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The Effect of Immigration on Occupational Injuries: Evidence from Administrative Data*

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Abstract

The task specialization literature suggests that migrant workers concentrate on physically intensive occupations, pushing natives towards less-risky jobs. What is the effect of immigration on the severity of work-related injuries? By matching administrative data on work-related injuries and residence registries in Italy, this paper shows that migrant inflows lead to a reduction of physical impairment and injury-related paid sick leave for native workers, independently from occupation and sector transitions. The effect is largest in manufacturing and construction and among the eldest employees. The analysis exploits spatial and temporal variation in foreign-born residents' province shares and an instrumental variable strategy based on historical co-national local settlements. To rationalize the underlying mechanism, we show that migrant workers sort into risky occupations and we study workforce composition effects. We rule out that the effect is due to higher unemployment among natives with lower education, more exposed to injury risks, or to native workers' local migration. Longitudinal worker-level data from the Labor Force Survey show that native workers' transitions between sectors and occupations in response to immigration are not significant. Hence, our results suggest that the reduction in injury severity may result from a reallocation of riskier *tasks* from native workers, especially of older ages, to migrant workers, even when occupational transitions do not occur.

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I. Introduction

Across surveys, up to 30% of respondents in the USA and Europe considered immigration to be the most critical problem in their country, before the recent pandemic outbreak (Eurobarometer, 2019; Gallup, 2019). The consequences of immigration are a pressing topic in the public debate. Misperceptions about the size of population inflows and their impacts on host economies' labour markets foster anti-immigration populistic sentiments (Alesina, Miano, and Stantcheva, 2018; Dustmann, Vasiljeva, and Piil Damm, 2018; Edo *et al.*, 2019; Grigorieff, Roth, and Ubfal, 2020). This paper adds to the existing literature on immigration by focusing on a specific aspect of the labour market that has not received much attention: occupational health safety. While there has been a significant amount of research on the impact of immigration on various aspects of the labour market, such as wages, employment rates, and working conditions, there has been relatively little research on the effects of immigration on workplace health and safety. By examining this issue, the paper sheds light on an important area of concern for policymakers, workers and employers alike. It is well established that workplace injuries and illnesses can have significant economic and social costs, both for individuals and for the society as a whole.

On average, countries spend up to 4% of the GDP on work-related accidents and illnesses (Arbeitsamt *et al.*, 2018; Tompa *et al.*, 2019). Beyond direct compensations and medical expenses, the private and public costs of injuries and sick leave include forgone productivity and profits, higher insurance premium payments, opportunity costs, and a limited income-generating capacity for permanently impaired workers. Hence, understanding whether immigration can have an effect on native workers' occupational injuries is important. Do increasing migrant inflows contribute to reducing the severity of impairment and shortening paid sick leave among host countries' native workers?

According to the task specialization literature, natives and migrants have different comparative advantages in abstract versus physically intensive occupations (Peri and Sparber, 2009; Ottaviano and Peri, 2012; D'Amuri and Peri, 2014). Because of limited institutional and language-specific knowledge, migrant workers with low education tend to concentrate on physically intensive occupations (Ronda Pérez *et al.*, 2012; Hargreaves *et al.*, 2019). In response to a higher migrant labour supply, natives have the incentive to shift towards jobs with higher institutional-specific content (Foged and Peri, 2016), which imply a lower exposure to injury risks (Giuntella *et al.*, 2018). We hypothesize that a similar mechanism applies to specific tasks, even in absence of occupational transitions. Newly arrived migrants may select into hazardous tasks because of different risk perception (Jaeger *et al.*, 2010), positive selection in terms of initial health endowments – that is, the 'healthy immigrant effect' (Chiswick, Lee, and Miller, 2008; Kennedy *et al.*, 2015), and limited outside options (Orrenius and Zavodny, 2009, 2012). As a consequence of migrant workers' uptake of riskier tasks, exposure to severe impairments for native workers may decrease.

This paper shows that immigration causes significant reductions in the severity of work-related accidents for native workers. In particular, using administrative data at the injury level from the Italian National Institute for Insurance against Accidents at Work (INAIL), this paper analyses a doctor-assessed measure of impairment severity (a standardized index of physical health impairment), and the number of doctor-prescribed

days of post-injury sick leave. By linking INAIL data with local residence registries, the analysis exploits variation in the share of migrants in the population across provinces and over time. To address the concern that the location of migrants may be endogenous with respect to labour market conditions, which correlate with workplace health safety, we use an 'enclave' or network-based instrument (Altonji and Card, 1991; Card, 2001). This methodology imputes province shares of foreign-born residents from the historical distribution of co-nationals across the territory and aggregate inflows by country of origin. We include province-specific and time fixed-effects and time-varying labour market characteristics, as well as lagged versions of the instrument to account for possible conflations of short and long-term effects (Jaeger, Ruist, and Stuhler, 2018).

This paper makes several contributions to the literature. First, it focuses on an under-unexplored area: the effect of immigration on the severity of work-related accidents and on occupational injury paid sick leave. While there has been growing attention to the over-representation of migrant workers in dangerous and demanding jobs (see Moyce and Schenker, 2018, Salvatore *et al.*, 2013, and Orrenius and Zavodny, 2009 for a review), research on its consequences for native workers' health is limited. Dillender and McInerney (2020) focus on a specific ethnic group and show that Mexicans in the USA contribute to overall workers' health safety.

Second, we use insurance claims data to assess the impact of immigration on the severity of injuries, which is distinct from previous studies that looked at transitions to different occupations. This approach has not been previously used in this area of research. It provides the opportunity to show that migrant inflows can improve native workers' occupational health even if they do not change jobs. While the literature agrees that native workers tend to move to more abstract and less risky occupations in response to immigration, there is no such evidence for the impact of immigration on workers that do not change jobs. This is particularly relevant for economies with low occupational transition rates. This is the main contribution of our work and represents a novel research question. Giuntella and Mazzonna (2015) show that native-born residents of Germany, especially low-skilled, self-report improved health and lower disability in areas with more immigration. However, they do not study occupational injuries. A related paper by Giuntella *et al.* (2018) showed that medium-skilled native workers in the UK moved to less physically intensive jobs in response to immigration, but their identification strategy does not allow them to analyse the impact for workers that did not change occupations. Conversely, by using administrative data at the injury level, our paper can show the causal effect of immigration on injuries even if workers do not change occupations.

Further, our analysis relies on objective doctor-assessed health outcomes, which are free from recall bias and self-reporting bias that may instead hamper analyses based on survey data. The way in which survey respondents self-report their health outcomes may be affected by omitted factors that correlate also with their proximity to migrants and, hence, lead to a biased estimation of the results. For example, Akay, Constant, and Giulietti (2014) show that natives report higher self-perceived well-being in regions with higher migrant inflows.

The results of our analysis show that a one standard deviation (SD) increase in the share of migrants over a province's population (3.8%) reduces native workers' prescribed sick leave by three and half days (11%, relative to a baseline mean of 32.5 days) and

the index of physical impairment by 0.28 points, or 6% of a SD. Our estimates likely represent the combined impact of the presence of workers with and without regular immigration status, whose spatial distributions are closely related (Bianchi, Buonanno, and Pinotti, 2012; Bratti and Conti, 2018). Readers should thus interpret the results as the effect of overall migration rather than only regular migration. Using worker-level labour force survey longitudinal data between 2009 and 2013, we show that native workers' transitions between occupations in response to immigration are not significant. This evidence supports the hypothesis that, as newly arrived migrants sort into riskier tasks (Peri and Sparber, 2009), native colleagues shift to less dangerous and demanding tasks and this reduces their injury risk exposure.

We provide evidence in support of a within-job task-reallocation mechanism in several ways. First, we match occupations with the Occupational Information Network (O*NET) index of exposure to hazardous conditions and the Occupational Physical Intensity (OPI) index (Kroll, 2016). Controlling for individual-level socio-demographic characteristics, we show that migrant workers have a 15%–17% higher exposure to injury risk than natives according to both measures. We also show that migrants experience a higher number of injuries per worker than natives, on average. This confirms that migrant workers concentrate in risky occupations, where their presence may be more relevant in terms of injury severity for native workers. Further, we find that the reduction in severity is highest among the eldest native workers (aged 50–65), while it is not significant among young ones (16–25). The largest effects occur in the manufacturing and construction sectors. This suggests that elder workers are more likely to shift away from physically intensive and riskier tasks than younger natives with fewer years of experience and better physical health endowments, and that immigration can provide an opportunity for native workers to avoid riskier tasks, especially in physically strenuous and hazardous sectors.

Next, we rule out two alternative possible explanations related to workforce composition effects. First, immigration may cause higher unemployment among less-educated natives, who are generally employed in physically hazardous jobs and who compete more directly with migrants (Edo and Rapoport, 2019). An increase in low-educated native workers' employment could 'mechanically' decrease injury severity. Second, native workers may move out of provinces that receive higher migrant inflows to avoid the increased labour market competition (Borjas, 2006; Mocetti and Porello, 2010). To test these mechanisms, we complement the analysis with labour force survey data. The results support their exclusion. In particular, we rule out that the reduction in injury severity is due to higher unemployment among low-skilled natives in riskier occupations. We also find no significant evidence that higher immigration determines increasing movements of native workers across areas.

Finally, the overall welfare effect of immigration on occupational health depends on whether the severity of injury increases or decreases for the entire population, which includes natives as well as migrant workers. If the reduction in injury severity for native workers was over-compensated by more critical accidents among migrant workers, net welfare effects would be negative. To investigate this, we repeat our main analyses including all injuries and migrant-specific injuries. A one SD increase in the share of migrants by province reduces the average severity of injury in the entire working population of Italy by 3.18 sick leave days (9% of the mean) and 0.25 degrees of impairment, or 0.06

SDs. Among migrants, coefficients are of the same sign but not statistically significant. The results show a Pareto-improving effect on the overall population's occupational injury severity.

The remainder of the paper is structured as follows. Section II introduces the background on immigration and on the regulation of work-related injuries in Italy. Section III describes the data. Section IV illustrates the empirical strategy, followed by the results in section V and a discussion of the mechanisms in section VI. Section VII concludes.

II. Background and context

Immigration

Immigration has been increasing rapidly in Italy in the past decade. The share of working-age migrants (16–65) grew from 7% of the native population in 2009 to more than 10% as of 1 January 2017. The largest nationality groups included Romania, Albania, Morocco, China, Ukraine and the Philippines. Most immigrant workers in Italy have low education and work in low-paid occupations (Bratti and Conti, 2018).[1]

Work-related injuries

The institution in charge of insurance and compensations for work-related injuries in Italy is the National Institute for Insurance against Accidents at Work (INAIL), overseen by the Ministry of Labour and Social Policies. According to Italian Law, injured workers are visited by a doctor that writes a medical certificate with a detailed description of the impairment and prescribes the appropriate number of sick leave days. Employers are obligated to report all accidents that cause at least one day of absence within 48 hours of receipt of the medical certificate, and all fatal accidents within 24 hours. This applies also to privately insured companies and the public sector.[2] INAIL assigns to each injury a degree of impairment using functional and anatomical loss coefficient weights.[3] INAIL formally verifies that the injury occurred at work or for work-related reasons.

III. Data

This study combines (i) administrative data from the insurance claims registry of work-related injuries collected by INAIL, (ii) Italian Labor Force Survey (LFS) data[4], (iii) longitudinal individual-level data from a panel subset of the Italian LFS (2009–13), and (iii) registries of foreign-born and native residents by province, for the years 2009–16.

[1] Some studies in the epidemiological literature show that migrants are highly exposed to hazardous health conditions at work (Salvatore *et al.*, 2013; Bena and Giraudo, 2014; Giraudo, Bena, and Costa, 2017).

[2] Sanctions for notification delays range between 548 (the lowest amount for 1-day accidents) and 4,932 euros (maximum for injuries with more than three days of absence) https://www.inail.it/cs/internet/attivita/prevenzione-e-sicurezza/promozione-e-cultura-della-prevenzione/comunicazione-infortunio.html

[3] The index is defined in the tables in the attachment to the Legislative Decree n.38/2000, approved in the Ministerial Decree of 12 July 2000.

[4] Prior to 2009, the province of residence of survey respondents is missing.

Migrant shares in 1992 are included as baseline year for the construction of the 'shift-share' instrument (see section IV).[5]

INAIL's administrative data contains basic demographic characteristics of the injured workers (age, gender, country of birth), work location (province), sector (three digits), date of occurrence, prescribed days of absence from work due to the injury, and the degree of impairment index established by INAIL.[6] We limit the sample to the working-age population, 16–65 years old.

Main outcomes

This study uses individual worker-level injuries as units of analysis. As main outcomes, we analyse two measures of the severity of work-related accidents: (i) the number of days of sick leave assessed by a doctor, and (ii) the degree of impairment established by INAIL's scheme, re-scaled to range between 0 and 100 (zero meaning absence of permanent impairments and 100 the maximum degree of permanent impairment).

Additionally, as a secondary outcome, we also analyse (iii) injury rates, which we compute as the total number of injuries occurring to native workers in a province and year, divided by the number of native workers of that province. The denominator of the injury rate measure is computed from the LFS.[7] Only for this third outcome, the unit of observation is the province-year, with a sample that is representative of the native population thanks to survey weights. Due to its sampling design, the LFS is not representative of migrant workers by province.[8]

Explanatory variable

As explanatory variable, we compute the share of foreign-born working-age residents among the total working-age population of a province p in year t (based on ISTAT's registry data on municipal residence) as follows:

$$\text{MIG}_{p,t} = \frac{\text{Number of foreign-born immigrants}_{p,t}}{\text{Number of total residents}_{p,t}} \times 100. \quad (1)$$

Residence registries include only regular immigration and there are no official counts of migrants without a regular permit by province. This implies that our analysis focuses only on legal migrants and potentially omits the effect of illegally residing foreign-born workers. However, as highlighted by Bratti and Conti (2018) and Bianchi *et al.* (2012),

[5]Because information on foreign-born residents by province and country of origin in 1992 is not broken down by gender, we pool men and women together.

[6]We exclude injuries under evaluation or rejected as not work-related.

[7]Note that it is not possible to estimate the impact of immigration on the probability to incur in an injury at the individual level because, while we do observe each injury occurring in a year, we do not have individual-level observations for non-injured workers as a counterfactual. Injury data from INAIL are not matched with social security data due to privacy laws. Hence, we rely on the injury rate using the province as a unit of analysis. Conversely, we can analyse the severity of injury at the individual level as it does not require data on non-injured workers.

[8]This sampling scheme does not allow us to calculate employment shares nor injury rates for migrants at this subnational administrative level.

the spatial distribution and the share of irregular migrants in Italy follow closely those of regular migrants, both within provinces and over time.[9] This mitigates the concern that the omission of illegal migrants may bias the results.

Unfortunately, we are not able to use the local labour market data as opposed to the province level (NUTS3). Provinces could include multiple local labour markets, and the results obtained may not reflect the change in each local labour markets making our results less precise for each area.

Individual-level data on transitions between sectors and occupations

ISTAT produces a longitudinal version of the LFS by re-interviewing half of the individuals surveyed in a quarter after 12 months. Until 2010, the survey includes only data for the first calendar quarter. We keep this design across the following years, for consistency. The longitudinal LFS reports the province of residence until the first trimester of 2013. From this source, we extract data on age, country of birth, province of residence, and we track labour market outcomes such as a four-digit activity code and four/two-digit occupations, used to compute yearly transitions over time within workers.

Physical intensity index

We compute occupation-specific degrees of physical intensity and exposure to health risks by combining three-digit occupation-specific codes from the Labour Force Survey (ISCO classification) with two indexes. The first is the occupational physical intensity exposure (OPI) index that ranges between zero and ten by increasing intensity (Kroll, 2016). The OPI index classification is based on working conditions such as, for example exposure to gas emissions, dust, working in extreme temperatures or immersion in wet environments, and the performance of demanding tasks such as heavy load carriage/lifting, etc.[10] The second index is the Occupational Information Network O*NET index, sponsored by the U.S. Department of Labor/Employment and Training Administration. It measures the frequency of exposure to hazardous working conditions by occupation and ranges between zero and one hundred.[11]

Descriptive statistics

Table 1 reports summary statistics differentiating between migrant and native workers. For natives, the mean degree of impairment is 1.36 and the average number of sick leave days is 32.50. The highest frequency of injuries occurs in the tertiary sector (59%), followed by the secondary sector (40%). On average, the share of working-age migrants in the population of a native workers' province of residence is 9.43%, with a SD of

[9]Bianchi *et al.* (2012) provide evidence of the spatial correlation in the location of regular and irregular migrants by analysing the regularization episodes that took place in 1995, 1998, and 2002.

[10]In matching *isco* codes across the two sources, we lose information for two occupations: 'Street vendors and related workers', and 'Shoe cleaning and other street services elementary occupations' due to absence in Kroll (2016) OPI data.

[11]https://www.onetonline.org/.

TABLE 1
Descriptive statistics of work-related accidents, administrative data (injury level)

	Natives		*Migrants*	
	Mean	*SD*	*Mean*	*SD*
Degree of impairment	1.36	4.33	1.10	4.11
Sick leave days	32.50	55.20	29.45	57.14
With permanent injury	0.19	0.39	0.15	0.36
Age	41.46	11.17	38.06	10.03
Female	0.31	0.46	0.24	0.43
Primary sector	0.01	0.11	0.01	0.09
Secondary sector	0.40	0.49	0.48	0.50
Tertiary sector	0.59	0.49	0.51	0.50
Accident on site	0.83	0.37	0.85	0.35
Accident travelling	0.17	0.37	0.15	0.35
Age group: 16–25	0.10	0.30	0.12	0.32
Age group: 26–49	0.63	0.48	0.74	0.44
Age group: 50–65	0.27	0.45	0.14	0.35
Migrant share in province	9.43	3.83	10.97	2.87
N	2,630,988		476,112	

Notes: Authors' estimation based on INAIL administrative data, years 2009–16. The sample is restricted to the working-age population (16–65).

3.83%. For migrant workers, the mean degree of impairment is 1.10 and the average number of sick leave days is 29.45. The highest frequency of injuries for migrants occurs in the tertiary sector (51%), followed closely by the secondary sector (48%). Given the different composition of the two demographic groups in terms of age, industry, and occupations, in section VI we will refine this analysis by running regressions that control for individual-level demographic and occupational characteristics.

Table 2 reports summary statistics using the sample of 91 provinces across eight years as units of analysis.[12] The province-level mean injury rate for natives is 2.51 accidents in 100 workers. The table reports additional province-level indicators that we include in the analysis, such as native workers' employment rate, the share of native workers by sector, the natural logarithm of per capita GDP, and measures of internal migration for native residents.

Figure 1 displays unconditional average sick leave days and degree of impairment with 95% confidence bands between 2009 and 2016 for migrant and native workers in the primary, secondary, and tertiary sectors. While in the primary sector, the difference between demographic groups is not statistically robust, in the secondary and tertiary sectors there is a significant gap, with higher sick leave days and physical impairment for natives. Figure 2 shows the injury rate for the two populations. With the exception of the agricultural sector, in which injury rates are low for both groups, migrant workers have higher injury rates than natives. Injury rates decreased over the time period for both groups. However, in 2016, injury rates for migrants were still higher by two additional

[12]In order to obtain consistent units of analysis over our period of study, we reclassified the 107 most recent local administrative units into 91 provinces, grouping together those that merged or separated after 1990 and computing total and average values.

TABLE 2
Descriptive statistics, province-level data (native workers)

	N	*Mean*	*SD*	*Min*	*Max*
Migrant share (% of province residents)	728	8.29	3.94	1.02	17.04
Imputed migrant share (instrument)	728	10.46	6.60	0.81	46.45
Injury rate	728	2.51	0.80	0.93	5.66
Severe injuries (% of total)	728	17.59	5.55	5.56	39.86
Share of workers in industrial sector	728	27.78	8.19	11.05	50.98
Share of workers in service sector	728	67.22	7.45	48.04	87.84
Log of workers commuting out	728	9.55	0.85	6.79	12.48
Log of residents migrating out (all ages)	728	8.33	0.70	6.68	10.89
Log of internally immigrating residents (16–65)	728	7.92	0.72	6.26	10.68
Employment rate	728	55.51	9.92	32.73	71.90
Employment rate tertiary education	728	75.62	7.50	52.66	90.28
Employment rate secondary or lower education	728	54.54	10.47	30.69	71.88
Workers with tertiary education (%)	728	0.23	0.06	0.10	0.48
Per capita GDP (natural log)	728	10.21	0.40	9.59	11.60

Notes: Authors' estimation based on INAIL administrative data, years 2009–16. Sample restricted to working-age population (16–65).

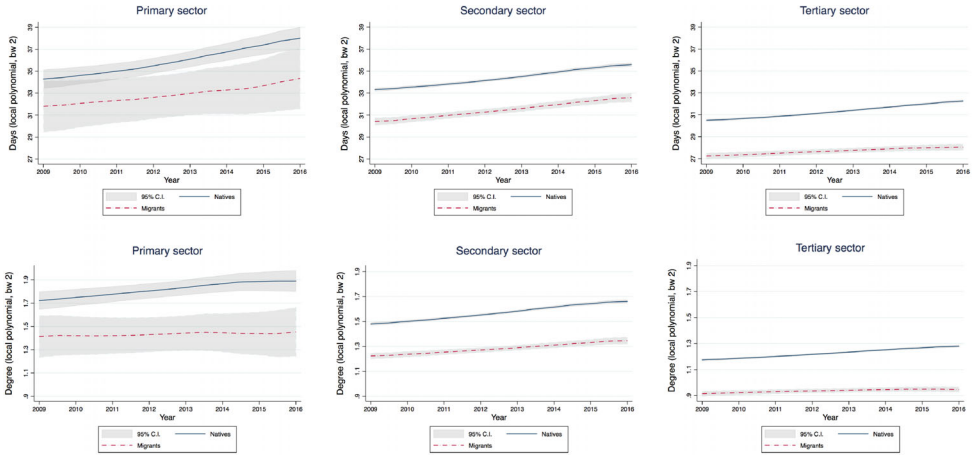

Figure 1. Sick leave days and degree of impairment by sector: native and migrant workers. Authors' estimations from the INAIL archive of work-related accidents. Sample sizes: 2,879,116 (natives); 524,194 (migrants). Primary sector: agriculture; Secondary sector: manufacturing, industry and construction; Tertiary sector: private and public services. [Colour figure can be viewed at wileyonlinelibrary.com]

injuries per 100 workers in the secondary sector and four in 1,000 workers in the tertiary sector. Figure 3 shows the OPI index by sector for the two demographic groups, with 95% confidence intervals. The OPI overlaps in the primary sector and is systematically higher for migrant workers in the secondary and tertiary sectors, respectively by about 1.5/10 and 2/10 points.[13]

Finally, we would like to stress some limitations in using these data. First, these data do not account for injuries of informal workers, which may be more likely to under-report

[13]The index displayed in this figure is computed from the Labour Force Survey, which includes undocumented migrants.

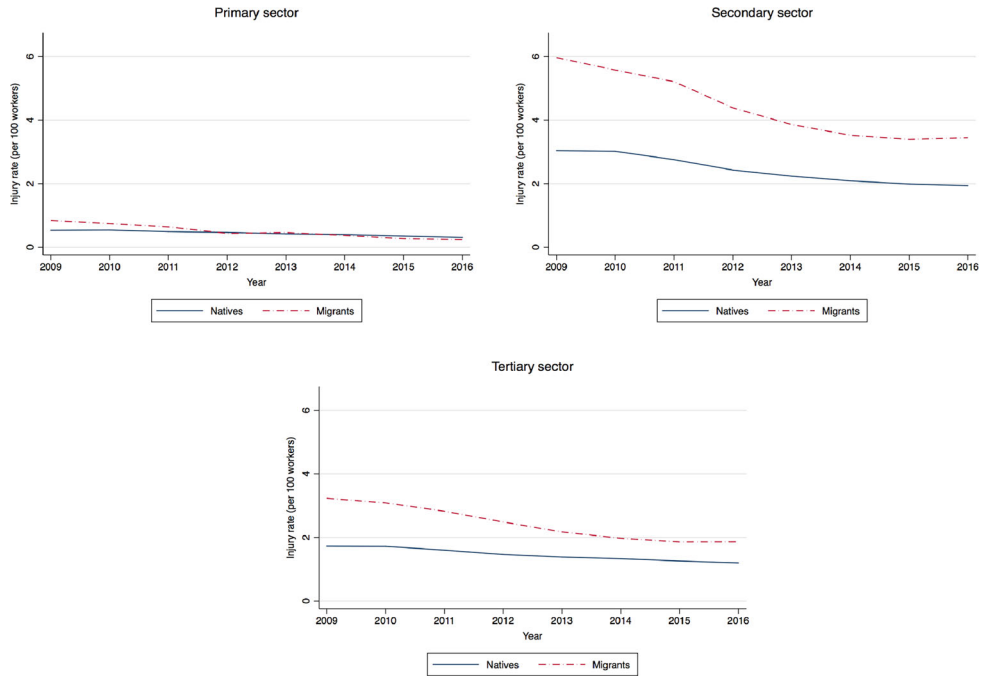

Figure 2. Injury rate by sector: native and migrant workers. Authors' estimations from the INAIL archive of work-related accidents and Istat. National level yearly injury rate (injuries per 100 workers). Estimates are based on national measures. Primary sector: agriculture; Secondary sector: manufacturing, industry, and construction; Tertiary sector: private and public services. [Colour figure can be viewed at wileyonlinelibrary.com]

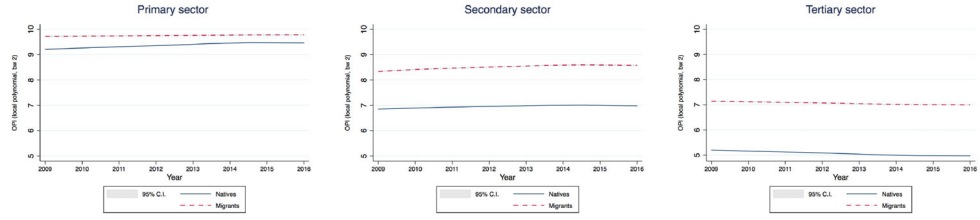

Figure 3. Average Occupational Physical Exposure Index (OPI) by sector: native and migrant workers. Authors' estimations Istat-LFS, years 2009–16. OPI is an index of exposure to physical intensive tasks by occupation (0–10) (Kroll, 2016). Primary sector: agriculture; Secondary sector: manufacturing, industry, and construction; Tertiary sector: private and public services. [Colour figure can be viewed at wileyonlinelibrary.com]

injuries. This could lead to an underestimation of the actual effect. By design, the LFS includes data on formal and informal workers. This may result in the limited validity of the results for measure iii (share of injuries over total native workers, see section Main Outcomes) if informal and formal workers are not evenly distributed across provinces and if the proportion between the two measures changes across provinces and over time (see, e.g. Di Caro and Nicotra, 2016). To address this concern, we collected data from National Social Security Institute (INPS) on the number of workers with formal employment

by province and year, available for the years 2014 through 2017. We estimated the relationship between formal workers and the number of workers sourced from the LFS by province and over time. Reassuringly, we found evidence of a constant linear relationship across data sources both between provinces and over time.[14]

Another limitation of our study is the unavailability of the LFS data at the province level before 2009. This means that the LFS cannot be used to examine changes in the labour force overtime at the province level in the years before. To analyse the absence of a relationship between pretrends and our instrumental variable base, we utilized historical data from the Chamber of Commerce on the number of active firms by province and time.

We should also notice that the dataset on injuries from INAIL does not contain information on the number of hours worked and/or the type of workers (full-time employment, part-time, temporary workers, etc.). As a result, the analysis in not able to look at heterogeneity in time worked and the exposure to risk that may differentiate natives from foreign-born in different classes of age.

IV. Empirical strategy

To identify the effect of immigration on native workers' severity of impairment, our empirical strategy relies on variations in the concentration of migrant workers across provinces and over time, with individual accidents as unit of analysis. We estimate the effect of immigration on the severity of injuries for native workers according to the following reduced-form model:

$$\text{InjSev}^{\text{nat}}_{i,p,t} = \alpha + \beta \text{MIG}_{p,t} + \gamma_p + \delta \text{LM}_{p,t} + \kappa W_i + \eta_t + \epsilon_{i,p,t}. \quad (2)$$

$\text{InjSev}^{\text{nat}}_{i,p,t}$ represents the severity of injury for native worker i in province p and year t. The severity of injury for worker i in province p and year t, $\text{InjSev}_{i,p,t}$ is based on two measures: (i) the number of sick leave days prescribed by the doctor assessing the accident and (ii) the degree of impairment determined by a predefined classification of severity, established by the law. $\text{MIG}_{p,t}$ is the share of working-age migrants among province p's residents. γ_p and η_t are province and time fixed effects. W_i is a vector of workers' characteristics including demographic traits (age, the square of age, gender) and a three-digit indicator of the sector of employment. The inclusion of province and year-fixed effects accounts for time-invariant province characteristics and year-specific aggregate shocks to the economy. In addition, we control for time-varying province-specific labour market characteristics ($\text{LM}_{p,t}$), which include the native workers' employment rate, the distribution of natives across the primary, secondary and tertiary sectors, the log of per capita GDP, and indicators of internal regional migration such as the natural logarithm of natives moving their residency in and out of the province and the natural log of native workers commuting out of a province for work-related reasons. Standard errors (SEs) are clustered at the province level.

Next, we estimate also the effect of immigration on native workers' injury rate, computed as the share of total yearly injuries among the population of native workers in

[14]Results available upon request.

province p. For this specification, the unit of analysis is the province and the fixed-effects estimation model is:

$$\mathrm{INJ}^{\mathrm{nat}}_{p,t} = \gamma_p + \beta \mathrm{MIG}_{p,t} + \eta_t + \delta \mathrm{LM}_{p,t} + \epsilon_{p,t}, \tag{3}$$

where $\mathrm{INJ}^{\mathrm{nat}}_{p,t}$ represents the share of injuries among native workers in province p at time t. $\mathrm{MIG}_{p,t}$ is the share of migrants among province p's residents. α_p and η_t are province and time-fixed effects, and we control for the same set of province-level time-varying characteristics as in equation (2).

A common concern in the estimation of the effects of immigration based on spatial distributions is that migrants may locate across the territory in a way that correlates with local labour market characteristics. This would imply an indirect correlation also with the degree of occupational health safety. For example, a growing labour demand that attracts more migrants may also be associated with an increase in the share of workers with less experience in terms of safety practices and hence concur in determining the severity of injuries for native workers. In order to tackle this source of endogeneity, we instrument the distribution of migrants across provinces and over time by relying on historical settlements of co-nationals, following the 'shift-share' network-based instrumental variable approach (Card, 2001). This strategy hinges on the rationale that the historical distribution of the first migrant communities across provinces, by country of origin, is independent from future labour market conditions. The shift-share approach consists in constructing an instrumental variable that allocates national-level inflows by country of origin across provinces on the basis of those co-nationals settlements in the past. In this way, the estimation captures a source of variation in migrant shares which is due to the interaction between national-level inflows of migrants and network-related settlements by country of origin, rather than contemporaneous location-specific features.

To construct the instrument, we use 1992 as a baseline year. We impute the distribution of migrant inflows by origin c[15]in year t across provinces p ($\hat{\mathrm{MC}}_{c,p,t}$), by allocating national-level inflows Flow $M_{c,t}$ on the basis of their historical spatial allocation shares (Sh $M_{c,p,1992}$):

$$\hat{\mathrm{MC}}_{c,p,t} = \mathrm{Sh}\ M_{c,p,1992} * \mathrm{Flow}\ M_{c,t} + \mathrm{Stock}\ M_{c,p,1992}. \tag{4}$$

Sh $M_{c,p,1992}$ is the share of migrants from origin c settled in province p on 1 January 1992 over total co-nationals. To obtain the imputed number of migrants from origin c in province p at time t ($\hat{MC}_{c,p,t}$), we multiply the national-level inflows of migrants in year t by area of origin ($FlowM_{c,t}$) by their ''historical" (year 1992) province-level shares, and then we add the initial (1992) stock of migrants from c in p.[16] Next, for each province, we sum over all areas of origin and divide this amount by the total number of residents

[15]We distinguish 12 areas of origin based on the first six communities by size as of 1 January 2017 (Romania, Albania, Morocco, China, Ukraine and the Philippines) and six larger geographic areas (Europe, Eastern Europe and North America, Africa, Latin America, East Asia and Oceania and the Middle East).

[16]Because our estimation relies on changes over time using province fixed effects, this estimation procedure is equal to multiplying the shares in 1992 by country of origin and province to the *stock* of immigrants from area c at time t.

aged 15–65 (including natives and the imputed stock of migrants). This way, we obtain the imputed share of migrants in p and t, $\hat{M}_{p,t}$:

$$\hat{M}_{p,t} = \sum_{c} (\hat{\text{MC}}_{c,p,t})/\text{Pop}_{p,t}. \tag{5}$$

A two-stage least-squares estimation then instruments the share of migrants among the resident population in province p ($\text{MIG}_{p,t}$) with the imputed share $\hat{M}_{p,t}$. We include the same set of fixed and time-varying controls as in equations (2) and (3), respectively.

Next, our analysis investigates the potential underlying mechanisms that may convey a reduction in native workers' injury severity. In particular, we study whether immigration drives a selection in the workforce of a province, which constitutes the denominator of the injury rate in equation (3) and the pool of native workers among which we compute the severity of injuries. We investigate whether immigration-driven labour supply shocks determine a change in the composition of native workers in terms of the likelihood that they are employed in more hazardous and physically demanding jobs. We consider the unemployment rate of natives, differential changes in employment rates by education, and differential regional migration patterns. We perform these analyses both at the province and at the individual level, using data from the LFS.[17]

V. Results

Immigration and the severity of impairment for native workers

Table 3 reports the OLS estimates of the effect of immigration on native workers' impairment severity (columns 1 and 2), followed by the second stage of the IV estimation in columns 3 and 4, and the first stage in column 5. Looking at the IV-2SLS estimates, we find that a one SD increase in the share of migrants in a province, 3.8% of the population, decreases native workers' sick leave by four days, which corresponds to 11% of a 32 days-average. The degree of impairment decreases by 0.28 points or 0.06 SDs. The coefficient is significant at the 1% level in both IV-2SLS regressions. The first-stage coefficient (0.652) is significant at the 1% level and has a positive sign, as expected, with an F-statistic of 48.2, largely above the threshold of 10, hence indicating that the instrument is sufficiently powerful. The results are robust to the inclusion/exclusion of the following covariates: three-digit sector-specific fixed effects, province-level natives' employment rate, the share of workers in the primary, secondary and tertiary sectors, log of out-migrating natives, log of internally immigrating natives and share of commuting-out native workers (available upon request).

The coefficient estimates are larger in IV regressions compared to OLS. This could be interpreted in light of a positive selection bias of migrants in areas in which native workers are already exposed to a lower average injury severity. As the selection bias is addressed by the instrumental variable estimation approach, the analysis demonstrates a more substantial impact of migrant inflows: the presence of immigrant workers contributes to a

[17]The paper reports the province-level analysis. Individual-level results confirm the findings and are available upon request.

TABLE 3
Immigration and the severity of native workers' injuries (individual level). OLS and IV-2SLS

	(1) *OLS*	*(2)*	*(3)* *IV-2SLS*	*(4)*	*(5)* *First stage*
	Days	*Impairment*	*Days*	*Impairment*	*Migrant share*
Migrant share	−0.565**	−0.041***	−0.911***	−0.071***	
	(0.243)	(0.009)	(0.296)	(0.017)	
Instrument					0.652***
					(0.093)
Mean dep. var.	32.498	1.361	32.498	1.361	9.421
SD dep. var.	55.201	4.329	55.201	4.329	3.835
N	2,630,988	2,630,988	2,630,988	2,630,988	2,630,988
Kleibergen-Paap first stage *F*-stat					48.244

Notes: Authors' estimations from INAIL and ISTAT, years 2009–16. All regressions include: a constant, age, age squared, gender and sector (three-digit), year, and trimester fixed effects. Province-year-level regressors: province FE, log of GDP, natives' employment rate, share of workers in the primary, secondary, and tertiary sector, log of out-migrating native, log of internally immigrating natives and share of commuting-out native workers. Age restriction: 16–65. 'Migrant share' is the share of working-age migrants in the province working-age population. *Days* (sick leave days) and *Impairment* (degree of physical damage, 0–100 index) are assessed by the doctor. SEs in parentheses are clustered at the province level. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

reduction in the severity of native workers' injuries more than what a simple correlation between migrant shares and injury severity for native workers would show.

Heterogeneous effects by sector, age and gender

Next, we estimate heterogeneous effects by sector, age and gender, for native workers. Figure 4 displays the point estimates and 95% confidence intervals of the migrant share coefficient in each different subsample, for sick leave days and the degree of impairment.[18] For both measures of severity, in panel A, we find that the reduction is largest in the secondary sector (manufacturing, industry and construction), followed by the tertiary sector (private and public service sector), while the coefficient is negative but not significant for the primary sector (agriculture). Looking at age groups, we find that the effect is highest for the age group 50–65, followed by the 26–49 years old, and is not significant for younger native workers (16–25). The effect is driven by male workers, while coefficients are negative but not statistically significant among women. Panel B of Figure 4 reports the results of separate regressions by age group and sector. The reduction in occupational injury severity is highest among older native workers in the manufacturing, industrial, and construction sector (secondary sector). For this group, aged 50–65, in the secondary sector, a one SD increase in the share of migrants reduces sick leave by 6 days, or 14% with respect to a mean of 42.6 days, and the degree of impairment by 0.1 SDs of the index.

Next, we estimate the effect of immigration on the injury rate, which is computed as the share of yearly work-related accidents among native workers aged 16–65, by province and year. Here, the analysis is at the province-year level. Table 4 reports the second-stage

[18]Tables A1–A3 in Appendix S1 report the full coefficients and SEs.

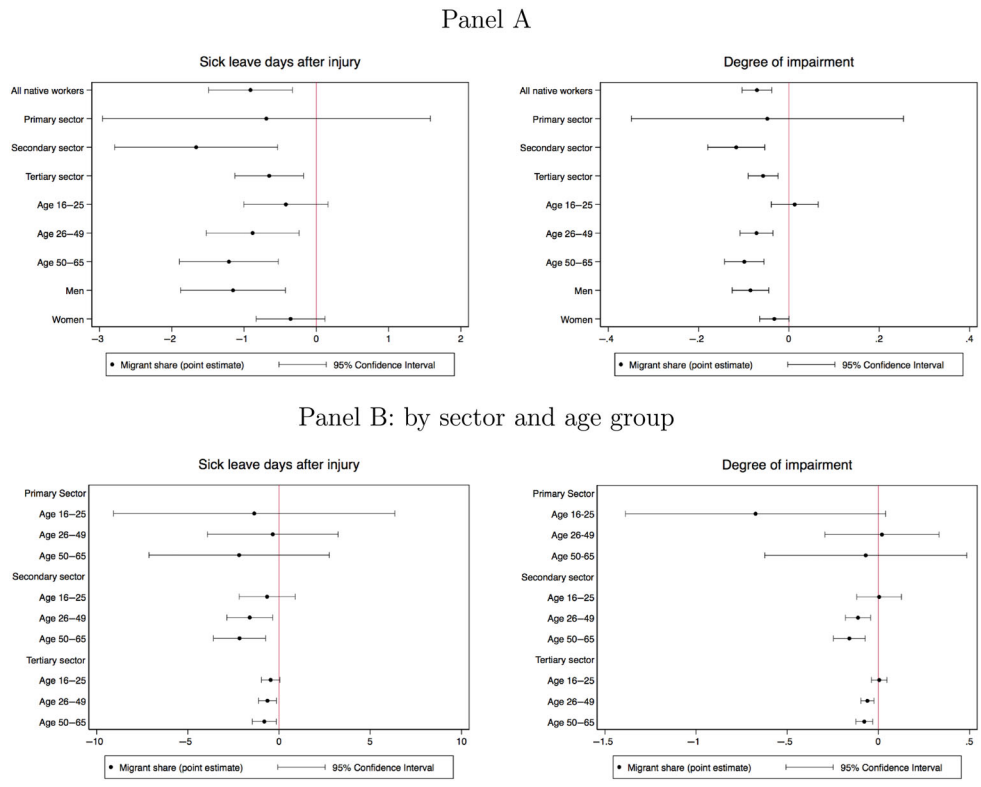

Figure 4. Immigration and the severity of native workers' injuries in different subsamples: heterogeneity analysis (IV-2SLS). Authors' estimations from INAIL and ISTAT, years 2009–16. Point estimates and 95% confidence intervals of the migrant share coefficient (second stage) from different regressions based on subsamples of native workers, as indicated in the y axis. Additional regressors: age, age squared, gender, and three-digit sector codes, year, and trimester fixed effects, a constant. Province-year regressors: province FE, log of GDP, workers (%) in primary, secondary, and tertiary sector, log of total population, log of out-migrating natives, log of internal immigrant natives, native workers commuting-out (%). Age restriction: 16–65. 'Migrant share' is the % of working-age migrants in a province's working-age population. SEs are clustered at the province level. Primary sector: agriculture; Secondary sector: manufacturing, industry, and construction; Tertiary sector: private and public services. [Colour figure can be viewed at wileyonlinelibrary.com]

and first-stage results of the IV-2SLS estimation. A one SD increase in the share of migrants corresponds to a reduction in the native workers' injury rate by 17% with respect to a baseline mean of 2.5 injuries per 100 workers (column 1). The coefficient is negative, but it is not statistically significant at conventional levels. For completeness, the other columns report the coefficients of the effect of immigration on sick leave days (column 2) and the degree of impairment (column 3), estimated at the province-year level. These confirm the results of the individual-level analysis (see Table 3), with greater magnitude. The coefficients are statistically significant at the 5% level. The first stage in column 7 displays a positive sign for the 'shift-share' instrument coefficient (i.e. the imputed share of migrants) and a Kleibergen–Paap F-statistic of 16.26. These results suggest that immigration induces a reduction in the severity of native workers' injuries, and this is not due to a change in the frequency of accidents per worker. Rather, as immigration increases, natives experience less severe injuries.

TABLE 4
Immigration and native workers' injuries (province level)

	(1) *Injury rate*	*(2)* *Sick leave*	*(3)* *Impairment*	*(4)* *(First stage)* *Migrant share*
Migrant share	−0.110	−1.744 ∗ ∗	−0.133 ∗ ∗	
	(0.087)	(0.760)	(0.052)	
Instrument				0.389***
				(0.097)
Mean dep. var.	2.511	27.415	1.323	8.286
SD dep. var.	0.805	5.245	0.485	3.944
N	728	728	728	728
Kleibergen–Paap first-stage *F*-stat				16.26

Notes: Authors' estimations from INAIL and ISTAT, years 2009–16. The dependent variables are at the province-year level (for native workers aged 16–65). Additional regressors: year and province fixed effects, log of GDP, share of workers in the primary, secondary, and tertiary sector, log of total population, log of out-migrating native, log of internally immigrating natives, and share of commuting-out native workers. 'Migrant share' is the share of working-age migrants in the province working-age population. SEs in parentheses are clustered at the province level. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

Results on the entire population

If migrant workers concentrate in jobs that are more exposed to hazardous conditions and physically demanding tasks with a higher incidence of injuries than natives, immigration may reduce the severity of injury for natives but may still induce a higher net effect through relatively more severe injuries for migrants. The overall welfare effect of immigration on occupational injuries depends on whether the severity of injury increases or decreases for the entire employed population, including native as well as migrant workers. If the decrease in injury severity for native workers is over-compensated by more critical accidents among migrant workers, net welfare effects will be negative. To investigate this, we run the same regressions as in section V, with individual injuries as units of analysis, but including all injuries of both native and migrant workers. The results show an improving effect on occupational health (see Table 5, columns 1 and 2). A one SD increase in the share of migrants by province reduces the average severity of injury in the entire working population of Italy by 3.18 sick leave days (9% of the mean) and 0.25 degrees of impairment, or 0.06 SDs. Looking separately at the effect on the migrant population, in columns 3 and 4, the coefficients are also negative (which would indicate a reduction in severity), but not statistically significant. Overall, this analysis shows Pareto-improving effects of immigration on the injury severity for the overall population.

Robustness checks and diagnostic tests for Bartik instruments

One potential limitation of the analysis is that workers and employers could under-report occupational injuries. If this practice was linked to the spatial distribution of migrants, for example due to higher competition between native and migrant workers as a result of higher migration inflows, it might undermine the validity of the results. However, the data provide evidence against this hypothesis. The type of injuries that would be more prone to omissions are those with a lower severity, which entail minor health complications, are

TABLE 5
Immigration and the severity of work-related injuries: all workers and migrant workers. IV-2SLS

	(1) *All workers*	*(2)*	*(3)* *Migrant workers*	*(4)*
	Days	*Impairment*	*Days*	*Impairment*
Migrant share	−0.852***	−0.068***	−0.368	−0.043
	(0.292)	(0.016)	(0.436)	(0.030)
Mean dep. var.	32.030	1.321	29.447	1.101
SD dep. var.	55.514	4.298	57.143	4.111
N	3,107,103	3,107,103	476,112	476,112
Kleibergen–Paap first-stage *F*-stat	44.40	44.40	24.27	24.27

Notes: Authors' estimations from INAIL and ISTAT, years 2009–16. All regressions include: a constant, age, age squared, gender and sector, year, and trimester fixed effects. Province-year-level regressors: province FE, log of GDP, natives' employment rate, share of workers in the primary, secondary and tertiary sectors, log of out-migrating native, log of internally immigrating natives and share of commuting-out native workers. Age restriction: 16–65. 'Migrant share' is the share of working-age migrants in the province working-age population. 'All workers' includes injuries of both native and migrant workers. *Days* (sick leave days) and *Impairment* (degree of physical damage, 0–100 index) are assessed by the doctor. SEs in parentheses are clustered at the province level. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

less likely to prevent the worker from executing her job, and are less likely to be detected if not reported. Thus, if there was systematic underreporting in areas where immigration is higher, we would observe a higher injury severity. On the contrary, we find the opposite result.

Another limitation is that injuries in the shadow economy may be more prone to under-reporting. The injury rate, our secondary outcome, is computed over total workers by province computed from the LFS, which includes informal workers. However, the National Statistical Institute estimated that the incidence of the informal economy on added value has been persistent both by sector and location in the past decade, in Italy (ISTAT, 2018). As a further robustness check, to account for informal employment, we compute the share of workers in each sector and province from the labour force survey, which includes irregular workers, and we add these shares as covariates in all our regressions. Their inclusion/exclusion does not alter our findings.[19]Next, we also analyse data from the National Institute of Social Security (INPS) from 2014 through 2017 on the number of workers with formal employment by province and year as compared to LFS data. We find that the two measures are very close and display a constant relationship both between provinces and across time. This suggests that the distribution of informal workers follows closely that of formal workers.[20]

Another element to consider is that the analysis focuses on the effect of regular migrants, as residence registries do not account for undocumented ones. However, as explained in section III, because the spatial distribution and share of irregular migrants in Italy are highly correlated with those of regular migrants, across provinces as well as overtime (Bianchi *et al.*, 2012; Bratti and Conti, 2018), the estimations may pick up also the effect of irregular migrants but this does not invalidate the empirical strategy.

[19]Results available upon request.
[20]Results available upon request.

TABLE 6
Robustness check: immigration and the severity of work-related injuries, IV-2SLS with instrument lag

	(1) *Native workers*	*(2)*
	Days	*Impairment*
Migrant share	−3.190∗	−0.149 ∗ ∗
	(1.778)	(0.063)
Migrant share $t-3$	2.604	0.089
	(2.301)	(0.076)
Mean dep. var.	32.498	1.361
SD dep. var.	55.201	4.329
N	2,630,988	2,630,988
First-stage *F*-stat		
Time *t*	26.54	26.54
Time $t-3$	39.56	39.56

Notes: Authors' estimations from INAIL and ISTAT, years 2009–16. 'Migrant share $t-3$' is the share of working-age migrants in the province working age population three years before. All regressions include: a constant, age, age squared, gender and sector, year and trimester fixed effects. Province-year-level regressors: province FE, log of GDP, natives' employment rate, share of workers in the primary, secondary and tertiary sectors, log of total population, log of out-migrating native, log of internally immigrating natives and share of commuting-out native workers. Age restriction: 16–65. *Days* (sick leave days) and *Impairment* (degree of physical damage, 0–100 index) are assessed by the doctor. SEs in parentheses are clustered at the province level. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

Recent contributions to the literature on the 'shift-share' instrumental variable methodology à la Card, 2001 (Jaeger *et al.*, 2018; Goldsmith-Pinkham, Sorkin, and Swift, 2020) highlight the concern that the distribution and the inflow of migrants by country of origin may be persistent over time and may imply that the observed effect of contemporaneous migration shares in fact results from a conflation of short and long-term impacts, and that *levels* of the Bartik shares (nationality-specific migrant shares, in this case) predict *changes* in local labour market outcomes. To address the first pitfall, Jaeger *et al.*, 2018 suggest including the lag of the instrument, as well as the contemporaneous one, in the two-stage least squares estimation. Table 6 reports the results of this robustness check (in columns 1 and 2): the coefficient of the same-year migrant share remains negative and statistically significant both in the regression of sick leave days, with a magnitude of −3.2, significant at the 10% level, and in the regression of the degree of impairment, with a magnitude of -0.15, significant at the 5% level. The size of the effect is larger than in the standard non-lagged estimation (see Table 3). The coefficient of the long-term effect (lag) of the migrant share is not significant at any conventional level. The *F*-statistic of the first stage is 26.54 for the excluded contemporaneous instrument.

We also addressed the concern that historical distributions of migrants across provinces may not be exogenous with respect to local labour market trends. We analyse the relationship between nationality-specific province-level shares of migrant residents by province with respect to the total number of co-national migrants in Italy in the baseline instrumental variable year (1992) and a pretrend indicator of economic activity growth by province: the percentage change in active firms between 1997 and 2000. Table 7 reports the results of a regression analysis with nationality group-specific fixed effects. The coefficient is not statistically significant at conventional levels. This suggests that

TABLE 7
Robustness check: economic activity pretrend (1997–2000) and share of migrant workers by national group and province in 1992

	(1) *Firm growth (%)*
Migrant share in 1992 by nationality group	5.849
	(8.579)
Contintent FE	Yes
Mean dep. var.	0.708
SD dep. var.	2.588
N	1,031

Notes: Authors' estimations from Italian resident registries and Chamber of Commerce data. SEs in parentheses are clustered at the province level. The unit of analysis is province-nationality. The explanatory variables is the province-specific share of migrant residents by nationality group over all co-national migrants in Italy in 1992. The dependent variable is the growth rate of active firms by province calculated as the difference in the number of active firms (2000-1997) as a percentage of active firms in 1997. The regression includes nationality group fixed effects and a constant. Nationality groups are defined as in the instrumental variable construction (see section IV). SEs clustered at the province level. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

there is no systematic association between the distribution of nationality-specific migrant shares and local labour market economic activity growth. This reinforces the necessary condition for the validity of the instrumental variable estimation that nationality-specific levels of migrant share are exogenous with respect to trends in local economic activity (Goldsmith-Pinkham *et al.*, 2020).

Further, to address contemporaneous industry dynamics, we repeated the main estimations of the impact of immigration on the degree of impairment and days of sick leave for native workers including one-digit sector-specific time trends across twenty-one industrial sectors in replacement of three-digit sector fixed effects. The coefficients of IV regressions are similar to the main estimation results both in size and magnitude, with statistical significance at the 1% and 10% levels (−0.903 for sick leave days and −0.077 for the degree of impairment, compared to −0.911 and −0.071 in the main IV regression with sector-specific fixed effects).

Goldsmith-Pinkham *et al.* (2020) conduct a comprehensive evaluation of the 2SLS estimator using the Bartik instrument. They suggest that the 2SLS estimator using the Bartik instrument can produce biased and inefficient estimates in certain situations, particularly when the treatment variable is highly skewed or the sample size is small. An important aspect of the Bartik instrument design is the combination of all instrumental variables used. To explore the validity of this design, they suggest decomposing the Bartik estimator into a weighted sum of just-identified instrumental variable estimators that use each (here, nationality-specific) share as a separate instrument. This decomposition can be carried out for a given sample where data is collapsed at the province and year level, as this is the level at which the shares vary. More formally, they illustrate that the shift-share Bartik estimator can be expressed as a sum of the weighted coefficients of the just-identified IV estimates for each nationality instrument. These coefficients are weighted by the Rotemberg weights. The validity of each weighted coefficient is dependent on the strength of the instrument and the exclusion restriction assumption. This decomposition provides valuable insights into the reliability of the Bartik instrument

design and can be used to evaluate the validity of the instrument in estimating the causal effect. If one of the instruments is misspecified, the estimated coefficients can inform us about the extent of the bias in the overall Bartik instrument. In Figure A2, we report the relationship to the F-statistic in the first-stage from the Rotemberg weights calculation. To ensure reasonable first-stage power (F-statistic > 5), instruments were only included if they met this criterion, following Goldsmith-Pinkham *et al.* (2020). This diagnostic test suggests that the exogeneity assumption holds for countries with higher weights in our instrument.

VI. Mechanisms: analysis and discussion

Several mechanisms may explain why immigration can reduce the severity of injury for native workers. To shed light on them, we develope a series of analyses focused on (a) workers' transitions between occupations and sectors, (b) the relative exposure of migrant and native workers to occupational injury hazards and strenuousness, (c) the labour force composition by native workers' seniority, and (d) internal migration of native workers between areas in response to migrant inflows.

Individual-level analysis of transitions between occupations and sectors

The longitudinal version of the Italian Labor Force Survey follows a rotating panel of respondents 12 months apart. We focus on the years 2009 through 2013 for which the longitudinal LFS includes a province identifier. This allows us to match individual-level observations with the migrant share explanatory variable. We use these data to study transitions between occupations (four digits) and sectors (four digits when available, two digits elsewhere) with individual-level fixed effects IV regressions, overall and by three age groups. This allows us to provide a longitudinal analysis of transitions between occupations. Table 8 reports the results. The regressions show (i) no significant evidence of native workers' transitions between sectors of activity, and (ii) no significant changes in occupational roles. The coefficients are all negative and close to zero, and not statistically significant at conventional levels. These findings suggest the following interpretation: the reduction in occupational injury severity does not result from native workers moving to a different sector, nor from transitioning to a different occupation. Overall, these findings suggest that the plausible underlying mechanism through which the severity of injuries decreases in presence of higher migrant workers' inflows is that native workers engage in less risky tasks while maintaining their occupation and jobs in response to immigration. As an illustration, let's assume that migrant workers join a construction firm and engage in riskier tasks (such as, e.g. lifting heavier objects, walking on roofs or hazardous surfaces) in place of native workers (especially, older adults). Native workers will thus have lower exposure to severe injuries, without changing occupation. This evidence is consistent with the hypothesis that migrants sort into the riskier activities and, as their number increases, native workers gain the opportunity to execute tasks that entail a lower injury hazard, as the task specialization theory suggests. The next set of results confirms that migrant workers sort into riskier jobs.

TABLE 8
Immigration and individual-level transitions between occupations and sectors, IV regressions

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	Sector change				*Occupation change*			
Variables	*All*	*Age 16–29*	*Age 30–49*	*Age 50–65*	*All*	*Age 16–29*	*Age 30–49*	*Age 50–65*
Migrant share	−0.015	−0.012	−0.017	−0.001	−0.046	−0.075	−0.056	−0.026
	(0.020)	(0.081)	(0.025)	(0.020)	(0.035)	(0.076)	(0.035)	(0.051)
Number of observations	218,228	10,706	140,132	67,390	99,438	4,765	63,421	31,252
Number of unique IDs	85,977	5,534	57,361	28,908	79,126	3,776	50,520	25,748
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Authors' estimations from ISTAT's longitudinal Labour Force Survey, years 2009–13 (12 months rotating panel). Age restriction: 16–65. Regressions in columns 1 and 5 include age as a covariate. The dependent variables are dichotomous indicators of a change in activity (sector, four digits) and change of occupation (four or two digits). All regressions include individual and year fixed effects and a constant. Robust SEs in parentheses. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

Task specialization, occupational injury risk exposure and migrant workers' sorting

To provide further insights on the degree of substitution between migrant and workers in terms of risk exposure, we analyse the difference between migrant and native workers in terms of (i) exposure to physically hazardous working conditions, and (ii) severity of work-related injuries. For the first analysis, we use individual-level observations as unit of analysis. We combine three-digit occupational codes from the LFS with two indexes of job-specific health risks: the Occupational Physical Index (OPI) (Kroll, 2016) and the classification of exposure to hazardous conditions of the Occupational Information Network (O⋆NET). We estimate relative conditional degrees of hazard exposure controlling also for demographic characteristics such as age, the square of age (as a proxy for experience/seniority), and gender, as well as province, year, and quarter fixed effects. For the second analysis, which estimates the relative degree of severity among native and migrant workers' injuries, in terms of the degree of impairment and a number of prescribed sick leave days, we include also three-digit sector code fixed effects. Table 9 reports the results. On average, we observe that migrants have a higher OPI index by one out of ten points (17%) and a higher O*NET hazard rate by 3.2 out of 100 points (15%) (columns 1 and 2). In columns 3 and 4 we report the different measures of impairment severity. On average, injured migrant workers have a lower degree of impairment by 0.075 (or 6% of the mean) and a lower number of sick leave days by one day (3%) than native workers. Hence, migrant workers have a relatively higher exposure to physically demanding and hazardous working conditions than natives but experience less severe injuries. The higher exposure to injury risk for migrants is also reflected in a higher injury rate for migrant workers (see Figure 2).[21]

A second piece of evidence in favour of the task specialization hypothesis is that we find a stronger reduction in injury severity and sick leave among older workers in

[21]These results are consistent with the hypothesis that native and migrant workers face segmented labour markets. Evidence from the USA suggests that it is the case for Mexican migrants that work in riskier tasks – without compensating wage differentials, despite having similar values of statistical life than natives (Hersch and Viscusi, 2010).

TABLE 9
Severity of work-related accidents, Occupational Physical Exposure Index (OPI) and occupational health hazard by immigrant status

	(1) *OPI index*	*(2)* *Hazard O*NET index*	*(3)* *Degree of impairment*	*(4)* *Sick leave days*
Migrant	1.006***	3.185***	−0.075 * **	−0.994 * **
	(0.050)	(0.310)	(0.007)	(0.090)
Mean dep. var.	5.871	21.436	1.321	32.030
SD dep. var.	2.811	17.410	4.298	55.514
N	1,644,815	1,656,999	3,107,100	3,107,100

Notes: Authors' estimations from INAIL administrative data (columns 1 and 2) and Istat-LFS (columns 3 and 4), years 2009–16. *Days* (sick leave days) and *Impairment* (degree of physical damage, 0–100 index) are assessed by the doctor. OPI is an index of exposure to physical intensive tasks by occupation (0–10) (Kroll, 2016), 'Hazard' is an index of exposure to hazardous conditions (O–100) from O'NET. Additional regressors: age, age squared, gender, sector (three digits, columns 1 and 2; two digits, columns 3 and 4), year, trimester and province fixed effects, and a constant. The sample is restricted to the working-age population (16–65) and SEs are clustered at the province level. Estimates in columns 3 and 4 are calculated using survey-specific sampling weights.

the manufacturing, industry, and construction sectors (see Panel b in Figure 4). This is consistent with the idea that older workers in those sectors, which have less physical strength and more experience than young ones, take the chance to shift away from riskier tasks as migrants can substitute them, either by changing occupations or by simply avoiding riskier tasks.

Labour force composition and internal migration

Next, we consider two alternative explanations. The first one is that migrants-driven labour supply shocks could lead to higher unemployment for native workers with lower education. As they concentrate in more physically intensive jobs with higher injury risk, a higher unemployment would imply a reduction in the observed impairment severity. The composition of the workforce may also change in response to immigration due to native workers changing internal migration patterns, such as, for example, by moving away from areas with higher labour-market competition.

To empirically assess these potential channels, we run IV-2SLS regressions of the effect of immigration on (i) a change in natives' employment rates, (ii) a change in employment rates by education, and (iii) changes in natives' internal migration patterns, at the province-year level, including also province and year fixed effects.[22] Table 10 reports the results. We find that a one percentage point-increase in the share of migrants *increases* the employment rate of natives by 2.5% of the mean (55.5%) (column 1). Looking at heterogeneous effects by education (tertiary vs. lower), we find that the increase in employment is larger for natives with tertiary education (3% of the mean, column 2, vs. 2.2% for less-educated natives, column 3). Consistently, the coefficient is positive and significant also when we look at the share of employed workers with tertiary education (column 4, showing a 12% increase w.r.t the mean). On the contrary, we do not find significant differential internal regional immigration or out-migration patterns in response

[22] All findings are confirmed when we perform the analysis at the individual level (results are available upon request).

TABLE 10

Mechanisms. Immigration and province-level labour market features: native workers' employment and regional migration (IV-2SLS). Province-level analysis

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	Labour market adjustments				*Regional migration*		
	Empl. rate	*Empl. rate tertiary educ.*	*Empl. rate lower educ.*	*High/low educated workers*	*%incoming*	*% out-migrating*	*% out-commuting*
Migrant share	1.391**	2.242**	1.291**	0.028**	0.016	0.041	0.453
	(0.639)	(1.064)	(0.521)	(0.012)	(0.025)	(0.026)	(0.509)
Mean dep. var.	55.507	75.620	54.544	0.233	1.018	1.486	10.783
SD dep. var.	9.917	7.504	10.469	0.059	0.308	0.308	6.060
N	728	728	728	728	728	728	728

Notes: Authors' estimations from ISTAT quarterly Labour Force Survey, years 2009–17. The dependent variables refer to native workers aged 16–65 and are defined at the province-year level. 'Migrant share' is the share of working-age migrants in the province working-age population. Additional regressors: year and province fixed effects, log of a province per capita GDP. SEs in parentheses are clustered at the province level. Asterisks denote statistical significance at the 1%(***), 5%(**) or 10%(*) level.

to migrant inflows: the coefficient is not statistically significant at any conventional level neither on the share of natives that relocate into the province (column 5), nor those that move out of the province (column 6), or commute out of the province for work-related reasons (column 7).

In sum, the results rule out that the observed reduction in injury severity is due to higher unemployment rates among less-skilled workers, more likely to work in riskier jobs. We rule out also a composition effect due to differential provincial migration patterns in response to immigration. On the contrary, the results show that immigration contributes to an increase in the employment rate of natives with tertiary education. This finding is consistent with existing empirical evidence in the literature that natives with high education increase their labour force participation at the intensive margin in response to immigration (Cortes, 2008; Cortes and Tessada, 2011).[23] In Table 11, we show that natives with tertiary education have lower exposure to occupational injury risks: the OPI index and the O*NET hazardous conditions index are lower by respectively 28% and 30% among tertiary educated workers than those with less education. Hence, higher employment rates for high-skilled natives are consistent with lower average injury severity.[24]

These findings suggest that the observed reduction in the severity of impairment for native workers as a consequence of immigration should thus be interpreted as the composite effect of higher employment rates of native workers with higher education and the hypothesis that migrant inflows allow (older) natives to perform less risky tasks and decrease their overall exposure to work-related injury severity.

[23] As larger shares of foreign-born increase the supply of services, natives (women, especially) with tertiary education substitute their time use away from home production activities as those become relatively more available and less expensive.

[24] An increasing presence in the workforce of natives with higher education may also be associated with higher compliance with occupational health safety norms and practices.

TABLE 11
Occupational physical exposure index (OPI) and occupational health hazard (O*NET) by education

	(1) *OPI index*	*(2)* *Hazard O* NET index*
Tertiary education	−1.564 ∗ ∗∗ (0.027)	−6.223 ∗ ∗∗ (0.171)
Mean dep. var.	5.615	20.436
SD dep. var.	2.795	17.436
N	1,447,096.000	1,452,347.000

Notes: Authors' estimations from ISTAT-LFS, years 2009-16. OPI is an index of exposure to physical intensive tasks by occupation (0–10) (Kroll, 2016), 'O'NET Hazard' is an index of exposure to hazardous conditions (O–100) from O'NET. Additional regressors: age, age squared, gender, sector (three digits, columns 1 and 2; two digits, columns 3 and 4), year, trimester, and province fixed effects and a constant. The sample is restricted to the native workers (aged 16–65). SEs are clustered at the province level. The estimates include sampling weights.

VII. Conclusions

Using administrative data on injury-recovery paid sick leave and doctor-assessed measures of impairment severity, we find that an increase in the share of migrants leads to a significant drop in prescribed sick leave and degree of physical impairment among native workers. Looking at heterogeneous effects, we find that the impact is largest among the eldest workers, aged 50–65, and in the manufacturing and construction sectors. Further, our findings show an overall positive welfare effect of immigration on occupational injuries for the entire employed population, including native as well as migrant workers. As the literature suggests that irregular migration follows the spatial distribution of regular migrants in Italy, our estimates likely represent the combined impact of the presence of workers with and without regular immigration status on the severity of occupational injuries. Using individual-level labour force data, we find that native workers' transitions between occupations and sectors and limited. This suggests that immigration can contribute to improving occupational health even if native workers do not move to less risky jobs.

These findings have direct policy-relevant implications. Public opinion considers immigration as one of the most critical issues faced by receiving countries nowadays. Preferences for immigration contribute to shaping electoral outcomes and extremist ideologies (Barone *et al.*, 2016; Halla, Wagner, and Zweimüller, 2017; Dustmann *et al.*, 2018; Mayda, Peri, and Steingress, 2018; Edo *et al.*, 2019), while the size and impact of immigration on receiving economies are largely misperceived (Alesina *et al.*, 2018).

Our analysis shows that immigration can contribute positively to native workers' occupational health. A reduction in the severity of work-related injuries and in the duration of postinjury mandated paid sick leave matters also in terms of public and private spending. On average, occupational illnesses and injuries cost 4% of a country's GDP per year (Arbeitsamt *et al.*, 2018; Tompa *et al.*, 2019). The consequences of injuries go beyond direct medical care compensations and include productivity losses, higher health insurance risk premium payments, as well as opportunity costs from alternative allocations of resources. The results of this paper suggest that immigration can contribute positively to

workers' occupational health and alleviate the burden of work-related injuries on private and public budgets.

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Supporting Information

Additional Supporting Information may be found in the online Appendix:

Appendix S1. Supporting information

Data replication package: the data replication package is available at https://doi.org/10.3886/E188961