The paper also contributes to a literature examining and comparing the occupational choices of immigrant and native workers, and the risk levels for the two groups that stem from these occupational choices. The literature has primarily focused on occupational hazards and has shown that immigrant workers are over-represented in occupations with higher rates of injuries and fatalities. This has been evidenced in the US context (Orrenius and Zavodny 2009; Hersch and

[1] For evidence on the labor market effects of COVID-19 in developing economies, see for example Kamis et al. (2021) and Kugler et al. (2021).

Viscusi, 2010; Dávila, Mora and González 2011; Zavodny, 2015), but also in Spain (Díaz-Serrano, 2010; Solé, Díaz-Serrano and Rodríguez, 2010), Germany (Giuntella et al., 2015), Canada (Premji et al., 2010; Smith, Kosny and Mustard, 2009) and Australia (Corvalan, Driscoll and Harrison, 1994).[2] The economics literature has shown that immigrant workers are concentrated in occupations that are more sensitive to business cycle fluctuations, exposing them to economic downturns and shocks (Dustmann, Glitz and Vogel, 2010; Orrenius and Zavodny, 2010). In this paper, we show that the greater exposure of immigrant workers to employment-related risks also manifested itself in the specific context of the COVID-19 pandemic, and we provide descriptive evidence of the drivers behind this greater risk exposure.[3]

The remainder of the paper is organized as follows: Section 2 describes our measurements of occupational vulnerability to COVID-19. Section 3 describes the datasets used in the paper. Section 4 provides descriptive statistics on occupational exposure to COVID-19 in the EU member countries. Section 5 discusses the empirical strategy. Section 6 explores the main contributors of the greater occupational exposure of immigrant workers to the COVID-19 shock. It investigates whether systematic differences in observable characteristics between native and migrant workers can explain differences in exposure, and it explores additional factors, such as the effects of networks and the imperfect transferability of skills. Section 7 examines actual job losses in the first year of the pandemic and their correlates by migrant status, using recent data from 2020. Section 8 concludes.

2. Measurement of Occupational Exposure to COVID-19

2.1 Different Measures of Risk Exposure

Risk exposure is an ex-ante measure; it needs to be assessed *before* the harmful events take place and people react to them. Otherwise, people's endogenous responses to the events and resulting changes in their behavior will confound attempts to measure the risk exposure. Therefore, we use information on workers' occupations and labor market outcomes *prior* to the emergence of the pandemic to measure their economic risk exposure and health vulnerability to COVID-19. This is also the general approach adopted in the rapidly expanding literature (see Dingel and Neiman, 2020; Garrote Sanchez et. al. 2020; Fasani and Mazza, 2020a; Fasani and Mazza, 2020b).

[2] Orrenius and Zavodny (2013) also summarize the literature on the higher concentration of immigrant workers in risky occupations.

[3] Limited host country language proficiency has been shown to be associated with higher-risk occupations in the United States (Orrenius and Zavodny, 2009; Marvasti, 2010; Dávila, Mora and González, 2011) and Australia (Corvalan, Driscoll and Harrison, 1994). A negative relationship between occupational risk and the number of years since migration in Taiwan, China (Wu et al., 1997) and the United States (Hao, 2008); this relationship could be due in part to increased proficiency in the host country language over time. It has also been argued that immigrant workers may have different risk preferences than natives; by virtue of selection, immigrants may be less risk averse, as suggested by a willingness to move overseas (Bonin et al., 2006; 2009).

We use five different metrics of occupational vulnerability and risk throughout this paper. The first metric categorizes whether jobs are or are not *essential* (i.e., whether the jobs are exempt from the mobility restrictions and lockdowns imposed by governments to limit the spread of the pandemic). The second metric assesses whether jobs are or are not *amenable to work-from-home arrangements*, which proved to be crucial when mobility restrictions were in place. The third measure is a combination of the previous two, and it serves as a proxy for the overall *vulnerability to income risks* for a given job as measured from the labor-supply side. The fourth metric focuses on the extent to which a given job involves *intensive face-to-face interactions* and, thus, results in more exposure to COVID-19 health risks. Finally, the fifth metric is based on *exposure to demand shocks*; it measures how much consumption of goods and services produced by that sector are likely to be affected by COVID-19.

Non-essential Jobs

When categorizing jobs as non-essential, we start with Fasani and Mazza (2020a), who use the European Commission's guidelines concerning the exercise of the free movement of workers during the COVID-19 outbreak[4] and then, supplement it with the Dutch government's definition of "key workers." After the onset of the pandemic, many governments created lists of occupations that were considered essential and thus were exempt from mobility restrictions and closures that were imposed during lockdowns. While the criteria for essential occupations vary from country to country, there is significant overlap. Every list, for example, includes core sectors that deliver critical healthcare (doctors, nurses and other medical professionals) and those that provide basic goods and services (food delivery, utilities, transport, security, ICT, and research and science). Lockdowns were initially imposed, progressively lifted during the summer of 2020, and then reintroduced by some governments over the course of the pandemic; thus, these restrictions had significant consequences on the ability to go to work. Based on these criteria, we identify essential workers at the three-digit ISCO-08 classification codes (which includes 182 occupations).

"Non-teleworkable" Jobs

The second measure we use is related to the degree to which the tasks of a given occupation can be performed from home. Recent literature on the impact of COVID-19 on labor markets highlights the feasibility of home-based work (telework) as the key to overcome governments' mobility restrictions and associated income/unemployment risks, and as a way to limit exposure to COVID-19 (Dingel and Neiman, 2020; Garrote Sanchez et al., 2020). In constructing our measure of the "teleworkability" of a job, we follow Dingel and Neiman (2020), who calculate the amenability of different occupations for telework in the United States by using surveys from the Occupational Information Network (O*NET) on work context and generalized work activities. Jobs that are <u>not</u> considered to be amenable to telework arrangements are defined to include those with the following attributes: requiring workers to spend most time outdoors; requiring workers to

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020XC0330(03)

perform physical activity, or to handle moving objects, such as vehicles or machines; requiring workers to repair large mechanical or electronic equipment; entailing worker exposure to diseases or infections; involving work in which email is very seldom used. This measure, however, is based on six-digit-level disaggregation of the Standard Occupational Classification (SOC) system. Given that the EU Labour Force Survey has a coarser disaggregation of occupations, we aggregate our telework measure to three-digit SOC occupations using employment weights based on the Current Population Survey of the US Bureau of Labor Statistics. Therefore, the six-digit-level variable used by Dingel and Neiman (2020) becomes a continuous variable between zero and one in our data; this variable reflects the share of jobs within each broad occupation category that is amenable to telework. We then transform this classification to the International Standard Classification of Occupations (ISCO08) used in the EU labor force survey.

Jobs with Greater Income Risks

Using these criteria, we categorize a job as vulnerable to income risks if it is neither essential nor able to be undertaken via telework. Workers in these jobs are exposed to higher risks of dismissal and loss of income given that mobility restrictions impact their ability to perform their duties at their workplaces.

Jobs with Greater Health Risks

When assessing job-specific exposure to health risks, as our fourth measure, we first quantify the extent of face-to-face interactions required by occupations. We follow Avdiu and Nayyar (2020) who create an index based on O*NET surveys. In this case, we assume that a job requires high face-to-face interactions if it involves tasks such as establishing and maintaining personal relationships, assisting and caring for others, performing for or working directly with the public, or selling to or influencing others through extensive personal interaction (Garrote-Sanchez et al., 2020). We categorize jobs as exposed to health risks, if they require above average face-to-face interaction level, are deemed essential and cannot be performed from home.[5] These jobs, such as those in healthcare or public transportation, are generally shielded from economic risks as they are considered essential, but they are highly exposed to the COVID-19 contagion given their high personal interaction and lack of amenability to work from home.

Jobs That Are More Vulnerable to Demand Shocks

COVID-19 affected not only the labor supply (by restricting mobility) but also labor demand by changing consumption patterns (Rio Chanona et al., 2020; Baker et al., 2020, Brinca et al., 2020). While certain sectors, such as the health care sector, experienced an increase in demand, overall

[5] Non-essential jobs that require a high degree of face-to-face interactions suffered more from income risks rather than from health risks; this is because mobility restrictions in many situations prevented workers from performing their duties.

economic activity fell sharply as sectoral GDP estimates have shown. Sectors such as tourism, hospitality and recreational activities were particularly hit hard as consumers reduced their exposure to the virus. We observe that jobs that have greater income risks are more likely to have experienced a reduction in demand too; so, there is a strong positive correlation between the supply and demand shocks. However, the demand shock may have continued for after government lockdown measures ended and other supply restrictions were lifted as the result of lower household spending capacity, and higher levels of uncertainty about the economy.

To capture the uneven impact of the pandemic experience on consumer spending across sectors, we follow Rio Chanona et al. (2020) who base their analysis on an earlier model developed by the US Congressional Budget Office (CBO, 2006) to generate scenarios to examine the possible impacts that could occur in the event of an influenza pandemic. The most-severe scenario, modeled after the SARS episode in east Asia, estimated that an 11.5 percent reduction in consumer spending would occur (CBO, 2006). For comparison, private consumption in 2020 in the Euro Area fell by 8.4% in real terms compared to 2019, and by 12.8% in the United Kingdom.[6] The CBO provides estimates of the size of the change in demand across two-digit categories of the North American Industry Classification System (NAICS); we convert these to two-digit categories used in the statistical classification system of the EU (NACE). Under a scenario that assumed an outbreak similar to the one that occurred during the Spanish flu pandemic of 1918-1919, the US Congressional Budget Office estimated that consumption in the hospitality and in arts, entertainment and recreation sectors would plummet by 80 percent (CBO, 2006). Under this scenario, it estimated that demand for healthcare services would rise by 15 percent, and that no major consumption changes would occur in other sectors, such as utilities, professional activities, financial and ICT services, public administration and education.

3. Data Sources

The primary data source used throughout the paper is the European Labor Force Survey (EU-LFS), which is constructed by harmonizing nationally representative labor force surveys in all of the 27 member countries of the European Union, in addition to Norway, Switzerland and the United Kingdom. The total sample size ranges between 4.5 million and 5.2 million observations, depending on the year. The dataset annually compiles detailed information on labor-market outcomes of the working-age population and their demographic characteristics, such as gender, age, and educational attainment. We focus on the survey results from 2018, prior to the COVID-19 pandemic as well as from 2020, the first year of the pandemic.

The dataset provides information on whether the individuals were born in the country in which they currently reside. We do not observe the specific country of birth or citizenship status of the migrant workers, but we see nine world regions. These are (i) the high-income EU-15 countries

[6] OECD (2021).

(including the UK),[7] (ii) high-income European Free Trade Association (EFTA) countries,[8] (iii) the new member states of the EU (referred to as NMS13)[9], (iv) non-EU European countries[10], (v) Latin America, (vi) Asia, (vii) the Middle East and North Africa, (viii) Sub-Saharan Africa, and (ix) other high-income OECD countries that are not in Europe (mainly, the US, Australia, Canada and New Zealand).

We have detailed information on various labor-market outcomes of the individuals in the dataset. In terms of labor market status, people are labeled as (i) out of the labor force, (ii) seeking employment, or (iii) currently employed. For the employed workers, there is detailed information on the characteristics of their jobs. These variables include the sector of activity at the one-digit-disaggregation level (using NACE classifications) and detailed occupational categories at the three-digit level (using ISCO-08 classifications). This information enables us to categorize jobs according to the degree of exposure to COVID-19.

The 2014 survey of the EU-LFS includes a special migration module that contains further information on immigrants. These variables include the reason for migration, the level of language fluency of the migrant, the main barriers to labor-market participation (legal documents, recognition of foreign qualifications, language fluency, ethnic or religious background), and the extent to which the migrant is overqualified for the job. These data allow us to better understand the skill profiles of migrants in comparison to those of native-born workers.

To assess the task content and different characteristics of occupations, we use two surveys administered by O*NET, the program sponsored by the US Department of Labor to improve the understanding of the nature of work. The O*NET database contains a vast array of standardized, occupation-specific characteristics for almost 1,000 occupations.

4. Exposure of Immigrant and Native-Born Workers to Pandemic-Related Risks

Measure 1: Non-essential Occupations

Our first comparison between immigrants and native-born workers focuses on the share of workers in non-essential occupations to assess their relative economic exposure to measures that were put in place to contain the spread of COVID-19. We find that migrants in the EU are less likely than native-born citizens to work in occupations that are defined as non-essential. As shown in Panel A of Figure 1, 58 percent of immigrants and 63 percent of native-born workers were employed in

[7] At the time of the EU-LFS surveys, the United Kingdom was a member of the European Union, but formally left on January 31, 2020. As such, in most of our analysis, the United Kingdom is included with the high-income EU15 countries.
[8] The EFTA Member States are Iceland, Liechtenstein, Norway, and Switzerland.
[9] These are the 13 countries that joined the EU as part of 2004 enlargement and subsequently. The group consists of Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, and the Slovak Republic.
[10] These countries are Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Georgia, Republic of Moldova, Montenegro, the Russian Federation, Serbia, Turkey and Ukraine.

non-essential occupations in 2018.[11] Although the share of non-essential occupations in the labor force varies across all destination countries, migrants are under-represented in these roles in almost every host country in the EU15. This is especially the case with migrants from non-EU countries or new member states (NMS13), as depicted by the last two columns. However, migrants from within the EU15 countries (the high-income Western and Northern European countries that were already EU members before the 2004 enlargement) are represented in these jobs to an almost identical degree as native workers.

Another relevant observation is about the age distribution of workers where we see that older workers are less likely to work in non-essential occupations. The relationship between employment in non-essential occupations and age is stronger among immigrants than among natives (Appendix Figure A1, Panel A). Essential workers also tend to be concentrated at the two extremes of the occupational skill/education spectrum, both in higher-skilled/education careers (such as those in healthcare) and in lower-skilled/education occupations (such as those in food delivery and transportation). This pattern holds for both the immigrant and native-born workers (Appendix Figure A1, Panel B). A natural consequence of essential workers clustering in these groups with lowest and highest levels of education is that they are also overrepresented in the highest and lowest income groups. And as it is the case with education categories, a significantly lower share of the non-essential immigrant workers is in the lowest income deciles relative to the native-born essential workers (Appendix Figure A1, Panel C).

The concentration of immigrants in lower-skill (and therefore lower-income) jobs within essential occupations shows some variation across destination countries. Figure A2 presents the share of migrant workers in six of the essential occupations with larger shares of immigrant employment for the five largest destination countries in the EU-LFS. This list includes high-skilled occupations such as medical doctors, nurses, and software developers; middle-skilled occupations such as personal care workers; and low-skilled occupations such as drivers, cleaners, and helpers. Except for the United Kingdom, where the share of migrants is higher for medical doctors, migrant workers in the main EU countries are concentrated to a greater degree in lower-skilled occupations within the essential occupations, particularly as cleaners and helpers.

Measure 2: Occupations That Are Not Amenable to Telework

Our second risk measure is the likelihood that a worker is in an occupation that cannot be performed from home ("non-teleworkable"). We find that immigrants are significantly more likely to work in jobs that are not amenable to telework (Figure 1, Panel B). While 64 percent of natives have jobs that do not make teleworking possible, the ratio rises up to 72 percent for migrants, increasing their exposure to the pandemic-related risks posed by this type of work. In addition to this overall gap, we again find significant heterogeneity across different immigrant groups.

[11] This estimate is slightly higher than that of Fasani and Mazza (2020a), who estimate that 33 percent of workers in the EU work in essential sectors. The disparities emerge from two sources. First, we include the occupations related to "Agriculture, Forestry and Fishery Laborers" (ISCO-08 code 921) based on government regulations. Second, we use an approximation of essential occupations at the two-digit level for Bulgaria, Poland and Slovenia because the EU-LFS does not include three-digit occupations for those countries.

Migrants from new member states (NMS13) are particularly at high risk given that 79 percent of them work in occupations that involve tasks that cannot be performed from home. By contrast, migrants from higher-income EU15 countries are even less likely to have non-teleworkable jobs than natives (60 percent vs. 64 percent).

Across age groups, prime-age (25-39) workers are more likely to telework, while very young workers (15-24) who recently entered the labor force are the least likely to do so (Appendix Figure A3, Panel A). The native-immigrant teleworking gap is larger for older populations. In terms of education and income groups, jobs amenable to telework are more concentrated among highly educated and high-income workers, regardless of whether they are native-born or immigrants. This teleworking gap between migrants and natives is quite stable across education levels, at slightly less than 10 percent (Panel B). The gap, however, declines as income levels increase (Panel C). While the highest-income natives and migrants hold almost identical shares of jobs that are amenable to teleworking, the gap is substantial for the lower deciles. For example, within the bottom four income groups, around 85 percent of migrant workers have non-teleworkable jobs, compared to 70 to 75 percent of native workers.

Measure 3: Occupational Exposure to Income Risks

Occupations that face the highest income and unemployment risks are those that are categorized as non-essential and, at the same time, as not amenable to telework. When an occupation is *both* non-essential and non-amenable to telework, social-distancing policies and mobility restrictions become truly binding, and lead to significant unemployment and income losses. Combining these two metrics, we find that migrants, in particular those from NMS13 countries, are more likely to work in occupations exposed to income risks (Figure 1, Panel C). On average, jobs defined as exposed to income risks (both non-essential and non-teleworkable) account for 38 percent of all employment in the EU. The share of migrants employed in essential jobs is higher, and the share employed in occupations that allow for teleworking is lower. Thus, on net, migrants are 5 percent more exposed than natives to the income risks that arose during the pandemic. Overall, 40 percent of migrants fit into this income risk category. By region of origin, migrants from the NMS13 countries are particularly vulnerable to these risks, with 44 percent of them working in such occupations.

Migrants and natives exposed to the same economic risks have similar demographic patterns, with younger groups significantly more likely to work in jobs that are both non-essential and non-teleworkable (Appendix Figure A4, Panel A). By education level, both native and migrant workers who have secondary education or less schooling are twice as likely as their peers who completed a university degree to have jobs exposed to income risks (Panel B). Overall, migrants in the poorest-earning deciles are less exposed to income risks than low-income natives (Panel C). This is due to the fact that low-income migrant workers are more likely to be in essential jobs. However, migrants in middle-income groups are the most vulnerable to income losses as they tend to work more in jobs that are non-essential and non-teleworkable compared to natives with similar earning levels.

Measure 4: Occupational Exposure to Health Risks

We measure health risks by the extent of face-to-face interactions required by an occupation by using a methodology similar that used in Avdiu and Nayyar (2020). Migrants tend to work in occupations that are more exposed to COVID-19-related health risks (Figure 1, Panel D). While only 15 percent of native workers in the EU28 have jobs in sectors that have high health risks, 23 percent of migrants do so. Exposure to COVID-19-related health risks again varies across immigrant groups. By region of origin, migrants from NMS13 and non-EU28 countries show the greatest health vulnerability (23 percent and 24 percent), while migrants from other EU15 countries and natives have similar exposure levels (16 percent). Migrant workers (who account for 13.5 percent of the working population in the EU) are overrepresented in essential occupations that have above-average health risks, accounting for more than 20 percent of medical doctors, nearly 25 percent of personal care workers in health services, and almost 40 percent of cleaners and helpers (Appendix Figure A5). This picture contrasts with the lower prevalence of migrants in essential sectors that do not require frequent in-person interactions, and/or do not offer the prospect of telework; some 15 percent of migrant workers and 22 percent of native-born workers are employed in these types of jobs.

Older and less- educated workers are more likely to work in jobs exposed to greater health risks; this is particularly true for immigrants (Appendix Figure A6, panels A and B). Low-income workers tend to work in occupations that are more exposed to COVID-19 health risks. This is especially true for low-income migrants from developing countries (Panel C).

Measure 5: Occupational Exposure to Demand Shocks

The previous measures examined labor supply-side risks (arising from government restrictions, an inability to work from home, and greater face-to-face interactions). But immigrant workers also face labor demand-side related risks that stem from their disproportionate share of employment in certain occupations. During the pandemic these risks arose due to rapidly declining consumer demand. The sharp decline of employment in travel-related sectors is a prominent example.

Our data reveal a positive correlation between the supply and demand shocks; that is, sectors that have higher labor-supply disruptions are also likely to have a larger drop in demand (Figure 2, Panel A). Given the different greater presence of migrant workers in vulnerable sectors, negative demand shocks associated with COVID-19 entailed larger labor disruptions for migrant than for natives. While natives work in sectors that have an estimated demand reduction of 11 percent, the estimated average fall in consumption in the sectors in which migrants work appears to have been much greater. Our figures show a decline of about 15.5 percent in those sectors which represents a 29 percent larger reduction than in sectors in which native-born workers concentrate (Figure 2, Panel B). Demand shocks in the short and medium terms might thus have posed a higher threat to the sustainability of migrants' jobs than those of native workers. The effects are also different for

migrants from different regions of origin. Comparisons of demand for the average sectoral occupations of native-born workers with demand for the average sectoral occupations of migrant workers shows that the fall in demand was 2.3 percentage points greater for EU15 migrants, 5 percentage point greater for NMS13 migrants, and 5.5 percentage points greater for NMS13 migrants.

For both native and migrant workers, younger cohorts and those with lower levels of education suffered higher demand shocks in their sectors of employment (Appendix Figure A7). Across income categories, workers from the lowest earning deciles faced a larger drop in sectoral consumption and thus likely faced more pressure to retain jobs (Figure A7, Panel C). The demand shock had a similar impact on high-income natives and migrants. However, the migrant-native gap is significantly larger for waged-workers in the medium-income deciles. While the demand shock increases in an almost linear fashion the lower the income decile of workers, the largest negative impact among migrants appears to have been among the lower-middle-income deciles. Migrants in the poorest deciles were slightly more shielded from a drop in demand because certain low-skilled occupations like personal care or cleaning experienced demand reductions to a lesser degree.

5. Methodology

The data and figures in the previous section present the patterns of exposure to various types of risks for native and immigrant workers. Since the risk measures are constructed at the occupational level, the differences between the natives and the immigrant workers are mainly due to their distributions across occupations. In addition, immigrants differ from native workers in terms of their age and education levels, which further impact workers' risk exposure as the data indicate. This section aims to see if the correlations between risk exposure and immigration status (native-born vs. immigrant) hold once we control for differences in observable personal characteristics, such as age and education.

To examine these issues, we first estimate a multinomial logit model at the worker level, where the dependent variable is a categorical variable for the labor-market status. We construct three possible outcomes for working-age adults in the sample for this variable:[12]

(a) Employed in "safe jobs:" These are workers with jobs in occupations that are classified as safe from health or income risks. That is, these are the occupations that are income safe (they can be performed from home, or they are deemed essential for the economy),

[12] For robustness checks, we also run another specification that includes a fourth category indicating if a worker is not employed (in addition to the three employment categories of safe jobs, jobs with health risks, and jobs with income risks). To minimize the number of adults that are not employed due to continuing education, the sample is restricted to adults ages 25 to 64. The main results are qualitatively similar to the results we obtain when using the three categories. Results are available upon request.

and they do not require extensive face-to-face interactions. An example would be a computer programmer who can work from home.

(b) Employed in occupations with health risks: These are workers with jobs in essential sectors that cannot telework. They require above-average numbers of face-to-face interactions. An example would be a surgeon or a bus driver.

(c) Employed in occupations with income risks: These are workers in occupations that are exposed to supply shocks because they are not considered essential and because they are not able to telework; thus, they are more at risk of being dismissed. An example would be the members of the kitchen staff at a restaurant.

These outcomes are mutually exclusive and capture all possible occupational categories. Figure 3 displays several Venn diagrams of the different categorization of jobs for workers from diverse regions of origin. Each circle represents whether a job is non-essential, non-teleworkable, or requires intense face-to-face interactions. (Jobs outside all three circles are thus essential, teleworkable, or does not require intensive face-to-face interactions). Jobs with a high degree of income risk because they are *both* non-essential and non-teleworkable are shown in red. Panel A shows that 37.6 percent of jobs held by native workers fall into that category; this is a lower share than the 39.6 percent of such jobs held by migrants (Panel B).

Jobs that entail high health risks because they are essential, non-teleworkable, *and* require intense face-to-face interaction are shown in green. Again, we observe that migrants are overrepresented in this category; 22.5 percent of the jobs held by migrants fall into this category, compared to 15.5 percent of the jobs held by native-born workers.

Finally, safe jobs are all other jobs. These are jobs that are essential, with low numbers of face-to-face interactions; these jobs can be either teleworkable or non-teleworkable. These are shown in the gray areas in the figures, which show that 46.9 percent of jobs held by native-born workers fall into this category, compared to 37.9 percent of the jobs held by migrants.

When we look at regional distribution of the migrants, those from western Europe (EU15) have almost the same occupational distribution as native workers (Panel C) across the three categories. By contrast, migrants from new member states of the EU (Panel D) and outside the EU (Panel E) have higher shares in jobs exposed to health risks (green area) and income risks (red area).

With the labor-market status defined as above, we estimate the following equation:

$$Y_{iok} = \alpha + \Omega_o + \beta X_i + \lambda L_i + \gamma \Pi_i + \Delta_1 F_i N_i + \Delta_2 (1\text{-}Fi)*N_i + \varphi_k + \varepsilon_{iok} \quad (1)$$

where Y_{iok} is the categorical variable for one of the three occupational statuses of individual *i* currently living in region of residence *k* in the EU[13] and originally from origin *o*. Ω_o is a vector of fixed effects for the world regions of origin *o* for the worker *i*. The regions of origin are defined as those countries that we put in the following categories: the EU15; the NMS13; the European

[13] Region is defined at the second level of the EU Nomenclature of Territorial Units for Statistics (NUTS2)

Free Trade Association (EFTA); other parts of Europe; Asia; Latin America; Sub-Saharan Africa; the Middle East and Northern Africa (MENA); and non-European OECD countries.[14] X_i is a vector of individual-level observable socioeconomic characteristics (age, age-squared, gender, and years of education). L_i is a vector of dummy variables that capture the different levels of fluency of an individual in the language of the host country. L_1 indicates a beginner level of command of the new host-country language; L_2 indicates an intermediate level; L_3 indicates an advanced level. The baseline indicates having language skills only in one's native language, not in the language used in the host country. Although questions concerning language ability in the EU-LFS 2014 ad hoc migration module are posed only to migrants, our model assumes that native-born workers have perfect language fluency. Π_i is a dummy variable that takes the value of one if immigrant respondents report that certifying their foreign education certificates was a major barrier in the host country's labor market. N_i is a dummy variable that takes value of one if a worker found his/her current job through friends or relatives, or zero if the job was found through other channels (to capture the role of networks). We interact this variable with the dummy variable denoting whether a person is a migrant or a native to allow for differential impacts of networks on the outcomes of interest for migrants and natives. φ_k is a vector of dummy variables for each NUTS2 region of residence $_K$ in the EU.

6. Determinants of Exposure to COVID-19 Related Risks

6.1. Demographic Characteristics of Migrants and Their Exposure to Income and Health Risks Due to the Pandemic

Tables 1 through 3 present the results for the multinomial logit estimation of Equation 1. Table 3 reports the results for the "safe jobs." Table 4 shows results for the "jobs with health risks." Table 5 shows results for the "jobs with income risks." Each reported coefficient in the tables is the marginal effect (in percentage points) of that explanatory variable on the likelihood of being in the respective labor market category (safe, health-risk, or income-risk jobs). For example, each coefficient for a world region (such as EU15, NMS13 or MENA) in Table 3 is the difference in percentage points in the likelihood of a migrant from that region being in a safe job vis-à-vis native worker (the baseline group).

Each table has seven columns corresponding to different specifications of the set of explanatory variables. Column 1 includes only a dummy variable for being foreign born. Column 2 includes separate dummy variables for each of the world regions of origin (the baseline being native born). In Column 3, we add personal characteristics such as age (and age-squared to capture non-

[14] EU15 is composed of Western EU countries. NMS13 are the Eastern European countries that joined the EU since 2004. EFTA countries include Iceland, Lichtenstein, Norway, and Switzerland; these are countries that are also part of the Schengen Area allowing free mobility within the EU. Other European countries are those that are not in the EU or in the EFTA; these are mostly countries in the Balkans and eastern Europe. Non-European OECD countries are Australia, Canada, New Zealand, and the United States. Please see earlier description above.

linearities), gender (via a dummy variable that is equal to one if the person is male) and years of education. Column 4 adds dummy variables for each one of the 159 NUTS2 regions of residence in the EU. Column 5 includes the three dummies that capture the different levels of language fluency (compared to the baseline that is having fluency in the local language only). Column 6 includes a dummy variable that captures the certification barriers faced by the migrants. Column 7 adds two variables assessing the impact of job referrals through networks for both migrants and natives.

As shown in Column 1 of Table 1, immigrants are 10 percent less likely to have safe jobs than natives. Immigrants tend to be over-represented in jobs exposed to both health and income risks (Column 1 of tables 2 and 3). Even though this is true for most migrants, there are critical differences across regions of origin (Column 2 of tables 1-3). Migrants from higher-income countries (EFTA, EU15, or other OECD countries) have similar labor outcomes. For example, migrants from EU15 countries are 4 percent more likely than the natives to be in a safe job and, similarly, those from non-European, high-income OECD countries 21.5 percent more likely to work in such safe jobs (Table 1, Column 2). Migrants from the rest of the world, by contrast, are significantly less likely than native-born workers to be in safe jobs. The risks for these migrants are 18.9 percent greater for those from NMS13 countries, 20.7 percent for those from the rest of Europe, and 8.6 percent greater for those from MENA. Naturally the reverse is true for jobs with income or health risks. Migrants from Sub-Saharan Africa and Latin America are highly likely to be found in jobs with health risks (Table 3) while migrants from NMS13 and non-EU Eastern European countries have the largest share of jobs with income risks.

Controlling for individual characteristics such as age, gender or education levels of individuals and their country of residence does not significantly change these results. The coefficients in columns 3 and 4 of tables 1 to 3 are not much different from those in Column 2. For example, the probability of migrants from NMS13 countries to be in income-risk jobs relative to natives declines by only 2.9 percentage points (5.5 percent compared to 8.4 percent). The likelihood that Sub-Saharan African or Latin American migrants are in jobs with high health risks essentially stays the same. Thus, the large gaps in income and health risks faced by migrants from lower-income regions of the world (relative to the native-born workers) are mostly due to factors other than personal characteristics, such as age and education.

6.2. Language Barriers and Recognition of Foreign Credentials

The imperfect transferability of skills and human capital from home to the destination country is among the most-cited factors behind the disparities observed between migrants and native-born residents in terms of their labor-market outcomes. Language barriers and difficulties in having credentials recognized are two main obstacles to skill transferability; these are among the possible reasons why migrants are sorted into lower-wage and less-appealing jobs at the destination.

The literature on the importance of linguistic skills has identified several key patterns. Different levels in local language skills lead to different sectoral and occupational allocations even if

migrants have similar education levels. Low-skilled workers tend to have lower language fluency, which tends to limit them to a greater degree to jobs that involve manual labor, rather than interactive tasks, as Peri and Sparber (2009) show. As a result, migrants concentrate in manual labor, while natives have a comparative advantage in finding occupations that involve more complex communication tasks (D'Amuri and Peri, 2014; Foged and Peri, 2016). Similarly, Peri and Sparber (2011) find occupational differences between migrants and native-born workers even if they are highly educated. Among workers with tertiary education, immigrants are concentrated in occupations that involve more quantitative and analytical tasks; by contrast, native-born workers tend to be in jobs that require more intense communication skills.

Thus, we want to examine whether language ability shapes the sorting of migrants into occupations with different skill requirements in the EU – and, as a result, the exposure to the different risks associated with the COVID-19 pandemic. We begin by using the O*NET survey to identify the intensity of the host-country language requirement per occupation. In particular, the knowledge questionnaire includes the question "What level of English language knowledge is needed to perform your current job?" with answers ranging from one to seven. We transform this measure available for each occupation in the US to ISCO three-digit occupations and create a standardized index of intensity of the host-country language requirement with mean of zero and standard deviation of one.

Our analysis shows that immigrant workers in Western European countries are disproportionately concentrated in occupations that require lower levels of host-country language fluency (Figure 4, Panel A). Across the EU labor markets, immigrants work in occupations in which language skill requirements are 0.2 standard deviations below the mean (Figure 4, Panel B). This difference is statistically significant at the 1 percent level. However, the difference in occupational choices between migrants and natives varies with migrants' fluency in the host-country language. Migrants with advanced or above-average levels of fluency have occupations with similar levels of language requirements to those required for native workers (just 0.03 standard deviations lower than those of the native-born workers), while migrants with beginner or intermediate levels of language ability are employed in jobs in which the language requirements are, on average, 0.64 standard deviations lower. OLS regressions show that, even after controlling for other individual characteristics (age, age squared, gender, years of education, as well as fixed effects for both regions-of-origin, and countries-of-destination), language fluency is significantly positively associated with the language intensity required in the occupation of workers.

Occupations with higher language requirements are associated with lower levels of job vulnerability. In particular, occupations that require a higher command of the native language, as well as higher communication skills, are significantly more likely to be amenable to telework, which shields them from pandemic-related income risks (Figure 5, Panel A). Such occupations typically require higher levels of education, but this finding holds even when controlling for differences in workers' average education by occupation. The correlation between language ability required per occupation and the exposure of occupations to health risks is less clear (Figure 5, Panel B).

Language fluency is a strong predictor of the type of jobs in which migrant workers are employed and the associated level of vulnerability that surfaces in the multinomial logit regression (Column 5, tables 1-33-5). Compared to workers for whom the language used in their place of residence is also their mother tongue, those with beginner or intermediate levels of language fluency are about 10 percentage points more likely to be employed in a safe job (Column 3, Table 3). This effect is very large, given that less than half of the employed population has jobs with neither income nor health risks. Moreover, language ability explains a significant gap in the share of "safe jobs" for several migrant groups. For example, the gap between migrants from NMS13 countries and natives' likelihood of having held a "safe" job during the pandemic falls from 16 percentage points to 9 percentage points when language skills are taken into account; the gap falls from 19 percentage points to 13 percentage points for migrants from other European countries, from 13 percentage points to 7 percentage points for Asians, from 10 percentage points to 6 percentage points for those from Sub-Saharan Africa, and from 9 percentage points to 3 percentage points for those from MENA countries.

Barriers to recognition of foreign credentials are also significantly correlated with the exposure to the labor-market risks of the pandemic. Migrants who report a lack of recognition of their credentials as a main barrier to integrate in the host-country labor market are 16 percentage points less likely to be employed in "safe jobs" compared to similar migrants who did not face difficulties validating their degrees (Column 6, Table 1). Although skill validation is an important factor, it does not explain a large part of the overall higher vulnerability of migrants in the labor market; as captured in the EU-LFS, it represents a main barrier for only 6 percent of working-age migrants. Moreover, when we compare the coefficients for different world regions (tables 1-3, columns 5-6), we do not see much of a change either. This indicates that barriers for certifying foreign credentials, although relevant for some migrants, are not one of the main factors that would explain the higher economic risk exposure of migrants from lower-income countries to the EU15.

6.3. Immigrant Network Effects

Even after we control for personal characteristics such as education level and fluency in the local language, there are still unexplained differences between migrants from different regions of the world, in terms of their occupations and the resulting income and health risks to which they are exposed. Results (tables 1-3, columns 5-6) show that migrants from NMS13 countries are still 9.5 percentage points less likely than native workers to be in safe jobs. The gap is 13.5 percent for migrants from other eastern European countries, 6.0 percent for those from Sub-Saharan Africa, 6.6 percent for those from Asia, and 10.5 percent for those from Latin America (Table 1, Column 5).

Another pattern found in the literature for the clustering of migrants into specific occupations is the role of migrant networks. Existing social and cultural networks provide numerous services, especially to newly arriving migrants. In addition to helping them with housing, schools and deciphering the cultural norms of the destination country, migrant networks help the new migrants

find jobs. These jobs tend to be in sectors in which previous cohorts of migrants are employed. This process leads migrants from the same communities to cluster in specific occupations and sectors. Beaman (2012) shows immigrant enclaves and networks in different localities of residence influence the occupational choices of different generations of immigrants. Similarly, Patel and Vella (2013) find that immigrants from specific countries cluster in particular occupations across different regions in the United States. This fact is not due to immigrants' skills or other characteristics but rather to referrals from previous cohorts of immigrants and the informational advantages they offer. While such networks help immigrants integrate in the host labor market and provide invaluable help in finding a job, they can at the same time restrict the occupational and spatial mobility of their members (Munshi and Rosenzweig, 2006). Therefore, the historical clustering of past waves of migrants in specific occupations and regions can have long-lasting repercussions through path dependence.

Although patterns of occupational clustering have been examined in different regional contexts, the role of immigrant networks in Europe has received less attention. We use two different migration waves to assess the path dependence in occupational choices of migrants in the EU. Figure 6 presents the relationship between the percentage of migrants in an occupation in 2005 (x-axis) and the percentage of recently arrived migrants in those occupations in 2018. To show the main trend line, we plot the fitted line of a kernel-weighted local polynomial regression as well as the confidence interval.[15] There is a strong and positive correlation between the relative share of migrant employment in an occupation and destination region in 2005 (representing an older wave of migration) and the share of recently arrived migrants in 2018 in each occupation and region.[16] These results remain robust when differentiating migrants by region of origin and controlling for occupation, region of origin, and region-of-destination (NUTS2 level) fixed effects, or when excluding occupations in which there were no migrants in 2005 (see Appendix 2).

Network effects as drivers of occupational choices can, in turn, have an impact on the vulnerability of migrants to pandemic-related shocks. Past studies analyze the role of networks using different measures, but in general, either using the share of co-ethnic migrants in the same region of residence (as in Beaman, 2012), or the share of co-ethnic migrants in the region of residence working in the same occupation as the migrant (Patel and Vella, 2012). To assess the role of networks, we cannot use these measures in the multinomial logit from the previous section given that the dependent variable is based on occupations; thus, any explanatory factor that is also based on ISCO occupations would create perfect multicollinearity, while region-level measures would be captured by the fixed effects.

We proceed by using a measure of networks at the individual level. The EU-LFS ad hoc migration module of 2014 includes a question on the method the individual used to find a current job. Options include advertisements; public or private employment agencies; training institutions; direct contact with employers; and contacts through relatives, friends, or acquaintances. As equation (1) shows,

[15] The confidence interval expands as the share of migrants increases (x-axis) since there are fewer number of such occupations.

[16] We restrict the sample of migrants in the 2018 EU-LFS to those that had been in the country for at most 10 years, so the newer cohort of migrants do not overlap with the older one in 2005.

N_i is a dummy variable that takes the value one if a worker used networks of relatives, friends, or acquaintances, and zero if s/he used any other method. The raw averages show that migrants are significantly more likely than native workers to use networks to find a job; on average, 40 percent of migrants used this network, compared to 30 percent of native-born workers. To see how this fact translates into occupational risk exposure, we estimate the multinomial logit model with the three types of occupations (safe, at health-risk and at income-risk) displayed in equation (1). We add two variables based on the networks for each of the migration categories (migrants and natives) so we can assess whether the impact of networks on job safety differs between those two groups. We show that both natives and migrants who used networks to find a job are about 6 percent less likely to have a safe job and that they are more likely to have jobs with either higher income risks or higher health risks (Tables 1-3, Column 7). The use of such networks is mostly associated with higher health risks among migrant workers; by contrast, among native workers, the use of networks increases the probability of having a job with greater income risks. Furthermore, the average migrant-native gap in the probability of having a safe job is reduced in half for migrants from NMS13 and Latin America, and becomes insignificant for migrants from Sub-Saharan Africa, Asia or MENA. Therefore, while networks (in general of co-nationals) are a key source for finding employment for many migrants, the use of such networks can translate into an occupational concentration in certain jobs; the jobs in which migrants who used these networks tended to concentrate proved to be more vulnerable to both health and income risks related to the COVID-19 pandemic.

6.4. Migrants' Responsiveness to Labor Demand

Prior studies show that the effects of local labor-demand conditions on immigrants' labor market outcomes are stronger than those for natives (Azlor et al., 2020). Importantly, immigrants are more responsive to changes in local labor-demand conditions, choosing locations with more available jobs and filling labor shortages more rapidly (Cadena and Kovak, 2016). The responsiveness of migrants to labor demand occurs not only geographically, but also occupationally, where migrants are found to be significantly more mobile than natives in changing jobs (Green, 1999). Occupations with labor shortages or openings that attract migrants are typically also characterized by poorer and riskier working conditions (Orrenius and Zavodny, 2009), more manual work (Peri and Sparber, 2009), and lower skill requirements (Dustmann and Frattini, 2013). All of these factors make those jobs less attractive to natives who may prefer to stay unemployed, depending on the welfare system (Constant, 2014). These more precarious occupations could, in turn, be more exposed to the negative shocks that surfaced during the pandemic.

To assess the role of labor demand by occupation, we follow a recent study by the European Commission (2015); we proxy for labor demand by using the share of new hires in total employment in each ISCO-08 occupation.[17] The EU-LFS provides information on whether a

[17] We acknowledge that this measure captures not only changes in demand in an occupation (because increases in demand are associated with larger share of new hires), but also other characteristics such as differences in turnover

person has been employed in the current job for less than a year. We therefore define new hires as those who obtained their job within the previous 12 months.

The evidence for Western Europe shows a strong and positive correlation between the share of new hires in an occupation (which we refer to as "turnover") and the share of foreign workers (Figure 7). That is, migrants tend to work in occupations with a more dynamic structure and with turnover that might be unmet by natives' supply of labor, resulting in labor shortages. The elasticity of the share of migrants to new employment is about 0.1, meaning that a 1 percent increase in the share of new hires is associated with a 0.1 percent increase in the share of migrants in a given occupation of a NUTS2-level division of destination (see Appendix 3). The correlation between turnover and the prevalence of immigrant workers per occupation is stronger for non-EU migrants and those coming from NMS13 countries, while migrants from high-income EU15 countries are not likely to be in high-turnover occupations (Appendix Figure A8, Panels a, b, c).

As a final step, we show that the higher responsiveness of migrants to labor-demand conditions and job openings results in higher exposure to income shocks derived from supply and demand changes that surfaced during the pandemic. Figure 8 shows that ISCO-08 three-digit occupations in the EU with a higher share of new hires in 2018 also have higher ex ante exposure to income risks. In conclusion, there is a strong, positive relationship between job openings, the share of immigrants (especially from NMS13 countries and non-EU countries) and high-income risks at the occupational level in high-income EU countries. Therefore, negative demand shocks that reduced jobs in certain sectors during the pandemic are likely to have had more impact in occupations in which immigrants are overrepresented.

7. From Ex Ante Vulnerability to Ex Post Job Losses

In this section, we examine the correlation between our different measures of ex-ante vulnerability to COVID-19, and the actual employment impacts of the pandemic on workers by immigration status. We utilize the latest available of EU-LFS in 2020, which covers the first year of the pandemic. As per the previous waves, the data covers all Western European Union countries as well as Norway and Switzerland.

Figure 9 presents the growth rates of different types of jobs over time, based on the categories of ex ante measures of risk we had identified earlier. In Panel A, we see that the growth rates of essential and non-essential jobs followed a parallel path since 2015, including the decline of around 1.5 percent 2020. In sharp contrast, in Panel B, the number of teleworkable jobs grew at an even higher rate in 2020, while the number of non-teleworkable jobs dropped sharply by 3.3 percent. Income risk combines the two previous measures and Panel C shows that employment in occupations categorized as having an income risk dropped much more sharply (-3.6%) than in occupations considered as income safe (-0,1%). Finally, employment in occupations with a health

and job tenure. However, better-suited proxies, such as job vacancies in the EU, are not available at finer levels of disaggregation of occupations and sectors.

risk (Panel d) declined more (-2.8%) than the occupations categorized as health safe (-1.1%). The teleworkability of occupations thus turns out to be the strongest predictor of the extent to which a given occupation has been negatively impacted by the pandemic.

The employment growth trends of native and migrant workers diverged during 2020. The number of employed migrant workers declined by 2.5 percent as opposed to 1.2 percent for native workers. Since migrant workers are significantly less likely to be employed in teleworkable or income-safe jobs, the diverging employment patterns may be partly explained by this sorting patterns into different occupations. We first carry out an Oaxaca-Blinder decomposition to understand the contribution of explained and unexplained factors to the migrant-native gap in job losses in 2020. To do so, we estimate the following regression:

$$L_n - L_m = [X_m (\beta_n - \beta_m)] + [(X_n - X_m) \beta_n] \quad (2)$$

where the dependent variable of interest is the gap in job losses ($L_n - L_m$) between migrants ($_m$) and natives ($_n$). The individual measure of job loss takes the value 1 if an individual had a job in 2019 but was not employed in 2020, and 0 if the individual was employed in both years. X_m and X_n are a set of explanatory variables for migrants ($_m$) and natives ($_n$) that vary depending on the model specification:

- Model 1: Age, gender, education, whether the person has/had a teleworkable jobs or not, or whether the job was essential or not.
- Model 2: The same variables as model (1) and adding NUTS2 region fixed effects.
- Model 3: Age, gender, education, NUTS2 region fixed effects and ISCO 3-digit occupation.

The first term in brackets $[X_m (\beta_n - \beta_m)]$ represents the "coefficient" or "unexplained" effect and the second term $[(X_n - X_m) \beta_n]$ is the "endowment" or "explained" difference in native and migrant probability of losing their jobs in 2020 due to differences in measured mean X's (socio-demographic, geographic and occupational differences).

The results of the Oaxaca-Blinder decomposition are reported in Figure 10 where we see that the vast majority of the gap in COVID-19 employment losses between native and immigrant workers are not explained by differences in socio-economic characteristics (first stacked bar). NUTS2 regional dummies do not change this pattern (second stacked bar). The exact occupation of a worker has the strongest explanatory power for the native-immigrant job loss gap (about one third of the gap) as seen in the third stacked bar. We should note that a large part of the gap still remains explained by unobservable factors.

To gain further insights on the individual-level correlates of job loss during the COVID-19 pandemic, we next report the results of individual-level regressions. The dependent variable of interest is a binary variable indicating job loss between 2019 and 2020 and it is regressed on a set of observable characteristics. Formally, the equations to be estimated can be written as:

$$Y_{ik} = \alpha + \beta X_i + \Delta_1 (1-F_i)^* O_i + \Delta_2 F_i^* O_i + \Delta_3 F_i^* (1-O_i) + \varphi_k + \varepsilon_{ik} \quad (3)$$

where Y_{ik} is a dummy variable of whether an individual i living in region k who was employed in 2019 lost the job in 2020 (1) or was still employed (0); X_i is a vector of individual-level observable socioeconomic characteristics (age groups, gender, and years of education); φ_k is a vector of fixed effects for the different NUTS2 regions of residence for the worker i; Fi is a dummy on whether a worker is a migrant or not; O_i are the characteristics of the occupation of worker i which can be either: (i) teleworkability; (ii) essential or not; (iii) income-safety and (iv) health-safety. Finally, we include interaction terms between migration status (F_i) and occupation type (O_i).

The results of this specification are reported in Table 4, where natives employed in teleworkable jobs is the omitted category in the first column. The results indicate that the likelihood of experiencing a job loss during the COVID-19 pandemic is greater for workers in non-teleworkable jobs, for both native and immigrant workers. However, the gap in the probability of being unemployed between telework and non-telework jobs is higher for migrant workers in teleworkable jobs when compared to native workers (2.8 percent versus 1.5 percent). Similar patterns are observed for essential occupations as reported in column 2 and income safe occupations in column 3.

These findings are also visually summarized in Figure 10 after we run the same regression separately for every year since 2011. In each panel, the baseline is the native worker in that specific type of risk group. Panel A shows that immigrant workers in non-teleworkable occupations (red line) experience a consistently higher probability of job loss. Migrant workers in telework jobs have more secure jobs, but still lose their jobs at a higher rate than natives in non-telework jobs. The pandemic, however, exacerbates these differences where migrants working in non-telework jobs experience the sharpest increase in job losses. Natives in non-telework jobs also show a higher likelihood of unemployment, while we see no difference with respect to previous years for migrants in telework jobs.

We observe similar patterns in other risk categories, with slightly smaller divergences. For example, in panel B, migrants in non-essential jobs again experience largest increase in unemployment. However, we also see that natives in non-essential jobs did not have the same outcome whereas migrants in essential occupations also lost jobs. These differences indicate that a job being essential or not is not as critical. In Panel c, in the income risk category, the patterns are similar as the teleworkability of the occupation is dominating the results. Finally, in Panel D, we see that the health-risk of an occupation is important. Both native and migrant workers in health-safe jobs are more likely to lose their jobs. And, similar to the other risk categories, migrants are also more likely to lose their job regardless of the health-risk level.

It will be a long time until we have the full picture of the impact of COVID-19 on the labor market outcomes of migrant and native workers. The data from its first year indicate that teleworkable or essential jobs were shielded from more sizable increases in unemployment levels. However, being employed in teleworkable or essential job does not fully insulate a migrant worker. These workers are still more likely to lose their jobs even when we control for the ex ante risk level of the occupation they selected into, which points at additional vulnerabilities that migrants face such as lower job tenure or potential discrimination.

8. Conclusion

This paper provides evidence that migrant workers in the EU were more exposed to both economic and health shocks associated with the COVID-19 pandemic. The source of this greater risk exposure of migrant workers to COVID-19 stems from the systematic differences in the occupations in which they are concentrated to a greater degree than native-born workers. The additional risks stem from three factors. First, migrants work to a greater degree in occupations that cannot be undertaken at home. Second, migrants work to a greater degree in occupations that were more severely hit by COVID-19-related demand shocks. Both of these exposed migrants to income risks to a greater degree than natives. Third, migrants who are employed in essential jobs are working in positions that require face-to-face interactions; thus, during the pandemic, they have been exposed to greater risks to their health, in addition to the risks to their economic security.

Our findings reveal notable differences in risk faced by migrant groups coming from different regions of the world. While immigrants from other EU countries were not more exposed to pandemic-related risks than native-born workers, immigrant workers from other regions of the world faced higher economic and health risks associated with COVID-19.

We find that differences in personal characteristics, such as age and education levels, explain only a small fraction of the risk exposure gap between native and immigrant workers. By contrast, we show that several other factors lead to the overrepresentation of migrant workers in occupations that proved to be high-risk jobs during the pandemic. One factor is the imperfect transferability of human capital across countries. A limited command of the host-country language leads migrants to concentrate occupations that require lower skill and have higher levels of COVID-19 exposure than is the case for native-born workers with similar levels of education. Second, migrant workers also tend to work in occupations in which there are larger labor shortages; by contrast, native workers are reluctant to take up these jobs. Third, the occupational sorting of migrant workers is reinforced by the effects of migrant networks between origin and destination countries.

In addition, migrant workers often have weaker social and employment protection in destination countries than those available to native-born citizens. Our findings call for policy interventions targeted at migrant workers to mitigate the adverse effects of the pandemic experience on this particularly vulnerable population. In particular, programs created to respond to the COVID-19 outbreak could be made more migrant-sensitive to take into account the unique challenges faced by migrant workers (Moroz et al., 2020). For example, emergency social safety net programs created to respond to the pandemic could include migrant workers and their families; other non-pandemic-specific measures could expand migrants' access to existing welfare programs; new schemes could be devised that specifically target foreign workers. Needed measures go beyond such safety-net programs to provide migrants with access to health services, which are particularly urgent given migrant workers' greater exposure to COVID-19 itself and related health risks. In addition, job losses for migrant workers can in some cases threaten their legal status in destination countries; such a situation raises the need for interventions – even if temporary – to relax visa or residency-status restrictions to protect migrant workers.

In the longer term, migrants' integration in the labor market can also be measured, not just by wages and employment rates, but also by gaps in the types of employment (e.g., the share of teleworkable jobs). Such gaps can predict vulnerability to certain employment shocks, as underlined in the pandemic. To reduce those gaps, interventions should address the main drivers of occupational disparities, in particular the limited language fluency and networks that migrants have in the host country.

References

Adams, Richard H., and John Page. 2005. "Do International Migration and Remittances Reduce Poverty in Developing Countries?" *World Development*, 33 (10): 1645–69.

Adams-Prassel, Abi, Teodora. Boneva, Marta Golin and Christopher Rauh. 2020a. "Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys." *Journal of Public Economics*, 189: 104245.

———. 2020b. "Work Tasks That Can Be Done from Home: Evidence of the Variation Within and Across Occupations and Industries." *Cambridge Working Papers in Economics* 2040, Faculty of Economics, University of Cambridge.

Ahonen, Emily Q., and Fernando G. Benavides. 2006. "Risk of Fatal and Non-fatal Occupational Injury in Foreign Workers in Spain." *Journal of Epidemiology and Community Health,* 60: 424-426.

Albanesi, Stefania, and Jiyeon Kim. 2021. "The gendered impact of the COVID-19 recession on the US labor market." No. w28505. National Bureau of Economic Research.

Aleksynska, Mariya and Ahmed Tritah. 2013. "Occupation–education mismatch of immigrant workers in Europe: Context and policies," *Economics of Education Review*, 36: 229-244.

Alon, Titan, Matthias Doepke, Jane Olmstead-Rumsey and Michele Tertilt. 2020. "The impact of covid-19 on gender equality," *National Bureau of Economic Research*, Working Paper 26947 doi:10.3386/w26947.

Amuedo-Dorantes, Catalina, and Susan Pozo. 2010. "Accounting for Remittance and Migration Effects on Children's Schooling." *World Development*, 38 (12): 1747–59.

Autor, David H., and Michael J. Handel. 2013. "Putting Tasks to the Test: Human Capital, Job Tasks, and Wages," *Journal of Labor Economics*, 31 (S1): 59-96.

Autor, David H., Frank Levy and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration," *Quarterly Journal of Economics*, 118(4): 1279-1334.

Avato, Johanna, Johannes Koettl and Rachel Sabates-Wheeler. 2010. "Social Security Regimes, Global Estimates, and Good Practices: The Status of Social Protection for International Migrants," *World Development*, 38 (4): 455-466.

Avdiu, Besart, and Gaurav Nayyar. 2020. "When face-to-face interactions become an occupational hazard: Jobs in the time of COVID-19," *World Bank Policy Research Working Paper* 9240.

Azlor, Luz, Anna Piil Damm and Marie Louise Schultz-Nielsenc. 2020. "Local labour demand and immigrant employment," *Labour Economics*, 63, 101808.

Baker, Scott R., R.A. Farrokhnia, Steffen Meyer, Michaela Pagel, and Constantine Yannelis. 2020. "How does household spending respond to an epidemic? consumption during the covid-19 pandemic," *National Bureau of Economic Research* Working Paper 26949.

Barrett, Alan, Seamus McGuiness, Martin O'Brien and Philip O'Connell. 2013. "Immigrants and Employer-Provided Training," *Journal of Labor Research*, 34 (1): 52–78.

Bartik, Alexander W., Marianne Bertrand, Feng Lin, Jesse Rothstein, and Matt Unrath. 2020. "Measuring the labor market at the onset of the COVID-19 crisis." *National Bureau of Economic Research,* Working Paper 27613.

Bayer, Patrick, Stephen L. Ross, and Giorgio Topa. 2008. "Place of Work and Place of Residence: Informal Hiring Networks and Labor Market Outcomes," *Journal of Political Economy*, 116 (6): 1150-1196.

Beaman, Lori A. 2012. "Social Networks and the Dynamics of Labor Market Outcomes: Evidence from Refugees Resettled in the U.S." *Review of Economic Studies*, 79 (1): 128-161.

Betcherman, Gordon, Nicholas Giannakopoulos, Ioannis Laliotis, Ioanna Pantelaiou, Mauro Testaverde, and Giannis Tzimas. 2020. "Reacting quickly and protecting jobs: The short-term impacts of the COVID-19 lockdown on the Greek labor market." *IZA* Discussion Paper No. 13516.

Bonin, Holger, Amelie Constant, Konstantinos Tatsiramos, and Klaus F. Zimmermann. 2006. "Ethnic Persistence, Assimilation and Risk Proclivity." *IZA* Discussion Paper No. 2537.

Bonin, Holger, Amelie Constant, Konstantinos Tatsiramos, and Klaus F. Zimmermann. 2009. "Native-Migrant Differences in Risk Attitudes." *Applied Economics Letters*, 16: 1581-1586.

Borjas, George J. 1985. "Assimilation, Changes in Cohort Quality, and the Earnings of Immigrants," *Journal of Labor Economics*, 3 (October): 463–89.

_____ 2015. "The Slowdown in the Economic Assimilation of Immigrants: Aging and Cohort Effects Revisited Again," *Journal of Human Capital*, 9 (4): 483-517.

Borjas, George J. and Hugh Cassidy. 2020. "The Adverse Effect of the COVID-19 Labor Market Shock on Immigrant Employment," *National Bureau of Economic Research* Working Paper 27243.

Brinca, Pedro, Joao B. Duarte, and Miguel Faria-e-Castro. 2020. "Measuring Sectoral Supply and Demand Shocks during COVID-19," Working Paper 2020-011B, *Federal Reserve Bank of St. Louis*.

Cadena, Brian C. and Brian K. Kovak. 2016. "Immigrants Equilibrate Local Labor Markets: Evidence from the Great Recession," *American Economic Journal: Applied Economics*, 8(1): 257–290.

Carlsson, Magnus, and Dan-Olof Rooth. 2007. "Evidence of ethnic discrimination in the Swedish labor market using experimental data," *Labour Economics*, 14 (4): 716-729.

Cattaneo, Cristina, Carlo V. Fiorio and Giovanni Peri. 2015. "What Happens to the Careers of European Workers When Immigrants "Take Their Jobs"?," *Journal of Human Resources*, 50 (3) 655-693.

Chiswick, Barry R. 1980. "An Analysis of the Economic Progress and Impact of Immigrants," National Technical Information Service, no. PB80-200454. Washington, DC: U.S. Dept. Labor.

Chiswick, Barry R., Yew Liang Lee and Paul W. Miller. 2005. "A Longitudinal Analysts of Immigrant Occupational Mobility: A Test of the Immigrant Assimilation Hypothesis," *International Migration Review*, 39(2), 332–353.

Chiswick, Barry R. and Paul W. Miller. 2009. "The international transferability of immigrants' human capital skills," *Economics of Education Review*, 28(2), 162-169.

Congressional Budget Office. 2006. "Potential influenza pandemic: Possible macroeconomic effects and policy issues". https://www.cbo.gov/sites/default/files/109th-congress-2005-2006/reports/12-08-birdflu.pdf

Constant, Amelie F. 2014. "Do migrants take the jobs of native workers?" *IZA World of Labor*: 10 doi: 10.15185/izawol.10.

Corvalan, Carlos F., Timothy R. Driscoll and James E. Harrison. 1994. "Role of migrant factors in work-related fatalities in Australia." *Scandinavian Journal of Work, Environment & Health* 20(5): 364-70.

Cortes, Matias and Eliza Forsythe. 2020. "Impacts of the covid-19 pandemic and the cares act on earnings and inequality", *IZA* Discussion Paper No. 13643.

Damm, Anna Piil. 2009. "Ethnic enclaves and immigrant labor market outcomes: quasi-Experimental evidence," *Journal of Labor Economics*, 27 (2): 81-314.

_____ 2014. "Neighbourhood quality and labour market outcomes: evidence from quasi-random neighbourhood assignment of immigrants," *Journal of Urban Economics*, 79: 139-166.

D'Amuri, Francesco and Giovanni Peri. 2014. "Immigration, Jobs, and Employment Protection: Evidence from Before and During the Great Recession," *Journal of the European Economic Association*, 12 (2): 432-464.

Dávila, Alberto, Marie T. Mora, and Rebecca González. 2011. "English-Language Proficiency and Occupational Risk Among Hispanic Immigrant Men in the United States." *Industrial Relations*, 50 (April): 263-296.

Diaz, Esperanza, Svenn-Eirik Mamelund, Jarle Eid, Henriette S. Aasen, Oddvar Martin Kaarbøe, Rebecca J. C. Brokstad, Siri Gloppen, Anders Beyer, and Bernadette N. Kumar. 2021. "Learning from the COVID-19 pandemic among migrants: An innovative, system-level, interdisciplinary approach is needed to improve public health." *Scandinavian Journal of Public Health* 14034948211019795.

Díaz-Serrano, Luis. 2010. "Do Legal Immigrants and Natives Compete in the Labour Market? Evidence from Catalonia." *IZA* Discussion Paper No. 4693.

del Rio-Chanona, R. Maria, Penny Mealy, Anton Pichler, Francois Lafond and Doyne Farmer. 2020. "Supply and demand shocks in the COVID-19 pandemic: An industry and occupation perspective," *Oxford Review of Economic Policy*, Volume 36, Issue Supplement_1, 2020, Pages S94–S137, https://doi.org/10.1093/oxrep/graa033.

Dingel, Jonathan I, and Brent Neiman. 2020. "How many jobs can be done at home?" *Journal of Public Economics,* Volume 189, September 2020, 104235.

Duleep, Harriet O., and Daniel J. Dowhan. 2002. "Insights from Longitudinal Data on the Earnings Growth of U.S. Foreign-Born Men." *Demography* 39 (August): 485–506.

Duleep, Harriet O., and Mark C. Regets. 1999. "Immigrants and human-capital investment," *American Economic Review*, 89(2): 186–191.

Dustmann, Christian, Albert Glitz, A. and Thorsten Vogel. 2010. "Employment, wages, and the economic cycle: Differences between immigrants and natives." *European Economic Review*, 54(1): 1–17.

Dustmann, Christian and Tommaso Frattini. 2013. "Immigration: The European experience." In D. Card and S. Raphael (Eds.), Immigration, Poverty, and Socioeconomic Inequality: Russell Sage Foundation.

Dustmann, Christian, Albrecht Glitz, Uta Schönberg and Herbert Brücker. 2016. "Referral-based Job Search Networks, *Review of Economic Studies*, 83 (2): 514–546.

Edin, Per-Anders, Peter Fredriksson and Olof Åslund. 2003. "Ethnic Enclaves and the Economic Success of Immigrants—Evidence from a Natural Experiment," *The Quarterly Journal of Economics*, 118 (1): 329–357.

European Commission. 2015. "Labor Market Shortages in the European Union," IP/A/EMP/ST/2013-06.

European Commission. 2020. "Communication from the Commission Guidelines concerning the exercise of the free movement of workers during COVID-19 outbreak," 2020/C 102 I/03. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020XC0330(03)&from=EN

Eurostat. 2021. "Labor Market Database", Eurostat, European Commission, reference period 2019q2/2020q2, Employment by sex, age and country of birth (1 000) [lfsq_egacob], https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do (accessed on 02 November 2021).

Fasani, Francesco, and Jacopo Mazza. 2020a. "A Vulnerable Workforce: Migrant Workers in the COVID-19 Pandemic," European Commission, JRC - EUR 30225

Fasani, F and J Mazza. 2020b., "Being on the Frontline? Immigrant Workers in Europe and the COVID-19 Pandemic," *IZA* Discussion Papers 13963.

Friedberg, Rachel M. 2000. "You can't take it with you? Immigrant assimilation and the portability of human capital," *Journal of Labor Economics*, 18(2): 221–51.

Foged, Mette and Giovanni Peri. 2016. "Immigrants' Effect on Native Workers: New Analysis on Longitudinal Data," *American Economic Journal: Applied Economics*, 8 (2): 1-34.

Garrote Sanchez, Daniel, Nicolas Gomez Parra, Caglar Ozden, and Bob Rijkers. 2020. "Which jobs are most vulnerable to COVID-19? Analysis of the European Union," *World Bank Research & Policy Briefs* No. 34. Washington, D.C.: World Bank Group.

Giuntella, Osea, and Fabrizio Mazzonna. 2015. "Do immigrants improve the health of natives?" *Journal of Health Economics* 43: 140–53.

Goel, Deepti, and Kevin Lang. 2017. "Social Ties and the Job Search of Recent Immigrants," *ILR Review*.

Green, David A. 1999. "Immigrant Occupational Attainment: Assimilation and Mobility over Time," *Journal of Labor Economics* 17 (1): 49-79.

Hao, Lingxin. 2008. "Workplace Nonfatal Injuries Among Immigrants to the U.S." Mimeo, Johns Hopkins University Department of Sociology. Available online at

http://paa2008.princeton.edu/download.aspx?submissionId=80386.

Hersch, Joni, and W. Kip Viscusi. 2010. "Immigrant Status and the Value of Statistical Life." *Journal of Human Resources* 45 (Summer): 749-771.

Hildebrandt, Nicole, and David J. McKenzie. 2005. "The Effects of Migration on Child Health in Mexico." *Economia* 6 (1): 257–89.

Juranek, Steffen, Jörg Paetzold, Hannes Winner, and Floris Zoutman. 2020. "Labor market effects of COVID-19 in Sweden and its neighbors: Evidence from novel administrative data." NHH Dept. of Business and Management Science Discussion Paper 2020/8.

Khamis, Melanie, Daniel Prinz, David Newhouse, Amparo Palacios-Lopez, Utz Pape, Michael Weber. 2021. "The Early Labor Market Impacts of COVID-19 in Developing Countries: Evidence from High-Frequency Phone Surveys." Policy Research Working Paper No. 9510. World Bank, Washington, DC. © World Bank.

Kramarz, Francis and Oskar Nordström Skans. 2014. "When Strong Ties are Strong: Networks and Youth Labour Market Entry," *Review of Economic Studies*, 81 (3): 1164–1200.

Kugler, Maurice; Mariana Viollaz, Daniel Duque, Isis Gaddis, David Newhouse, Amparo Palacios-Lopez, Michael Weber. 2021. "How Did the COVID-19 Crisis Affect Different Types of Workers in the Developing World?" Jobs Working Paper No. 60. World Bank, Washington, DC. © World Bank.

Lubotsky, Darren. 2007. "Chutes or Ladders? A Longitudinal Analysis of Immigrant Earnings," *Journal of Political Economy*, 115:5, 820-867.

Martin, Philip L. 1993. "The Missing Bridge: How Immigrant Networks Keep Americans Out of Dirty Jobs." Population and Environment 14 (July): 539-565.

Marvasti, Akbar. 2010. "Occupational Safety and English Language Proficiency." *Journal of Labor Research* 31: 332-347.

Mongey, Simon, Laura Pilossoph, and Alex Weinberg. 2020. "Which workers bear the burden of social distancing policies?', *National Bureau of Economic Research*, Working Paper No 27085. doi:10.3386/w27085.

Montgomery, James D. 1991. "Social Networks and Labor-Market Outcomes: Toward an Economic Analysis," *American Economic Review*, 81 (5): 1408-1418.

Munshi, Kaivan. 2003. "Networks in the Modern Economy: Mexican Migrants in the U.S. Labor Market", *Quarterly Journal of Economics*, 118: 549–597.

Munshi, Kaivan and Mark Rosenzweig. 2006. "Traditional Institutions Meet the Modern World: Caste, Gender, and Schooling Choice in a Globalizing Economy," *American Economic Review*, 96(4): 1225-1252.

OECD. 2021. "Main Economic Indicators - complete database", Main Economic Indicators (database), https://doi.org/10.1787/data-00052-en (accessed on 02 November 2021).

Oreopoulos, Philip. 2011. "Why Do Skilled Immigrants Struggle in the Labor Market? A Field Experiment with Thirteen Thousand Resumes." *American Economic Journal: Economic Policy* 3(4): 148-171.

Orrenius, Pia M, and Madeline Zavodny. 2009. "Do Immigrants Work In Riskier Jobs?" *Demography*. 46(3): 535–551.

Orrenius, Pia M. and Madeline Zavodny, M. 2010. "Mexican immigrant employment outcomes over the business cycle." *American Economic Review* 100(2): 316–20.

Orrenius, Pia M., and Madeline Zavodny. 2013. "Immigrants in risky occupations." In Amelie F. Constant and Klaus F. Zimmermann (Eds.), *International Handbook on the Economics of Migration*, pp. 214–26. Cheltenham, UK: Edward Elgar.

Ottaviano, Gianmarco I. P., Giovanni Peri, and Greg C. Wright. 2013. "Immigration, Offshoring, and American Jobs." *American Economic Review*, 103 (5): 1925-59.

Patel, Krishna, and Francis Vella. 2013. "Immigrant Networks and Their Implications for Occupational Choice and Wages," *Review of Economics and Statistics*, 95 (4): 1249-1277.

Peri, Giovanni, and Chad Sparber. 2009. "Task Specialization, Immigration, and Wages," *American Economic Journal: Applied Economics*, 1(3): 135–169.

Peri, Giovanni, and Chad Sparber. 2011. "Highly Educated Immigrants and Native Occupational Choice," *Industrial Relations: a journal of economy and society*, 50 (3): 385-411.

Piracha, Matloob and Florin Vadean. 2013. "Migrant educational mismatch and the labour market." In A. F. Constant & K. F. Zimmermann (Eds.), *International Handbook on Economics of Migration* (pp. 176-192). Edward Elgar Publishing Ltd.: Cheltenham, UK.

Premji, Stephanie, Patrice Duguay, Karen Messing and Katherine Lippel. 2010. "Are immigrants, ethnic and linguistic minorities over-represented in jobs with a high level of compensated risk? Results from a Montréal, Canada study using census and workers' compensation data." *American journal of industrial medicine*, *53*(9): 875-885.

Rojas, Felipe Lozano, Xuan Jiang, Laura Montenovo, Kosali I. Simon, Bruce A. Weinberg, and Coady Wing. 2020. "Is the cure worse than the problem itself? Immediate labor market effects of COVID-19 case rates and school closures in the US." *National Bureau of Economic Research* Working Paper No.27127.

Rich, Judith. 2014. "What Do Field Experiments of Discrimination in Markets Tell Us? A Meta Analysis of Studies Conducted since 2000." *Institute for the Study of Labor (IZA) Discussion Paper* 8584.

Sanromá, Esteve, Raúl Ramos and Hipólito Simón. 2015. "Portability of Human Capital and Immigrant Overeducation in Spain," *Population Research and Policy Review*, 34 (2): 223-241.

Smith, Peter M., Agnieszka A. Kosny, and Cameron A. Mustard. 2009. "Differences in access to wage replacement benefits for absences due to work-related injury or illness in Canada." *American Journal of Industrial Medicine*, *52*(4), pp.341-349.

Solé, Meritxell, Luis Díaz-Serrano, and Marisol Rodríguez. 2010. "Work, Risk and Health: Differences between Immigrants and Natives in Spain." *IZA Discussion Paper* No. 5338.

World Bank. 2018. "*Moving for Prosperity: Global Migration and Labor Markets*," Policy Research Report. Washington, DC, The World Bank.

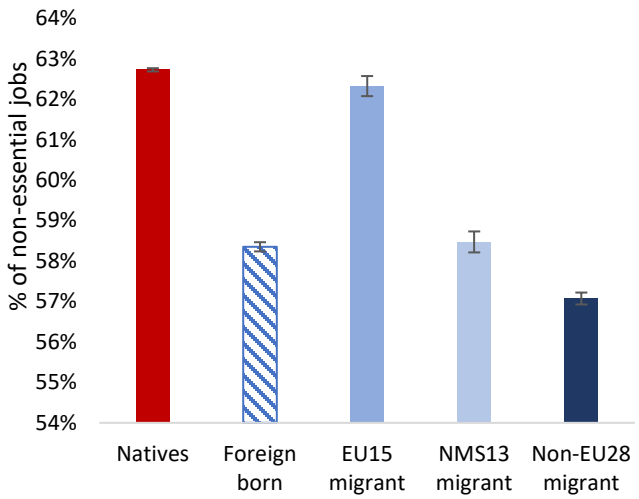
Wu, Trong-Neng, Saou-Hsing Liou, Chao-Chun Hsu, Show-Lin Chao, Shu-Fen Liou, Kquei-Nu Ko, Wen-Yu Yeh, and Po-Ya Chang. 1997. "Epidemiologic Study of Occupational Injuries Among Foreign and Native Workers in Taiwan." *American Journal of Industrial Medicine* 31: 623-630.

Yasenov, Vasil. 2020. "Who Can Work from Home?" *IZA Discussion Paper* No. 13197.

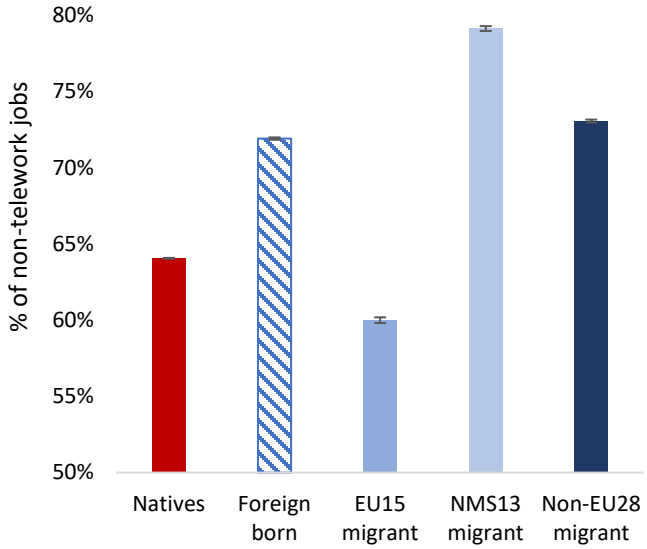
Zavodny, Madeline. 2015. "Do immigrants work in worse jobs than U.S. natives? Evidence from California." *Industrial Relations* 54(2): 276–93.

Figure 1: Share of jobs in the EU region of birth by different risk categories

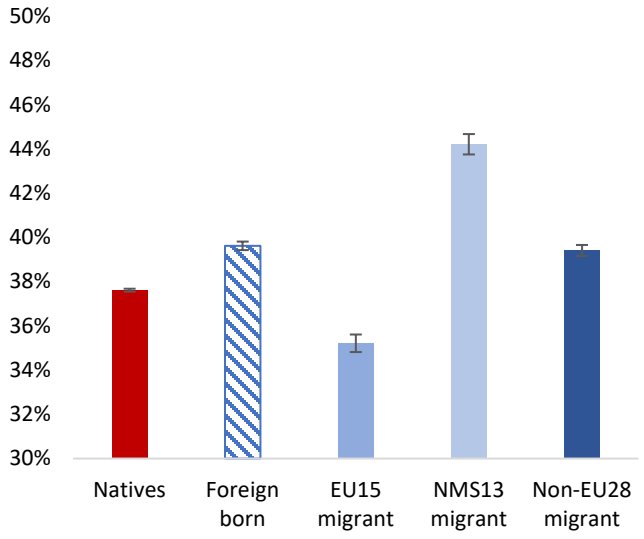
Panel a. Non-essential jobs



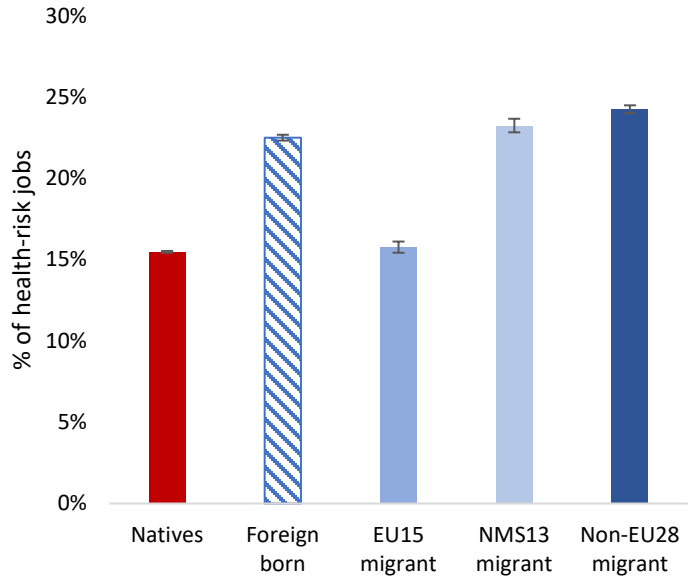
Panel b. Non-teleworkable jobs



Panel c. Income-risk jobs (non-essential and non-teleworkable)



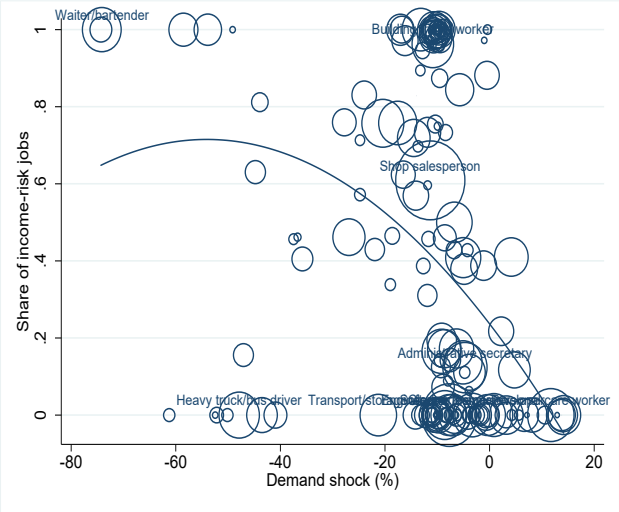
Panel d. Health-risk jobs



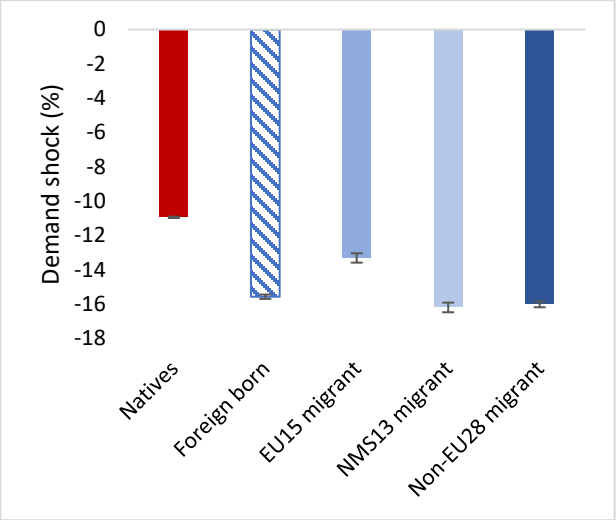
Source: Own calculation based on EU-LFS 2018 data, following EC directive (2020) and Fasani and Mazza (2020a).

Figure 2: COVID-19 demand shock: comparison with supply shock and uneven impact by region of birth

Panel a. Supply and demand by occupation (by ISCO 3-digit)



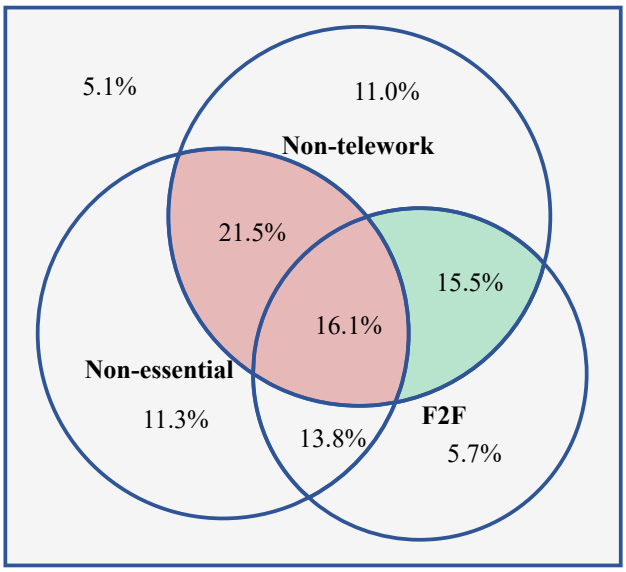
Panel b. Expected demand shock given occupation profile (CBO 2006, Rio-Chanona et al 2020)



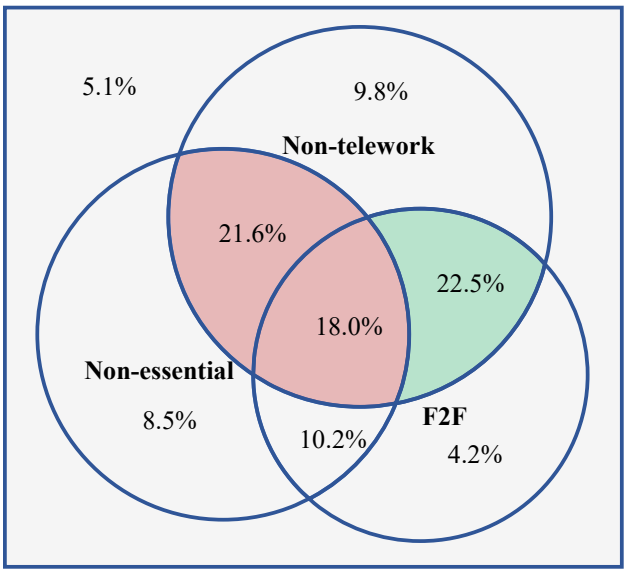
Source: EU-LFS 2018 database, following estimates of Rio-Chanona et al (2020) and CBO (2006).
Note: The sectoral demand estimates by the US Congressional Budget Office (2006) are based on Hong Kong's experience with the past influenza pandemic "SARS" between 2002 and 2004. The CBO provides two scenarios and, following Rio Chanona et al. (2020), we use the severe scenario which describes a pandemic that is similar in size to the 1918-1919 Spanish flu outbreak. The CBO lists demand side estimates for broad industry categories, which we mapped to the NACE sectors.

Figure 3: Share of each type of occupation by migration status

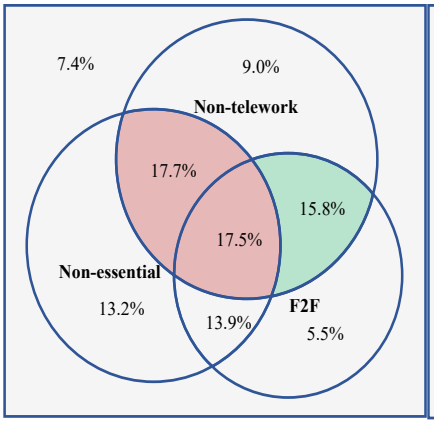
Panel a. Natives



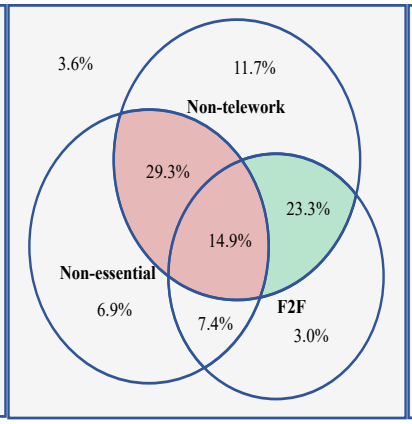
Panel b. Migrants



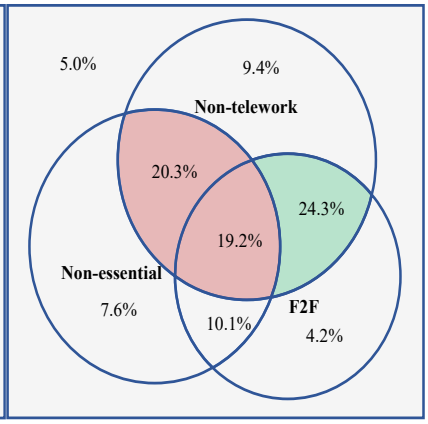
C. Migrants from Western Europe



D. Migrants from Eastern Europe



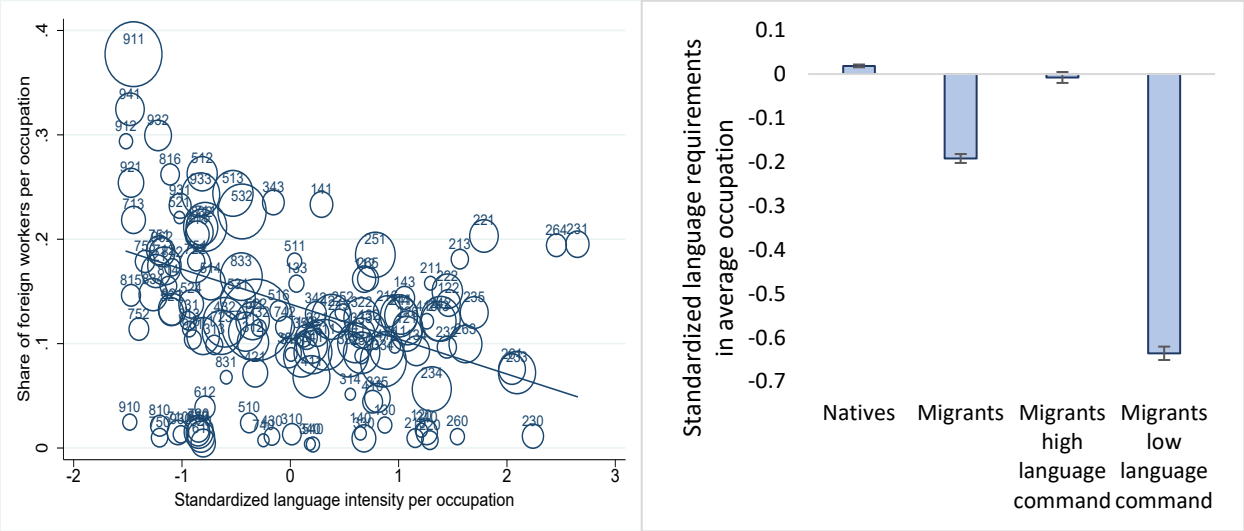
E. Migrants outside Europe



Source: Own elaboration based on data from the 2018 EU-LFS and combining Dingel and Neiman (2020), Rio-Chanona et al (2020) and Avdiu and Nayyar (2020) methodologies.

Figure 4: Language requirements and share of migrants per occupation and average by type of migrants

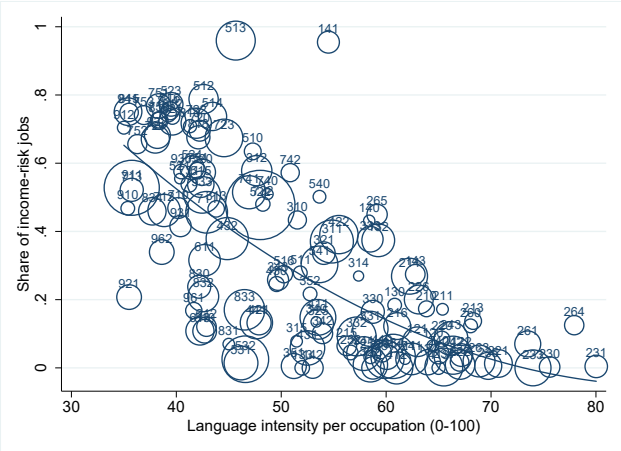
Panel a. Language requirements and share of migrants Panel b. Language requirement by type of migrant



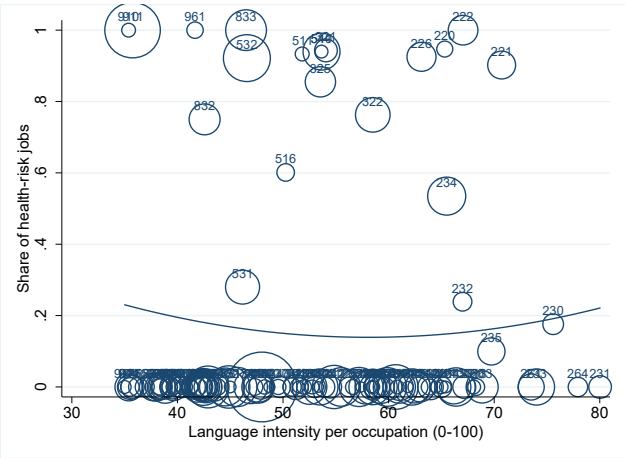
Source: Own elaboration based on the EU-LFS 2018 and the ad-hoc migration module of 2014.
Note: The size of the circles represents the share of each occupation in the total employment in the EU. 95% confidence intervals are included for comparison. Panel b shows language intensity of in the average occupation in standardized terms, that is, the original language intensity minus the mean, divided by the standard deviation.

Figure 5: Language requirements per occupation and share of at-risk jobs

Panel a. % of jobs with income risks

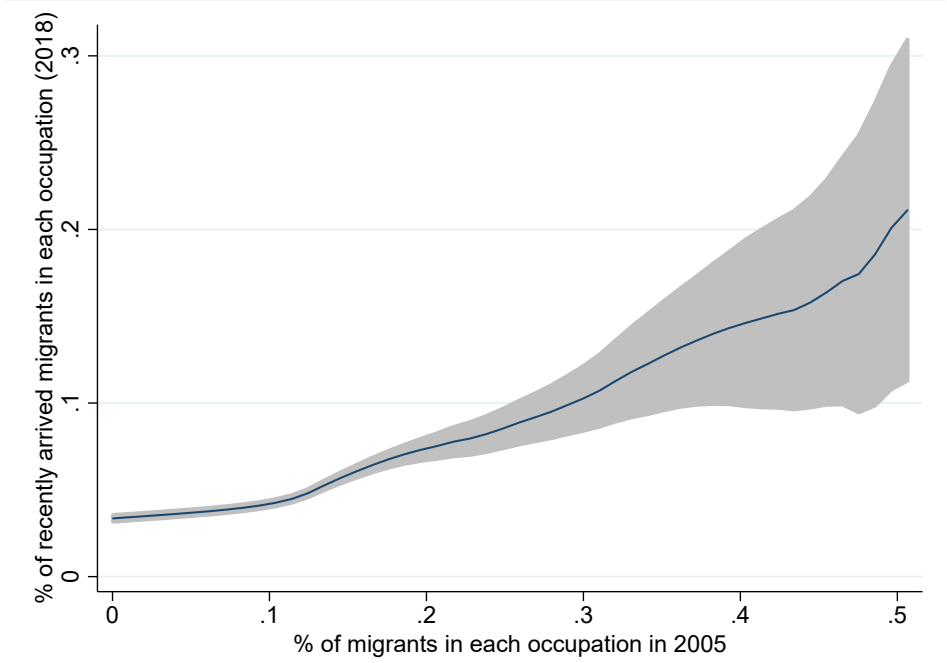


Panel b. % of jobs with health risks



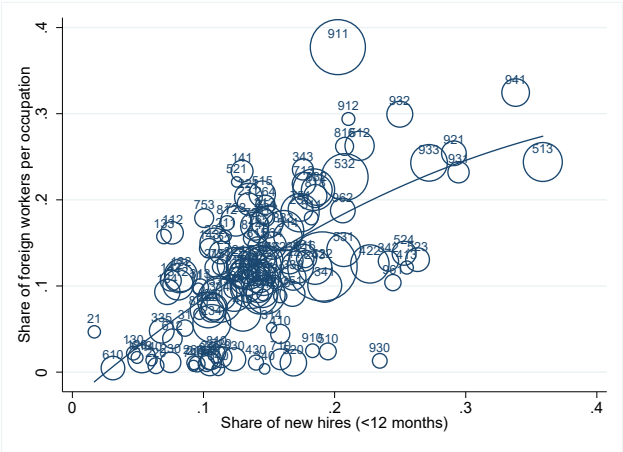
Source: Own elaboration based on the EU-LFS 2018 and the ad-hoc migration module of 2014.
Note: The size of the circles represents the share of each occupation in the total employment in the EU.

Figure 6: Correlation between occupational choices of migrants in the EU in 2005 and 2018



Source: Own elaboration based on the EU-LFS 2005 and EU-LFS 2018.
Note: Share of migrant workers in each occupation for each NUTS2 division of residence. For 2018, migrants are restricted to those recently arrived in the country (less than ten years) so there is no overlap with the migrants in the country in 2005.

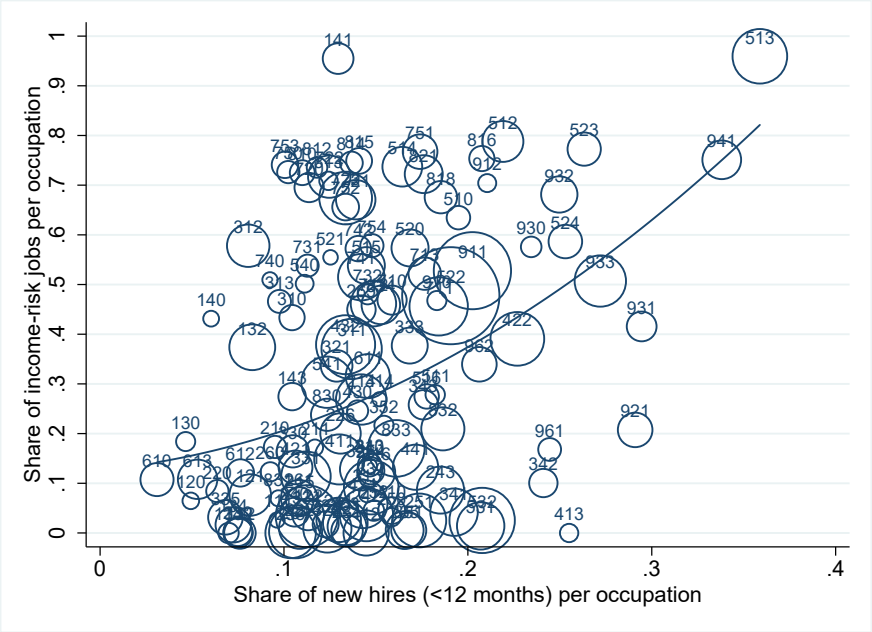
Figure 7: Correlation between turnover (% of new hires) and the share of migrants in each occupation



Source: EU-LFS (2018).

Note: Correlation based on the 136 ISCO-08 3-digit occupations that represent more than 0.1% of the total employment in the EU. The size of the circles represents the share of each occupation in the total employment in the EU. In grey, 95% confidence intervals are reported for comparison.

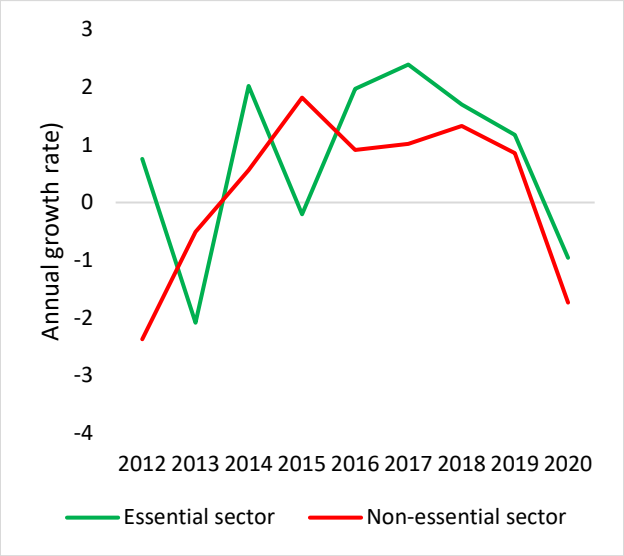
Figure 2: Correlation between turnover (% of new hires) and the share of income-risk jobs in each occupation



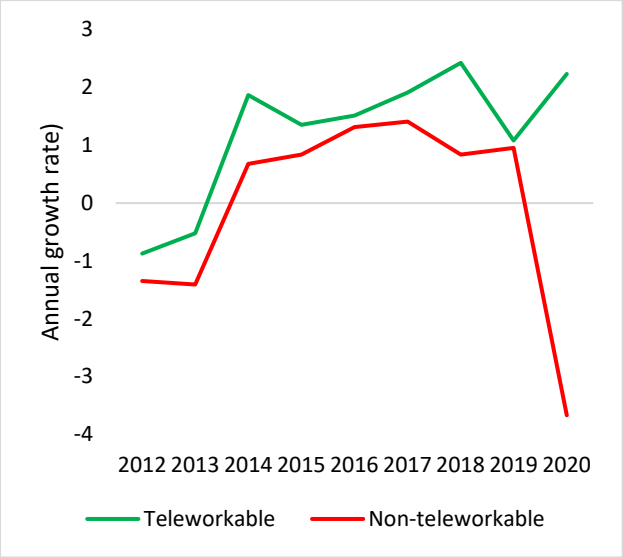
Source: EU-LFS (2018).
Note: Correlation based on the 136 ISCO-08 3-digit occupations that represent more than 0.1% of the total employment in the EU. The size of the circles represents the share of each occupation in the total EU employment.

Figure 9: Employment growth rates by ex-ante type of vulnerability jobs

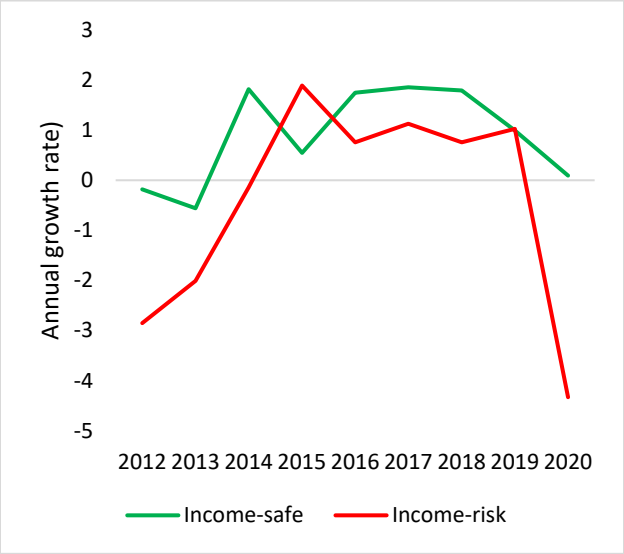
a. Essential Jobs



b. Teleworkable Jobs



c. Income-risk



d. Health-risk

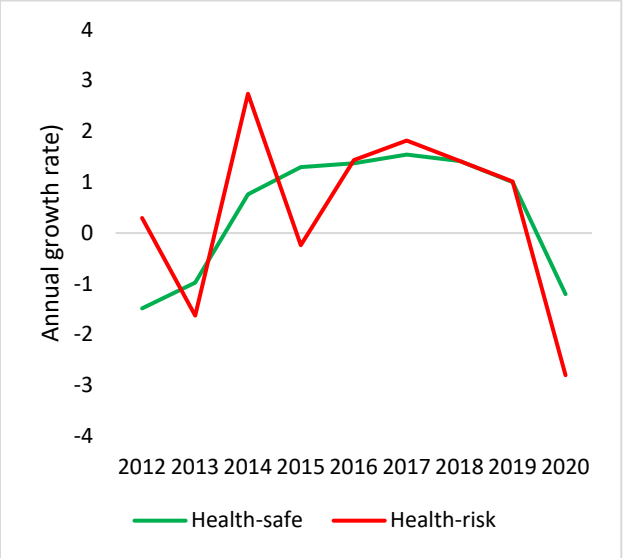


Figure 10: Oaxaca-Blinder decomposition explaining migrant-native gap in job losses in 2020 vs 2019

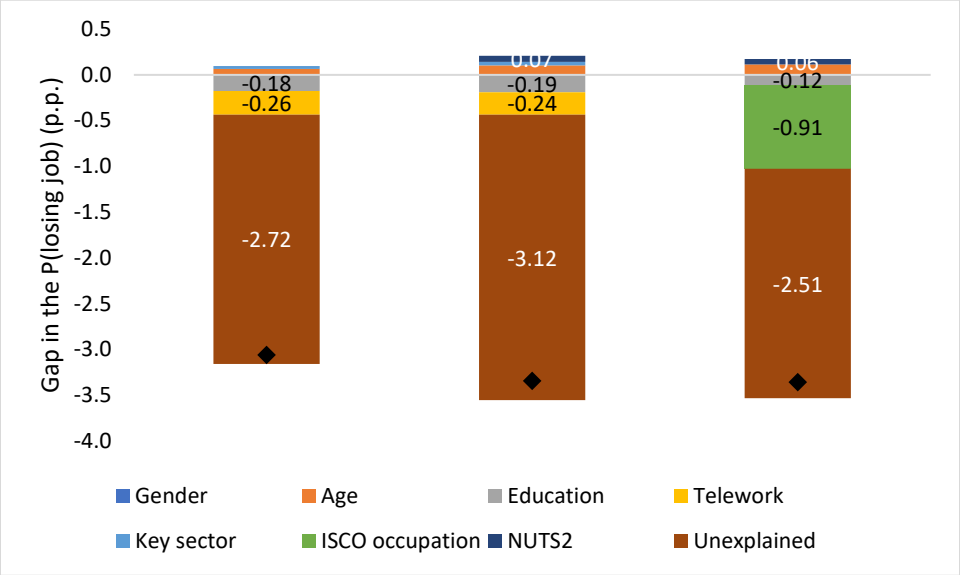
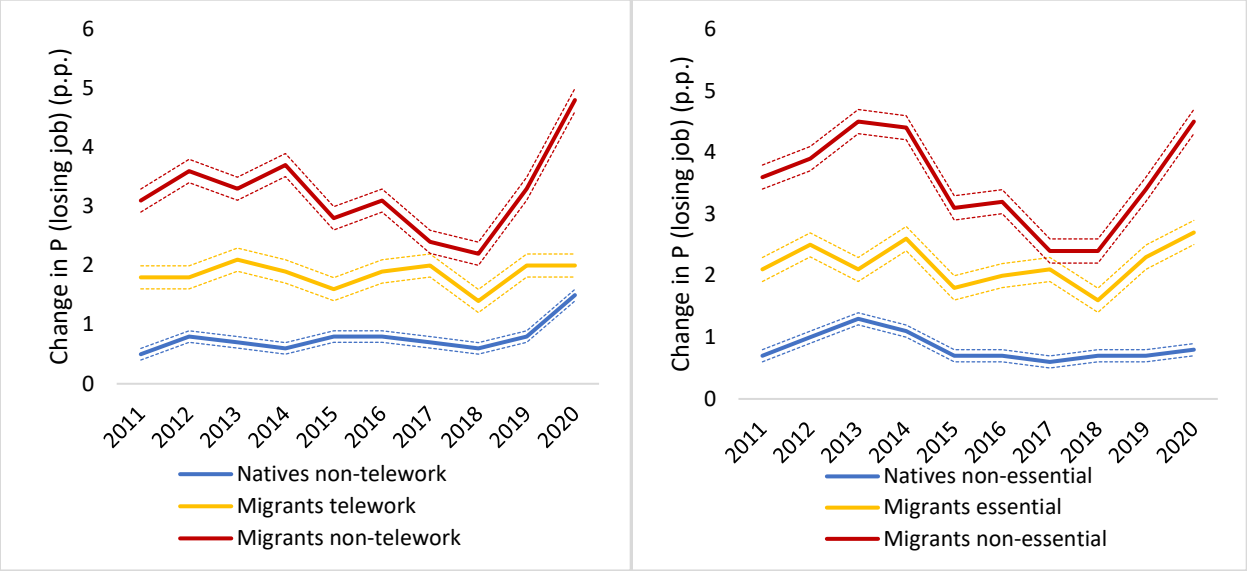


Figure 11: Change in the probability of losing a job by migration status and type of occupation

a. Teleworkability (baseline natives in telework jobs) b. Essential jobs (baseline natives in essential jobs)



c. Income-risk (baseline natives in income-safe jobs) d. Health-risk (baseline natives in health-safe jobs)

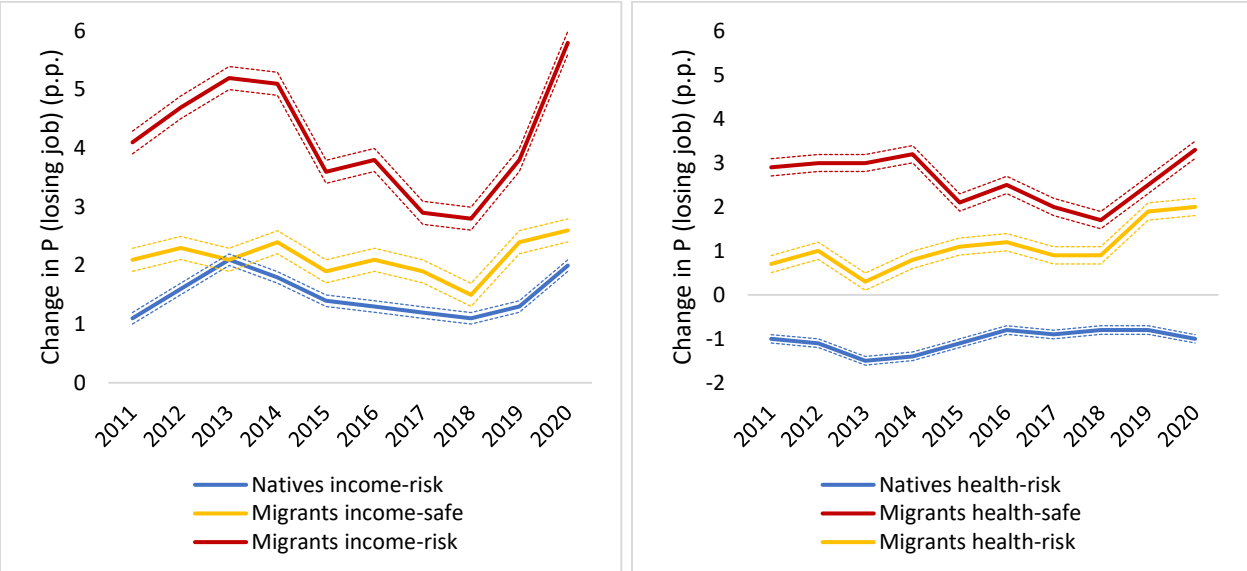


Table 1: Probability of having a safe job based on marginal effects of the multinomial logit

VARIABLES	Model 1: Raw gaps	Model 2: Raw gaps by origin	Model 3: Individual characteristics	Model 4: NUTS2 FE	Model 5: Language ability	Model 6: Barriers to certification	Model 7: Networks
Foreign born	-0.101***						
	(0.004)						
Origin: EU15		0.040***	0.013	-0.006	0.034***	0.033**	0.028*
		(0.009)	(0.009)	(0.009)	(0.095)	(0.010)	(0.016)
Origin: NMS13		-0.189***	-0.168***	-0.162***	-0.095***	-0.089***	-0.051**
		(0.007)	(0.008)	(0.009)	(0.012)	(0.012)	(0.019)
Origin: EFTA		-0.022	-0.032	-0.009	0.003	0.002	-0.023
		(0.026)	(0.028)	(0.028)	(0.028)	(0.028)	(0.058)
Origin: other Europe		-0.207***	-0.196***	-0.192***	-0.135***	-0.128***	-0.110***
		(0.008)	(0.008)	(0.008)	(0.011)	(0.012)	(0.018)
Origin: MENA		-0.086***	-0.068***	-0.085***	-0.027	-0.017	0.022
		(0.015)	(0.017)	(0.017)	(0.019)	(0.019)	(0.029)
Origin: Sub-Saharan Africa		-0.089***	-0.084***	-0.104***	-0.060***	-0.057***	-0.039
		(0.014)	(0.015)	(0.015)	(0.016)	(0.016)	(0.025)
Origin: Asia		-0.126***	-0.121***	-0.134***	-0.066***	-0.062***	-0.033
		(0.010)	(0.011)	(0.011)	(0.014)	(0.014)	(0.022)
Origin: LAC		-0.183***	-0.172***	-0.131***	-0.105***	-0.092***	-0.061**
		(0.011)	(0.012)	(0.013)	(0.014)	(0.014)	(0.022)
Origin: non-Europe OECD		0.215***	0.151***	0.130***	0.146***	0.150***	0.163***
		(0.020)	(0.023)	(0.023)	(0.023)	(0.023)	(0.033)
Age			0.005***	0.008***	0.008***	0.008***	0.006***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age^2			0.000***	-0.000***	-0.000***	-0.000***	-0.000***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male			0.032***	0.034***	0.034***	0.034***	0.034***
			(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Years of Education			0.053***	0.054***	0.054***	0.054***	0.055***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Language – advance					-0.065***	-0.060***	-0.058***
					(0.011)	(0.011)	(0.016)
Language – intermediate					-0.114***	-0.103***	-0.091***
					(0.013)	(0.013)	(0.019)
Language – beginner					-0.093***	-0.086***	-0.079***
					(0.018)	(0.018)	(0.024)
Barriers Certification						-0.161***	-0.171***
						(0.021)	(0.028)
Job through networks*Migrant							-0.060***
							(0.014)
Job through networks*Native							-0.063***
							(0.005)
Observations	395,284	395,284	394,291	394,291	393,300	393,300	373,350
R-squared	0.003	0.006	0.078	0.088	0.089	0.089	0.088
NUTS2 division FE	No	No	No	Yes	Yes	Yes	Yes
P(safe jobs)	0.452	0.451	0.460	0.465	0.465	0.465	0.472

Note: Robust standard errors are reported in parentheses; ***: p<0.01, **: p<0.05, *: p<0.1.

Table 2: Probability of having an income-risk job based on marginal effects of the multinomial logit

VARIABLES	Model 1: Raw gaps	Model 2: Raw gaps by origin	Model 3: Individual character.	Model 4: NUTS2 FE	Model 5: Language ability	Model 6: Barriers to certification	Model 7: Networks
Foreign born	0.013***						
	(0.004)						
Origin EU15		-0.055***	-0.032***	-0.001	-0.017	-0.017	-0.019
		(0.008)	(0.009)	(0.010)	(0.010)	(0.010)	(0.015)
Origin NMS13		0.084***	0.055***	0.061***	0.044***	0.044***	0.011
		(0.009)	(0.009)	(0.009)	(0.012)	(0.012)	(0.018)
Origin EFTA		0.002	0.017	0.015	0.011	0.011	0.052
		(0.025)	(0.027)	(0.027)	(0.027)	(0.027)	(0.053)
Origin other Europe		0.103***	0.082***	0.082***	0.069***	0.069***	0.035*
		(0.008)	(0.009)	(0.009)	(0.011)	(0.011)	(0.018)
Origin MENA		0.020	-0.026*	0.020	0.002	0.002	-0.028
		(0.015)	(0.016)	(0.017)	(0.018)	(0.018)	(0.026)
Origin Sub-Saharan Africa		-0.075***	-0.088***	-0.053***	-0.059***	-0.059***	-0.104***
		(0.013)	(0.013)	(0.014)	(0.015)	(0.015)	(0.021)
Origin Asia		0.041***	0.015	0.038***	0.022	0.022*	-0.005
		(0.011)	(0.011)	(0.012)	(0.014)	(0.013)	(0.020)
Origin LAC		-0.026**	-0.041***	-0.037***	-0.041***	-0.041***	-0.098***
		(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.018)
Origin non-Europe OECD		-0.156***	-0.098***	-0.076***	-0.084***	-0.084***	-0.092***
		(0.017)	(0.020)	(0.021)	(0.021)	(0.021)	(0.031)
Age			-0.012***	-0.013***	-0.013***	-0.013***	-0.012***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age^2			0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Male			0.089***	0.085***	0.085***	0.085***	0.080***
			(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Years of Education			-0.049***	-0.050***	-0.050***	-0.050***	-0.051***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Language – advance (reference category is mother tongue)					0.026***	0.023***	0.025
					(0.010)	(0.009)	(0.016)
Language – intermediate (reference category is mother tongue)					0.034***	0.031***	0.017
					(0.013)	(0.012)	(0.019)
Language – beginner (reference category is mother tongue)					0.038***	0.034***	0.019
					(0.017)	(0.016)	(0.023)
Barrier Certification						0.095***	0.115***
						(0.022)	(0.031)
Job through networks*Migrant							0.023*
							(0.013)
Job through networks*Natives							0.044***
							(0.005)
Observations	395,284	395,284	394,291	394,291	393,300	393,300	373,350
R-squared	0.003	0.006	0.078	0.088	0.089	0.089	0.088
NUTS2 division of residence FE	No	No	No	Yes	Yes	Yes	Yes
P(income-risk jobs)	0.368	0.369	0.358	0.356	0.356	0.356	0.353

Note: Robust standard errors are reported in parentheses; ***: p<0.01, **: p<0.05, *: p<0.1.

Table 3: Probability of having a health-risk job based on marginal effects of the multinomial logit

VARIABLES	Model 1: Raw gaps	Model 2: Raw gaps by origin	Model 3: Individual character.	Model 4: NUTS2 FE	Model 5: Language ability	Model 6: Barriers to certification	Model 7: Networks
Foreign born	0.089***						
	(0.004)						
Origin EU15		0.015**	0.019**	0.007	-0.017**	-0.016**	-0.009
		(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.011)
Origin NMS13		0.105***	0.114***	0.101***	0.065***	0.048***	0.040***
		(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.013)
Origin EFTA		0.020	0.014	-0.006	-0.014	-0.013	-0.029
		(0.023)	(0.023)	(0.021)	(0.020)	(0.020)	(0.037)
Origin other Europe		0.104***	0.114***	0.109***	0.065***	0.061***	0.076***
		(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.014)
Origin MENA		0.066***	0.095***	0.065***	0.025*	0.020	0.007
		(0.013)	(0.015)	(0.014)	(0.013)	(0.013)	(0.018)
Origin Sub-Saharan Africa		0.164***	0.171***	0.157***	0.118***	0.117***	0.143***
		(0.014)	(0.015)	(0.015)	(0.014)	(0.014)	(0.022)
Origin Asia		0.085***	0.106***	0.095***	0.044***	0.042***	0.037**
		(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.014)
Origin LAC		0.210***	0.213***	0.169***	0.146***	0.139***	0.159***
		(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.018)
Origin non-Europe OECD		-0.058***	-0.054***	-0.054***	-0.062***	-0.064***	-0.071***
		(0.014)	(0.015)	(0.015)	(0.014)	(0.014)	(0.019)
Age			0.006***	0.006***	0.006***	0.006***	0.006***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age^2			0.000***	0.000***	0.000***	0.000***	0.000***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male			-0.122***	-0.119***	-0.120***	-0.120***	-0.114***
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Years of Education			-0.004***	-0.004***	-0.004***	-0.004***	0.003***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Language – advance (reference category is mother tongue)					0.039***	0.037***	0.033***
					(0.008)	(0.003)	(0.011)
Language – intermediate (reference category is mother tongue)					0.080***	0.072***	0.074***
					(0.010)	(0.010)	(0.014)
Language – beginner (reference category is mother tongue)					0.055***	0.052***	0.060***
					(0.013)	(0.013)	(0.016)
Barrier certification						0.069***	0.056***
						(0.014)	(0.016)
Job through networks*Migrants							0.037***
							(0.009)
Job through networks*Natives							0.018***
							(0.004)
Observations	395,284	395,284	394,291	394,291	393,300	393,300	373,350
R-squared	0.003	0.006	0.078	0.088	0.089	0.089	0.088
NUTS2 division of residence FE	No	No	No	Yes	Yes	Yes	Yes
P(health-risk jobs)	0.180	0.180	0.182	0.179	0.179	0.179	0.175

Table 4: Drivers of job losses in Western Europe in 2020 vs 2019

Dependent variable: whether a person that was employed in 2019 lost the job in 2020 (1) or was still employed (0).

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Age 25-34	-0.008***	-0.008***	-0.007***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
Age 35-44	-0.033***	-0.034***	-0.032***	-0.034***
	(0.001)	(0.001)	(0.001)	(0.001)
Age 45-54	-0.043***	-0.044***	-0.042***	-0.044***
	(0.001)	(0.001)	(0.001)	(0.001)
Age 55-64	-0.008***	-0.009***	-0.006***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
Mid education	-0.010***	-0.014***	-0.011***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.001)
High education	-0.030***	-0.037***	-0.031***	-0.039***
	(0.001)	(0.001)	(0.001)	(0.001)
Male	-0.015***	-0.014***	-0.016***	-0.015***
	(0.001)	(0.001)	(0.001)	(0.001)
Native non-telework	0.015***			
	(0.001)			
Migrant telework	0.020***			
	(0.002)			
Migrant non-telework	0.048***			
	(0.001)			
Native non-essential		0.008***		
		(0.001)		
Migrant essential		0.027***		
		(0.001)		
Migrant non-essential		0.045***		
		(0.001)		
Native income-risk			0.020***	
			(0.001)	
Migrant_income-safe			0.026***	
			(0.001)	
Migrant_income-risk			0.058***	
			(0.001)	

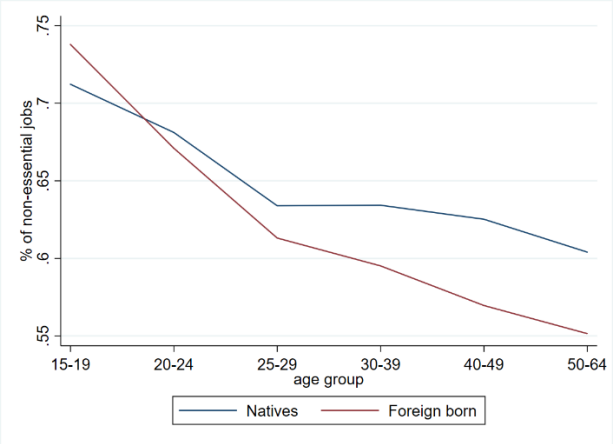
Native health-risk				-0.010***
				(0.001)
Migrant health-safe				0.033***
				(0.001)
Migrant health-risk				0.020***
				(0.001)
Constant	0.109***	0.116***	0.111***	0.124***
	(0.002)	(0.002)	(0.002)	(0.002)
Observations	766,427	766,427	766,427	766,427
R-squared	0.025	0.025	0.026	0.025
NUTS2 FE	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

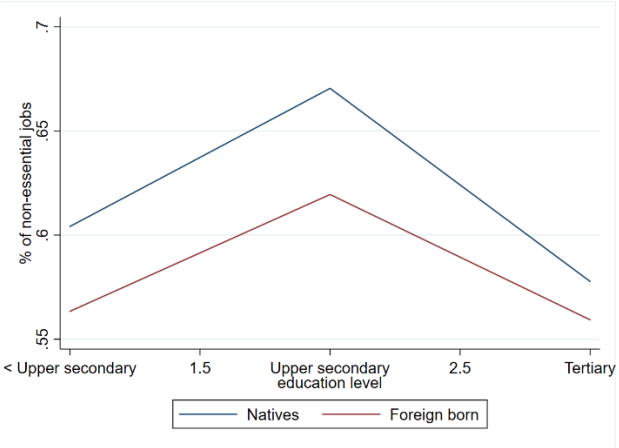
APPENDIX 1. Additional Figures

Figure A3: Share of non-essential jobs in the EU by age group, income decile, education level and nativity

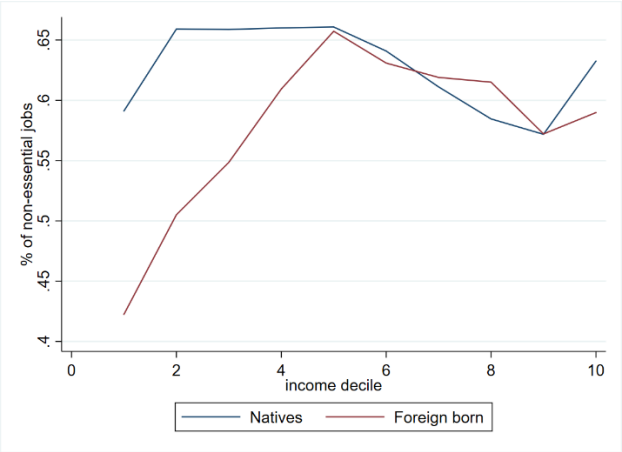
Panel a. By age group



Panel b. By education levels

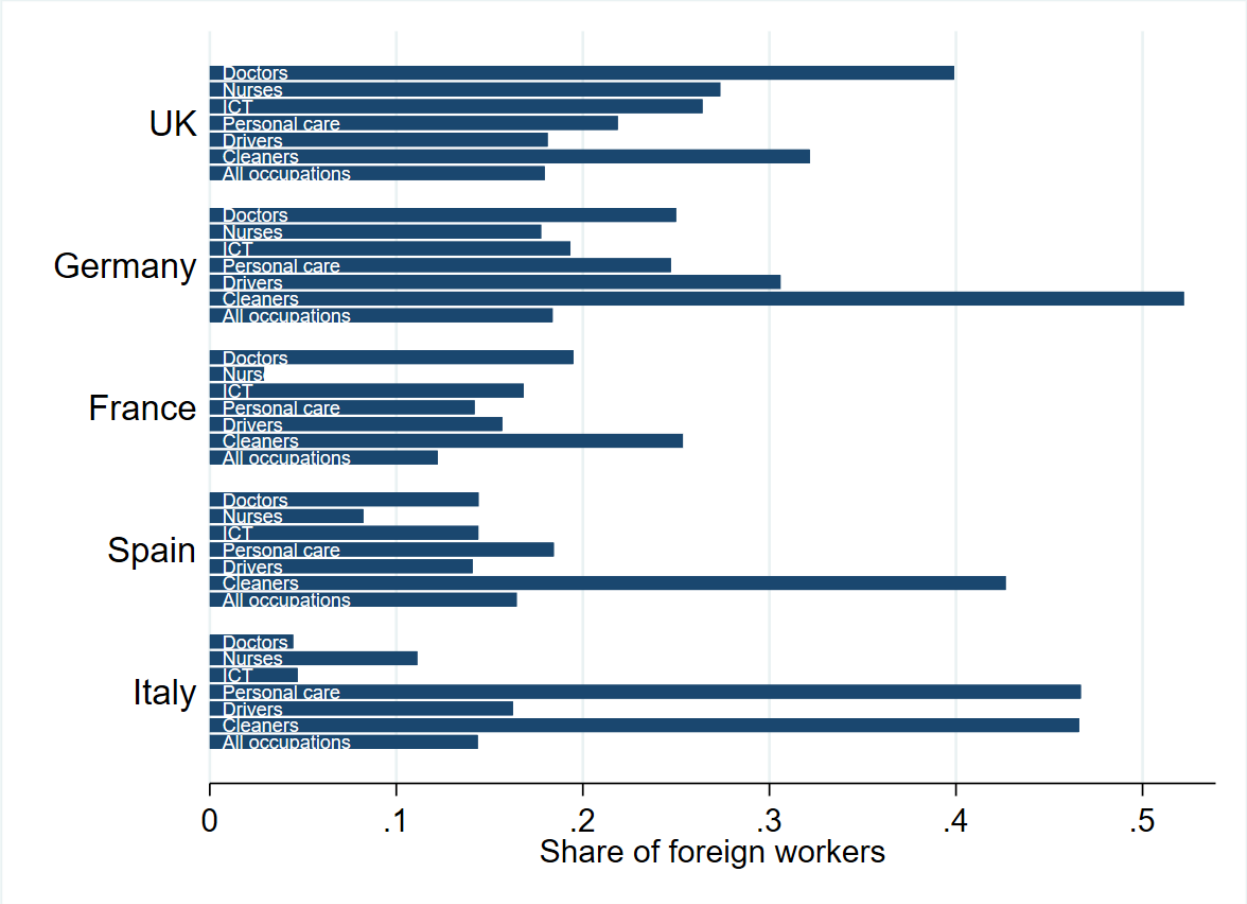


Panel c. By income decile



Source: Own calculation based on EU-LFS 2018 data, following EC directive (2020) and Fasani and Mazza (2020a).

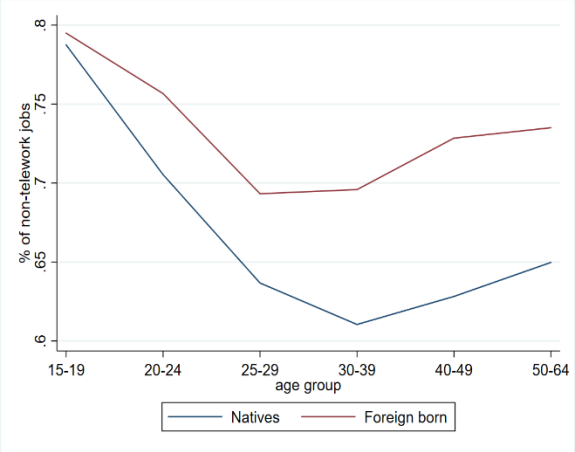
Figure A4: Share of foreign workers in some essential occupations by main country of residence



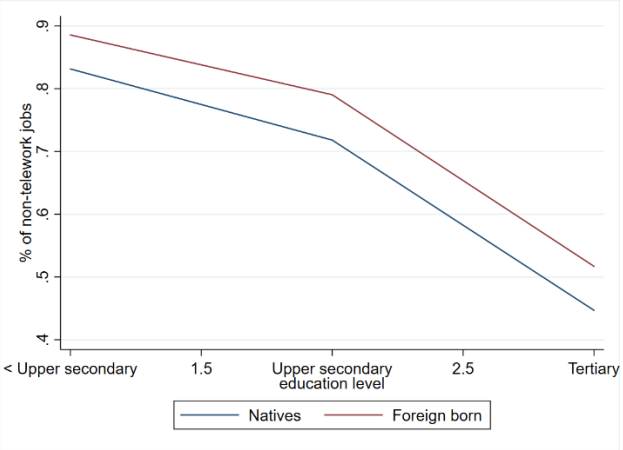
Source: Own calculation based on EU-LFS 2018 data.

Figure A3: Share of non-teleworkable jobs in the EU by age group, income decile, education level and nativity

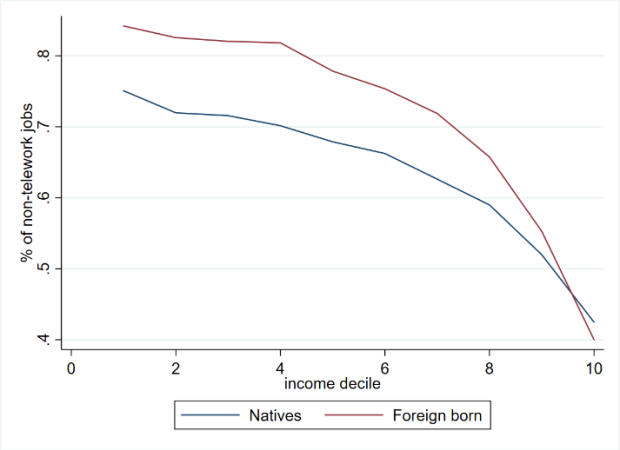
Panel a. By age group



Panel b. By education level



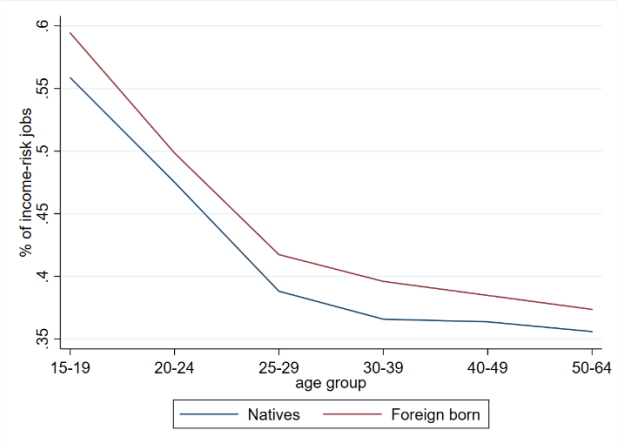
Panel c. By income decile



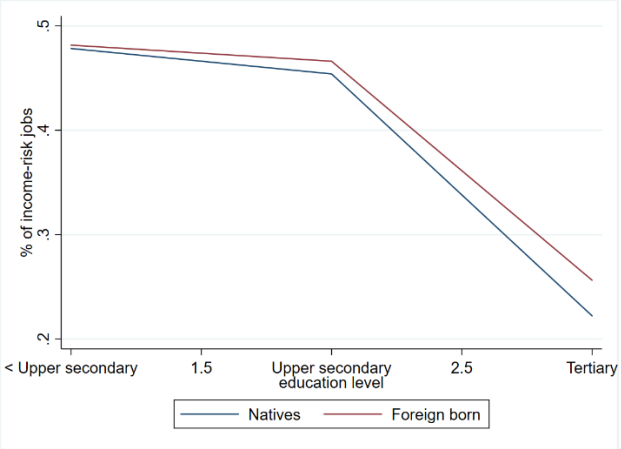
Source: Own elaboration based on data from the 2018 EU-LFS and following Dingel and Neiman (2020) methodology.
Note: 95% confidence intervals are included for comparison.

Figure A5: Share of jobs exposed to income risks (non-essential and non-teleworkable)

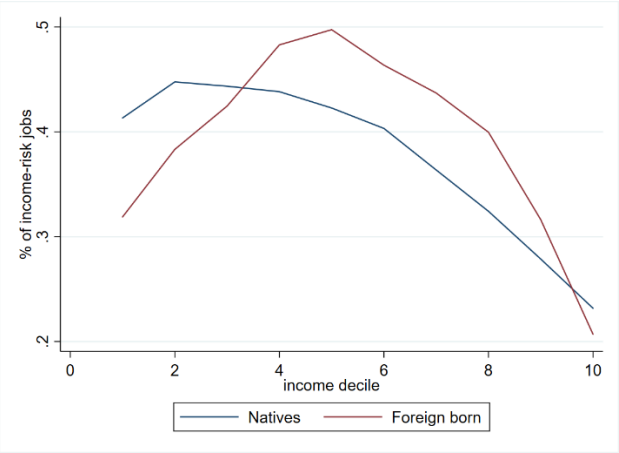
Panel a. By age group



Panel b. By education level

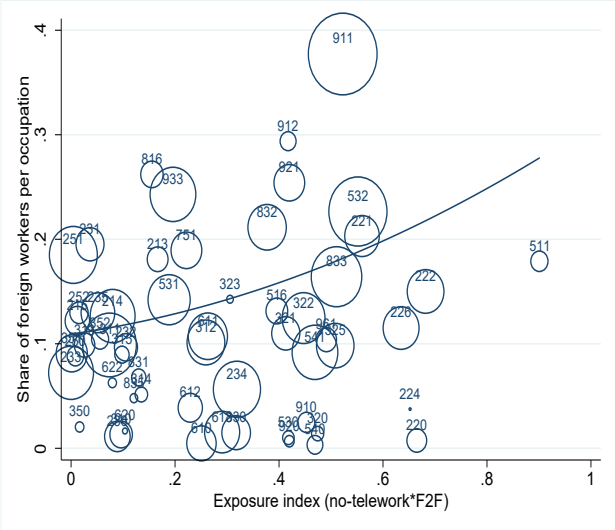


Panel c. By income decile



Source: Own elaboration based on data from the 2018 EU-LFS and combining Dingel and Neiman (2020), Rio-Chanona et al (2020) and Avdiu and Nayyar (2020) methodologies.
Note: 95% confidence intervals are included for comparison.

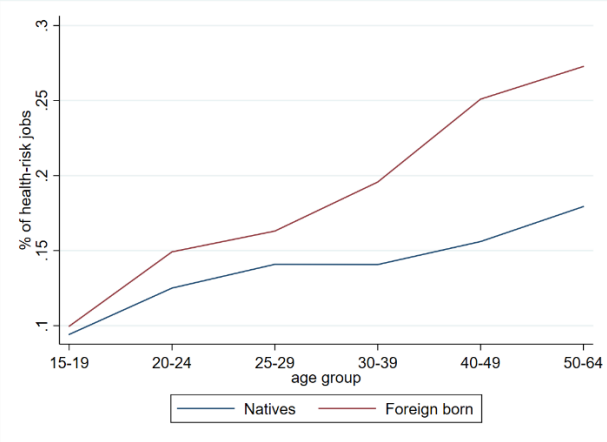
Figure A6: Share of migrants in essential jobs by health exposure



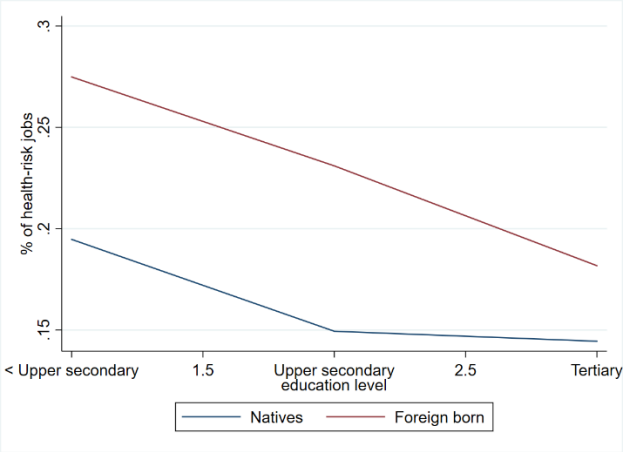
Source: Own elaboration based on data from the 2018 EU-LFS and combining Dingel and Neiman (2020), Rio-Chanona et al (2020) and Avdiu and Nayyar (2020) methodologies.
Note: The exposure index is the combination of the share of jobs not amenable to telework in each 3-digit occupation and the intensity of face-to-face interactions. The size of the circles represents the share of each occupation in the total employment in the EU.

Figure A7: Share of jobs with health risks by age group, education and income levels

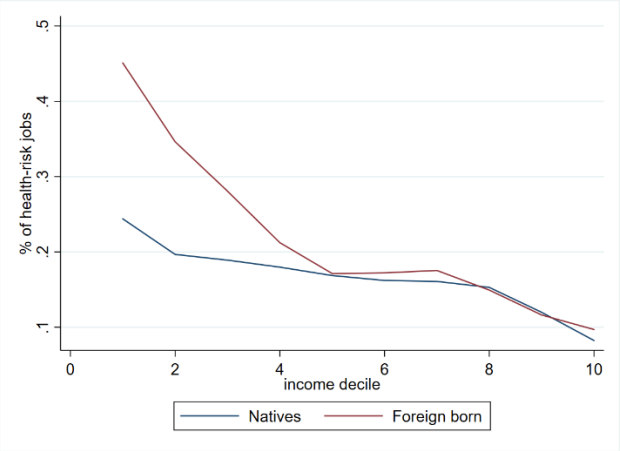
Panel a. By age group



Panel b. By age group



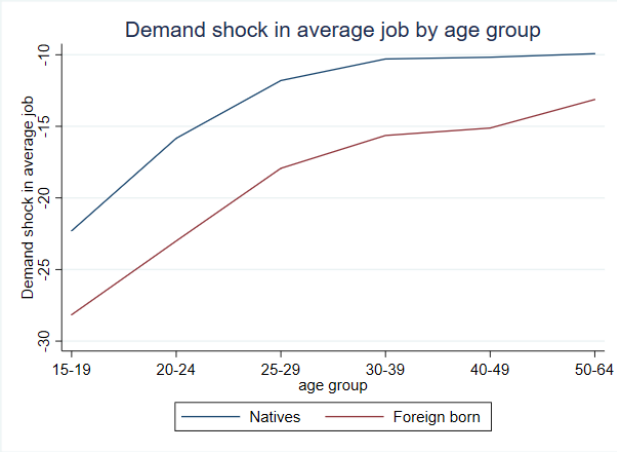
Panel c. By income decile



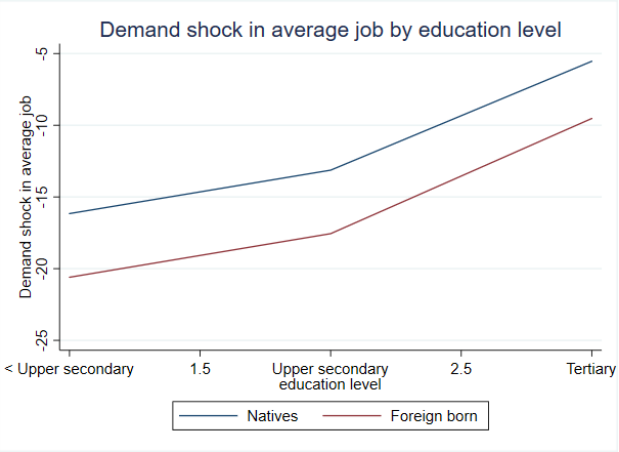
Source: Own elaboration based on data from the 2018 EU-LFS and combining Dingel and Neiman (2020), Rio-Chanona et al (2020) and Avdiu and Nayyar (2020) methodologies.

Figure A7: Demand shock across age groups, education levels, income and nativity

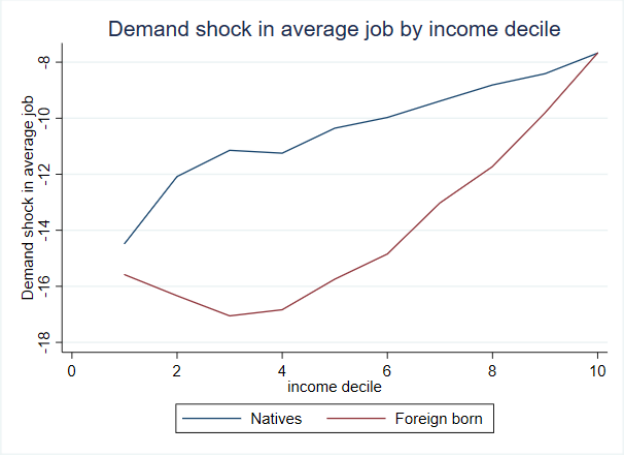
Panel a. By age group



Panel b. By education level



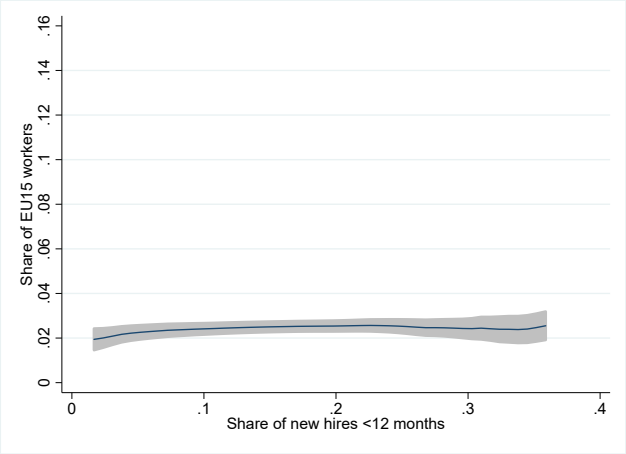
Panel c. By income decile



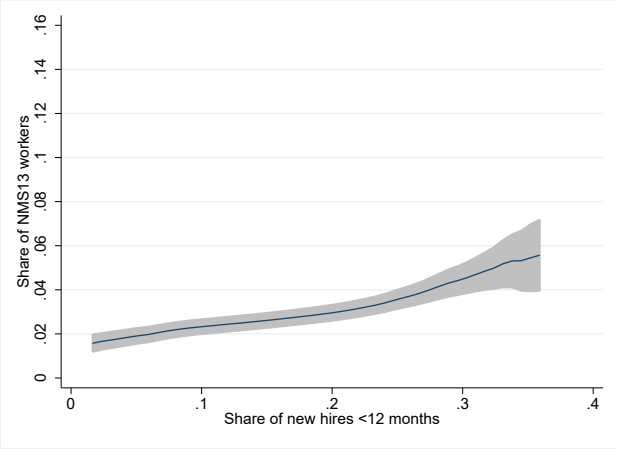
Source: EU-LFS (2018).

Figure A8: Correlation between turnover (% of new hires) and the share of migrants in each occupation for migrants from different regions

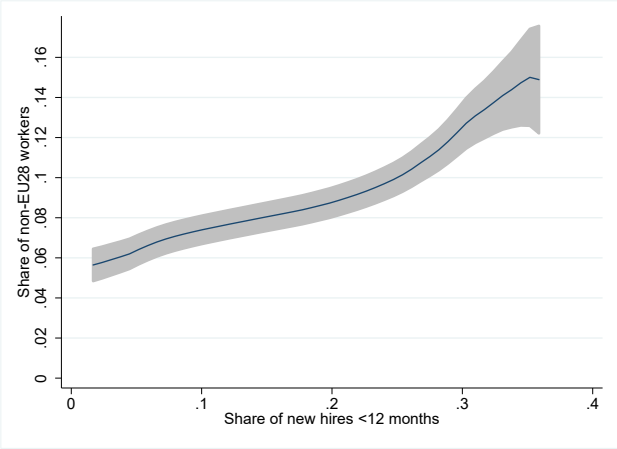
Panel a. EU15 migrants



Panel b. NMS migrants



Panel c. Non-EU28 migrants



Source: EU-LFS (2018).

Note: Correlation based on the 136 ISCO-08 3-digit occupations that represent more than 0.1% of the total employment in the EU. The size of the circles represents the share of each occupation in the total employment in the EU. In grey, 95% confidence intervals are reported for comparison.

Appendix 2: The role of networks in explaining migrants' occupational choices

To better understand the role of networks of co-national migrants in the occupational choices of migrants, we estimate the following regression using two different waves of the EU-LFS:

$$\text{Log(pct\_migrant\_2018)}_{cok} = \alpha + \beta \log(\text{pct\_migrant\_2005})_{cok} + \eta_c + \Omega_o + \varphi_k + \varepsilon_{cok} \qquad (2)$$

where $\log(\text{pct\_migrant\_2018})_{cok}$ is the logarithm of the percentage of migrants in 2018 in each ISCO 3-digit occupation *c* that are from the region of origin *o* in NUTS2 division of destination *k*. $\text{Log(pct\_migrant\_2005)}_{cok}$ is the logarithm of the share of migrant population from region of origin *o* in each occupation *c* residing in NUTS2 division of residence *k* in 2005. Ω_o is a vector of regions of origin *o* (native, EU15, NMS13, EFTA, Other European countries, MENA, Sub-Saharan Africa, Asia, Latin America and non-Europe OECD countries); η_c is a vector of dummy variables for each ISCO 3-digit occupation; and φ_k is a vector of dummy variables for each NUTS2 division of residence $_K$. In order to avoid overlapping of migrants in the two periods, we restrict the sample of migrants in 2018 to those that arrived within the previous ten years.

Migrant networks are particularly strong among co-nationals in the same area of residence. We run the OLS regression in equation (2) in which the cell of analysis is the ratio of migrants from world region of origin *o* to native in NUTS2 division of residence *k* working in occupation *c*. The results of this regression analysis show a strong path dependence in occupational choices of migrants even after controlling for occupation, region of origin and NUTS2 division of residence fixed effects (Table A1). Our preferred regression includes all occupations – even those without a single migrant – and origin region, host NUTS2 division and occupation fixed effects. The results (Column 2) show that a 1 percent increase in the share of co-national migrants in an occupation in 2005 is associated with a 0.13 percent increase in the share of new migrants in that occupation in 2018.

Table A1: Regression analysis on the role of networks in occupational choices of migrants in the EU

Dependent variable: log (% of migrants in 2018) per 3-digit occupation, nuts2 division of residence and region of origin	Model 1 (OLS)	Model 2 (OLS)	Model 3 (OLS)	Model 4 (OLS)
Log(% migrants in 2005)	0.188***	0.127***	0.0828***	0.0344***
	(0.00539)	(0.00518)	(0.00628)	(0.00611)
Constant	-6.983***	-6.529***	-3.830***	-2.944***
	(0.0472)	(0.129)	(0.0421)	(0.256)
Observations	92,294	92,294	8,439	8,439
R-squared	0.060	0.262	0.041	0.500
NUTS2 division of residence FE	NO	YES	NO	YES
Region of origin FE	NO	YES	NO	YES
ISCO 3-digit Occupation FE	NO	YES	NO	YES
Including occupations with no migrants	YES	YES	NO	NO

Note: Robust standard errors are reported in parentheses; ***: p<0.01, **: p<0.05, *: p<0.1.

Appendix 3: Labor demand and share of migrants per occupation

In order to formally assess the link between labor demand and the prevalence of migration in each occupation we estimate the following regression:

$$\text{Log(pct\_migrants)}_{ck} = \alpha + \beta \log(\text{pct\_new\_hires})_{ck} + \eta_c + \varphi_k + \varepsilon_{ck} \quad (3)$$

where $\log(\text{pct\_migrants})_{ck}$ is (the natural logarithm of) the percentage of migrants in 2018 in each ISCO 3-digit occupation *c* in UTS2 region of residence *k*. $\text{Log(pct\_new\_hires)}_{ck}$ is the logarithm of the share of new hires migrant population from origin region *o* in each occupation *c* residing in NUTS2 division *k* in 2005; η_c is a vector of dummy variables for each ISCO 3-digit occupation; and φ_k is a vector of dummy variables for each NUTS2 division of residence $_K$.

The results of the above regression in Equation 3 are reported in Table A2. The strong relationship between labor demand and the share of migrants per occupation in the EU holds even when we control for ISCO-08 3-digit occupation and NUTS2 region of residence fixed effects (Column 3). In particular, a 1 percent increase in the share of new hires in an occupation in a given NUTS2 division –which we use as a proxy for the dynamism of the labor demand– is associated with a 0.02 percent increase in the share of migrants per occupation. The coefficient is statistically significant at the 1 percent level.

Table A2: Regression analysis on the role of labor demand in occupational choices of migrants in the EU

Dependent variable: Log (% of migrants) per 3-digit occupation and NUTS2 division in 2018	Model 1 (OLS)	Model 2 (OLS)	Model 3 (OLS)
Log (% new_hires (<1 year))	0.102***	0. 089***	0.020***
	(0. 003)	(0.003)	(0.003)
Constant	-1.793***	-1.883***	-2. 675***
	(0.012)	(0.112)	(0.678)
Observations	23,803	23,803	23,803
R-squared	0.066	0.147	0.408
NUTS2 division of residence FE	NO	YES	YES
ISCO 2-digit Occupation FE	NO	NO	YES

Note: Robust standard errors are reported in parentheses; ***: p<0.01, **: p<0.05, *: p<0.1.