On the gap in workplace injuries and wages between native and foreign workers: the role of observable characteristics

Anna D'Ambrosio*[1], Roberto Leombruni†[1,2] and Tiziano Razzolini‡[2,3,4]

[1]University of Turin, Department of Economics and Statistics "Cognetti de Martiis"
[2]LABOR
[3]University of Siena
[4]IZA

July 20, 2016

Abstract

Applying propensity score reweighting to Italian administrative data covering the period 1994-2012, we study the distributions of injuries and wages of native and foreign workers and distinguish between the component that is explained by observable characteristics and the component that is instead attributable to the immigrant status. Our analyses highlight some stylized facts. Consistent with previous literature, we detect a gap in wage and injury risk that cannot be attributed to differences in the workers' and workplace characteristics. The magnitude of the residual component in wages faces a peak in 2003, the year where a set of restrictions to immigration policy and a related immigration amnesty entered into force. As regards injury risk, after this year we find evidence of increased underreporting. Looking at the distribution of injury rates by wage deciles, we find that foreign workers systematically face higher levels of risk by the same level of wages, to a much greater extent than their observable characteristics would predict. We identify an empirical threshold after which workers appear to trade-off wage and workplace safety. Before this threshold, no significant relationship between wage and injury risk emerges. While, however, the threshold is reached by native workers between the 3rd and the 4th decile of the wage distribution, it is reached by foreign workers at higher deciles (between the 6th and the 7th). This implies that, for a majority of foreign workers, wages are too low to allow for a trade-off between safety and wage, which leads to a fairly equal distribution of risk within this population - as is shown in a set of concentration curves. The concentration curves also show that, following the global financial crisis, we observe a convergence between the characteristics of the less wealthy natives (up to the 25% percentile) and those of immigrants.

*anna.dambrosio@unito.it
†roberto.leombruni@unito.it
‡tiziano.razzolini.unisi@gmail.com

Keywords: Foreign workers, wage gap, occupational injuries, propensity score reweighting Di Nardo-Fortin-Lemieux decomposition

1 Introduction

There is growing international evidence in the literature that foreign workers are employed in riskier jobs, and that they tend to accept jobs that are remunerated less. To analyze the determinants of this gap, one crucial question to be addressed is whether the gap is due to differences in the characteristics of native and foreign workers, or whether it is due to a different "remuneration" of the same characteristics - i.e., whether, being equivalent on all observable characteristics, natives and foreign workers, immigrants are still facing a wage differential. This distinction, first introduced in the labour economics literature on gender wage gaps by Oaxaca (1973) and Blinder (1973), is criticised because of the difficulties in attributing purely to discrimination the determinants of the wage differential which are included in the "residual" component and are not attributable to differences in the characteristics (see, for instance Fortin et al., 2011). Indeed, this "residual component" includes all characteristics which are specific to the group of foreign workers - ranging from the inferior mastery of the local language, to alleged preferences for "worse" jobs due to different attitude towards risk, to discriminatory attitudes by employers. While there are currently no statistical techniques able to disentangle the different determinants of the residual gaps in wage and injuries, in this paper we propose to study the time variation in this residual component, and to link it with policy and institutional changes that may ultimately yield insights on its determinants. A further contribution relates to the analysis of the wage and injury gap jointly, which is done only by a minority of studies, in spite of the important insights that can be gained from combining wages with other indicators of job quality (see, for instance Leombruni et al., 2013).

The wage gap between immigrants and natives in Italy has been reported to range between 14.7% and 38.7%, (Venturini and Villosio, 2002; Allasino et al., 2004; Falzoni et al., 2004; Piazzalunga, 2015), where a large component is attributable to differences in the characteristics. Similarly, Orrenius and Zavodny (2009) and Orrenius and Zavodny (2013), show that, in most countries, immigrants are overrepresented in occupations and industries with greater injury risks. Whether this also translates in *ceteris paribus* greater injury and fatality rates for immigrants than for natives (as found by Orrenius and Zavodny, 2009; Salminen, 2009; Ahonen and Benavides, 2006; Bena and Giraudo, 2014) is an empirical issue which is heavily affected by the availability of data and by the empirical specification applied. Indeed, a non-negligible number of studies find that the gaps in wage and injuries between foreigners and natives should rather be attributed to the the dynamics of labour market segmentation (segregation) than to differential treatment at the workplace (e.g. Hamermesh, 1997; Bauer et al., 1998). In Italy, the workplace safety of immigrants with respect to natives has been investigated by Bena and Giraudo (2014); Bena et al. (2007); Capacci et al. (2005), who documented a significantly increased injury risk for some categories of immigrants, in particular those originating from Morocco and "high migration pressure countries", compared with natives and with immigrants from developed countries. According to their estimates, a foreign worker faces on average a 45% higher risk of workplace injury than a native.

In this paper, we address the question of whether native and foreign workers in Italy would have similar injury rates by similar wages if they had the same profile. This implies referring to the relationship between workplace safety and wages, i.e. the extent by which immigrants can be expected to claim a wage differential to compensate for workplace injury risk. In general, for all workers, risk aversion is expected to lead workers to claim higher wages for riskier jobs (Rosen, 1987). However, empirical studies have often observed a negative relation between wages and injury risk. Indeed, more more skilled and better-paid workers may want to trade off part of their earnings for greater safety and sort into safer occupations - i.e. higher skills and salaries would allow them "buy" more safety at work(Hamermesh, 1999a,b; Biddle and Zarkin, 1988).

The economic immigrant status may be associated with less risk aversion, considering the often temporary nature of the project, especially in its early phases: immigrants may accept risky jobs if these allow them to make fast money, which would locate them in the relatively "high risk" ends of the workplace safety distribution. If this applies, everything else equal, we should observe immigrants to undertake riskier but on average also better paid jobs. However, a number of factors could account for differences in immigrants' demand for a wage premium by more risky jobs (Orrenius and Zavodny, 2013). Essentially, disproportionate market pressure associated with inferior language mastery, bureaucratic difficulties with the recognition of their skills, institutional constraints on the legal authorizations to stay, smaller social networks and trade union integration can be expected to reduce workers' bargaining power and their ability to claim a higher wage for any given level of risk (Orrenius and Zavodny, 2013; Bena and Giraudo, 2014). For instance, if the residence permit issuance is conditioned to having a job, immigrants may be keen to accept lower-quality jobs or to accept worse working conditions within the same occupation. Also, as noted by Dávila et al. (2011), imperfect information may lead foreign workers to underestimate occupational risk and thus accept riskier occupations without claiming compensation for such risk: this could be the case if the average risk level in their home country is greater and leads them to mistakenly underestimate the risk of their occupation in the host country, or if employers deliberately misinform them about occupational risk. By segmented labour markets, immigrants are also likely to face flatter wage offer curves(Hersch and Viscusi, 2010; Orrenius and Zavodny, 2013). On the one hand, there are factors which are likely to increase the injury rates of immigrants compared to those of natives: injury prevention programmes and norms promoting the use of safety equipment may be less effective for immigrants because of language and cultural barriers. This would comparatively increase the costs of safety training and decrease their "safety-related productivity" (Hersch and Viscusi, 2010, p.752) with respect to natives. Furthermore, perceived racism and race-related stress are *per se* considered as risk factors for a number of diseases[1].

Overall, both demand and supply side considerations lead us to expect that immigrants will have different combinations of risk and wages compared with natives, leading us to observe on average higher levels of occupational risk by the same level of salaries (see Orrenius and Zavodny, 2009, for a graphic illustration). Notice that,

[1]Clark (2004) provides an overview of the literature and a conceptual framework to analyse the role of racism in affecting the health of immigrants. Murray (2003) reviews the methods to uncover the racial/ethnic bias in health.

in the above discussion, we considered only immigrant-specific factors which would add up to the gap due to the characteristics of the workers (who are on average less qualified, younger and more frequently male) and to their sectoral concentration in riskier sectors, which is certainly also associated with their lower bargaining power - in some riskier sectors with relatively low value added, the costs of investing in workplace safety may be so high that the employer may not be able to bear them and to adjust salaries accordingly. The wage offer curve will be more rigid than in other sectors, and these jobs will be left vacant by workers with greater reservation safety and wages. Greater market pressure and less outside options may force immigrants to accept these jobs, leading to a concentration of immigrants into "3D" jobs ("dirty, dangerous and demanding", see Abella et al., 1994).

In this paper, we investigate the extent to which the gaps in wages and injuries can be attributed to differences in the workers' characteristics and the extent to which the differential can be attributed to the fact of being an immigrant, and we study the evolution of both components over the 1994-2012 period. Our results show that, a substantial gap in wage and injury risk that cannot be attributed to differences in the characteristics, and that foreign workers face higher levels of risk by the same level of wages. For a majority of the foreign workers, wages are too low to allow for a trade-off between safety and wage, which leads to a fairly equal distribution of risk within this population.

Section 2 presents our data and our methodological approach and our data. Section 3 presents the results; section 4 discusses the main findings; section 5 concludes.

2 Methodology

In order to analyze the different components of the wage gap, we apply the decomposition introduced by DiNardo et al. (1996) (hereinafter DFL decomposition) as well as its application to discrete data (Biewen, 2001). This methodology allows us creating a counterfactual immigrant population which is employed in the same sectors, with the same occupation, age, tenure and gender profile as the observed immigrant population, but is paid according to the wage schedule of the natives (or faces an injury risk comparable to those of natives (cfr. DiNardo et al., 1996). This allows us distinguishing the effect of the workers' characteristics on injury and wages from the effect of the remuneration of the workers' characteristics along the whole wage and injury distributions.

In essence, this is done by computing the propensity scores to be an immigrant and to be a native based on a set of characteristics, and by reweighting each observation in the native subsample by the ratio of the two (Hirano et al., 2003)[2]. In this reweighed distribution, those natives who are more similar to immigrants are weighted more; hence, analysing injury rates and wages of this distribution gives a measure of what wages and injury rates natives would display if they had the same characteristics as the immigrants.

This approach is equivalent to viewing the immigration status as a "treatment" (cfr. Barsky et al., 2002; DiNardo, 2002; Brunell and DiNardo, 2004) and to analyze the effect of being an immigrant on the distribution of wages and injuries under a "selection on observables" set of assumptions (e.g. Heckman et al., 1997). In

[2]This is implemented in practice by including the weights in a kernel density function applied to the observations of the natives.

this sense, the DFL decomposition is very similar in its approach to propensity score matching techniques. The main difference is that, instead of looking for the counterfactual by matching treated and non-treated units on the propensity score, we construct the counterfactual by reweighting each individual in the non-treated group to give more weight to individuals that are more similar to the treated. For this reason, the technique is also known as "propensity score reweighting" (DiNardo, 2002) and, similarly to the propensity score, is semiparametric.

More formally, in the DFL framework, we can write the density of an outcome variable y (the wage density, or the distribution of injuries) as a function of the immigration status T, where $T = 1$ if the person is an immigrant and $T = 0$ if the person is not an immigrant, and of a set of characteristics z (see DiNardo, 2002; Brunell and DiNardo, 2004)[3]. This simply derives from the definition of conditional probabilities:

$$f(y|T=1) = \int f^1(y|z)h(z|T=1)dz \tag{1}$$

$$f(y|T=0) = \int f^0(y|z)h(z|T=0)dz \tag{2}$$

In our case, $f(y|T=1)$ is either the wage density or the injury density[4] that applies to immigrant workers. $f(y|T=0)$ is instead the wage density or the injury density that applies to non-immigrant workers. The key contribution of the DFL approach is in showing that the counterfactual distribution of y that would prevail if the natives would have the same distribution of characteristics as the immigrants, can be written as a reweighted distribution of the observed density of natives[5]:

$$\int f^0(y|z)h(z|T=1)dz = \int w_z f^0(y|z)h(z|T=0)dz \tag{3}$$

The weights w_z are defined as the ratio of the density of characteristic z in the two subsamples. They can be seen as the ratio of the probability to observe a given characteristic (or combination of characteristics) among immigrants to the probability to observe it among natives. This way of seeing it allows a convenient simplification:

$$w_z = \frac{h(z|T=1)}{h(z|T=0)} = \frac{P(T=1|z)}{1-P(T=1|z)}\frac{P_0}{P_1} \tag{4}$$

where the second equality derives from applying the Bayes' law. While estimation of $h(z|T)$ is hampered by a dimensionality problem, the conditional probability of being an immigrant given a set of characteristics can be estimated by binary choice models such as logit or probit; P_0 and P_1 are respectively and the share of natives

[3]Conditioning on a single characteristic is not a very restrictive assumption if we see it as a discrete variable taking as values all the permutations of a set of characteristics.

[4]We can treat injury density as a continuous variable considering that we measure injuries as a ratio of the number of injuries to total person-years worked in a given cell of homogeneous characteristics.

[5]Notice that, as discussed in details in Barsky et al. (2002), one might be tempted to study the opposite, i.e. the counterfactual distribution of wages and injuries which would prevail if immigrants had the same characteristics as natives. This, however, would imply an extrapolation rather than an interpolation, and would increase the estimation error: we do not observe, among immigrants, a large number of combinations of characteristics that we do observe for natives. This makes natives a natural control group for immigrants, and not the opposite.

over the sample and the shares of immigrants over the sample[6]. In essence, w_z give more weight to the native individuals who display characteristics that are more similar to those of immigrants. Plugging the weights into a kernel density function allows estimating the counterfactual densities of y at each point y_t:

$$\hat{f}(y_t) = \sum_{i \in S_y} \hat{w}_{z_i} \frac{1}{Nh} K(\frac{y - y_t}{h})$$

Where h is the bandwidth and K is a kernel function - the gaussian in our application as well as in DiNardo et al. (1996). The reweighting procedure allows constructing a fictitious immigrant population which is employed in the same sectors, with the same occupation, age, tenure and gender profile as the observed immigrant population, but is paid according to the wage schedule of the natives (or has a risk propensity comparable to that of natives) (cfr. DiNardo et al., 1996). This procedure can be straightforwardly extended to construct the counterfactual concentration curves for injuries and wages (as in Razzolini et al., 2014), as well as the counterfactual joint distribution of wages and injuries.

The choice of the characteristics z which we use to estimate the propensity scores is largely data driven (see section 2.1): as regards the work relationship, we include firm size, firm age, 18 sectoral dummies, region of work, and type of contract; as regards the individual, we include age, gender, qualification, tenure, and, for the years where the information is available, a binary variable equal to 1 if the person received family allowances or not.

The differences between the observed distribution of natives and the counterfactual give a measure of the gaps due to the difference in characteristics; the differences between the counterfactual and the observed distribution of foreigners give a measure of the "unexplained" or "residual" difference (see DiNardo et al., 1996; Biewen, 2001; Barsky et al., 2002, for a more formal discussion). Hence, the latter can be attributed the "effect" of being an immigrant. As mentioned above, however, this approach does not allow disentangling systematic differences between the natives and the immigrants which are due to observable characteristics that are an exclusive attribute of immigrants - for example, language difficulties - from more subtle differences due, for example, to discrimination. Yet, the dynamics of both the "explained" and "residual" component can be studied and yield useful descriptive insights.

The necessary underlying assumption for this analysis is that, controlling for observable characteristics of the workers, the only systematic differences in the injury rates and expected wages between natives and immigrants are due to the immigration status[7]. This does not rule out, as argued for example by Starren et al. (2013)

[6]If these combinations could be fully explained by discrete data, the nonparametric analog of this procedure would be to study the relative shares of immigrants and natives within each cell.

[7]This is not a neutral assumption. Some works, indeed, argue that immigrants sort into immigration because they are less risk averse (Berger and Gabriel, 1991; Bonin et al., 2009); other works underline that immigrants are able to undertake more strenuous jobs because they are on average younger and healthier than the average in their origin populations (the so-called "healthy immigrant effect" Antecol and Bedard (2006)). As to the first critique, we may argue that it is not quite clear how the sort of risk aversion that is needed to undertake a migration project would translate into the workers' safety behaviour at work: exactly because one undertook the (income) risk of migrating, she may want to be more careful at work not to waste an economic opportunity. Hence we consider the effect of this kind of

and Bena and Giraudo (2014), that cultural differences may play a role in determining heterogeneity in the occupational safety perceptions and behaviours within the group of immigrants. Unfortunately, such immigrant-specific characteristics cannot be included in the specification of the propensity scores. Indeed, the weights are constructed as the ratio of the propensity score to be an immigrant to the propensity score of being a native: if the latter is very close to zero, the corresponding weight will be extremely large. This means that the treated and untreated groups must be compared over realisations of characteristics that are observed in both groups - something analogous to the "common support" condition of the propensity score matching (see Heckman et al., 1997, 1998). To avoid extremely large weights, we discarded the observations for which $\hat{P}(T = 1|z) < min[\hat{P}(T = 0|z)]$ (cfr. Dehejia and Wahba, 2002), which typically implied dropping a negligible number of observations every year. Another practical implication of this problem is that we cannot control for variables such as the language abilities of immigrants or their countries of origin. For this reason, we conducted all our analysis using five factuals: the whole of the immigrant population; the immigrant population from "high migration pressure countries" (HMP); and the immigrant population from the two most representative countries: Morocco, Romania. In this paper, we report the results of the analyses where the "treated", or "factual", group is represented by immigrants from HMP countries - which for illustrative purposes we often refer to as "foreigners"; the corresponding "untreated" group is composed of workers born in Italy and in advanced development countries - which we often refer to as "natives" for simplicity. The choice of such factual and unfactual groups is motivated by the need to ensure the largest possible homogeneity among each group of workers. Anyway, the results are very similar to those obtained in the analysis adopting the whole of the foreign population as group of the "treated" and the strictly Italian-born population as the "untreated" group, given that the population of foreign workers in Italy is largely composed of workers from HMP countries[8].

To analyse the relationship between injuries and wages, we use concentration curves (Wagstaff et al., 1991; Kakwani et al., 1997). Concentration curves are in essence a two-variable modification of the Lorenz curve which allow comparing the distribution of the cumulative shares of "ill health" (e.g., injuries) with the corresponding quantiles of population ranked by wage. As with the Lorenz curve, the further away the concentration curve is from the 45-degree line, the more concentrated is the distribution. As we are measuring "ill health", a concentration curve that lies above the diagonal indicates concentration of ill-health among the lower wages, while a concentration curve lying below the diagonal indicates concentration among the high wages. The corresponding concentration index can be computed as twice the area between the concentration curve and the diagonal. The counterfac-

risk aversion as *a priori* ambiguous in determining the injury rates of immigrants with respect to natives. As to the second critique, fortunately, our database allows us controlling for the age of the worker in the empirical analysis. Other kind of systematic differences, such as misperceptions about the level of risk in the host country, can be considered as effects of the immigration status which would not apply if the person did not migrate.

[8]These results are available upon request. The results obtained for the whole of the immigrant population and for HMP countries are confirmed and even more neat when adopting Morocco as a factual group. The findings for Romania support the hypothesis of heterogeneity across cultural groups, considering that most of the findings are reversed for this subset of workers. For reasons of space, we do not include them in the present paper, but they are also available upon request.

tual concentration curve was obtained by reweighting the observations by the DFL weight.

In all cases, we performed the analysis using two measures of injuries: all reported and certified injuries; immediate-care injuries, i.e. the injuries requiring immediate hospitalization[9].

2.1 Data

We use administrative data deriving from the linkage of the Work Histories Italian Panel (WHIP), a 1:15 sample of the Italian social security data, with administrative records from the Italian Workers' Compensation Authority (INAIL) for the years 1994-2012 Bena et al. (2012). This dataset uniquely offers individual level information on injuries. Overall, the data set includes between 600,000 and 1,400,000 individual records for each of the 18 years in the sample. It provides information on worker and job characteristics (age, sex, place of birth, type of occupation, type of contract, family allowances, tenure, firm age, sector, size of firm, number of weeks worked in a year, part-time job, earnings), as well as on the number of work-related injuries (all of which are certified by physicians), their level of severity, and the lost days of work. Hence, our data set provides an exceptionally rich source of information which we use to analyze the joint distribution of (deflated) weekly earnings and workplace injuries. Despite this wealth of information there are two main limitations in our data. First, a precise estimation of injury risk is only available for employees in the non-agricultural private sector, as employees in other sectors are either not covered (public sector, agriculture and fishing), or the available information is inadequate to measure the exposure to injury risk (hours of work and days of work for self-employed workers are imprecisely measured). Lack of reliable information in the data also forces us to exclude domestic workers, whose exclusion is particularly unfortunate in an analysis of immigrant wage gaps considering the importance of this sector for the employment of female immigrants in the Italian context. Therefore, we opt to focus on male workers. Second, like many administrative records that are used to compute social security benefits, our data set has no information on education, as education does not enter the benefit formula directly. Fortunately, the data does include information on whether the worker is a blue or a white collar, or whether he has managerial tasks, which tends to be highly correlated with education.

Our dataset allows investigating a relatively long time span of 18 years, during which a number of significant policy changes of relevance to immigration and, in particular, to the access of foreign workers to regular employment occurred: considering that restrictions to regular employment are considered among the legal and institutional risk factors for severe labour exploitation (FRA, 2015), these changes are likely to have an effect on the distribution of wages and injuries among foreign workers. Among these, in 1997 the Schengen Treaty establishing free movement of people within the EU entered into force; in 1998 the first major immigration reform introduced by law nro. 40/1998, entered into force in 1999; in 2002 law 189/2002 amended immigration law in a more restrictive sense and entered into force in 2003 jointly with a massime immigration amnesty; in 2004 the accession of 10 Eastern European countries to the EU and in 2006 the lifting of the temporary restrictions

[9]The results are similar also when using the number of lost workdays as a measure of injuries and are available upon request

to the free movement of their citizens in Italy; in 2007 the accession of Romania and Bulgaria to the EU, with restrictions lifted in 2012 (Einaudi, 2007; Salis, 2012; Cangiano, 2014). Furthermore, the time span under consideration covers the years of the global economic crisis bursted in 2008. In this framework, we study the time variation in the explained and residual differences between immigrants and natives.

Based on preliminary year-by-year analysis, in what follows, we will split our data into four periods. The first period covers 1994-1998, and corresponds to the years preceding the entry into force of the two major immigration reforms in Italy, Law nro. 40/1998, popularly known as Turco-Napolitano after its proponents. The second period corresponds to 1999-2002 and lasts from the first entry into force of the Turco-Napolitano law to the introduction of the second major immigration reform, Law nro. 189/2002, which is popularly known as the Bossi-Fini law. The third period that we consider (2003-2006) is the one between the passing of the Bossi-Fini law and the enlargement of the EU to Romania and Bulgaria. The fourth, lasting from 2007 to 2012, is the post-enlargement crisis period during which the great recession took place.

Some descriptive statistics for 1994, 2003 and 2012 are reported in the Appendix in table A.3. While substantial gaps and differences emerge between the groups of natives and foreigners, a tendency towards some convergence can be noted for most variables.

3 Results

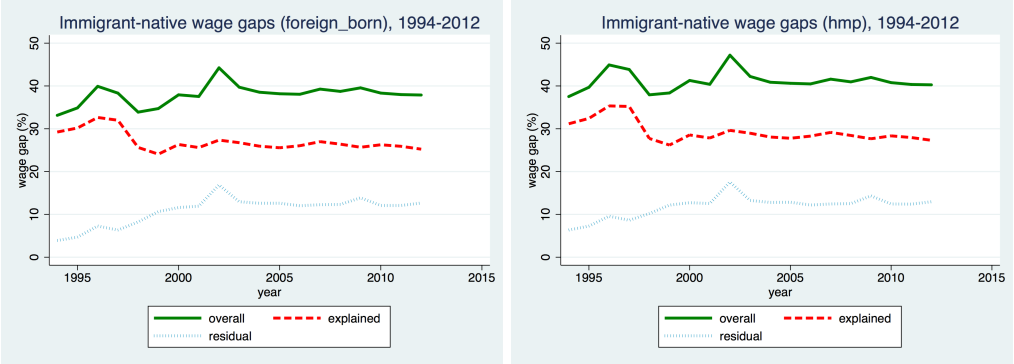
3.1 Wages

Over the whole period, the distribution of wages of foreigners is shifted to the left and more concentrated around the mean than the distribution of natives. The counterfactual distribution is quite similar to the one of foreigners, but shifted towards the right around a higher mean (cfr. Fig **??** and A.9 in Appendix). The average foreign wage is around 40% of natives' wages, and the gap remains relatively stable over time, with a single peak in 2003 (Fig. 1). The figure also reports the component that is "explained" by the difference in characteristics (i.e. the difference between the natives' and the counterfactual curve) and the "residual" component, which is attributable to the effect of being foreigner - that is, the difference between the counterfactual and the foreigners. Inspection of the time variation in these two components shows that, in the early years of the period, the differences in characteristics almost entirely explained the gap; since the late nineties, the explained component of the gap has stabilised around three quarters of the wage gap. The residual component has grown until 2003 and has stabilised around 12-13% since then; these results are somewhat smaller but in line with the recent findings in the literature on the wage gaps of immigrants (see also table 1 and Fig. A.9 in Appendix for a closer look at the variation in the explained and residual component along the whole of the distribution).

3.2 Injury risk

To study the distribution of injury risk we constructed cells of homogeneous characteristics (genere, age class, qualification, family allowances, region of work, semesters of tenure, type of contract, sector, firm size and firm age) and computed the average

Figure 1: Earning gaps 1994-2012.
Source: own computations on WHIP 2015.



injury risks per each cell. Based on the observed range of injury rates over the 18-year period, we assigned the injury rates of each cell to 80 risk classes of equal size. Based on the numerosity of the cells, we were in this way able to count the number of natives and of foreigners in each risk class, and their relative shares over their respective subsamples. The counterfactual distribution was obtained by reweighting the count of each cell by the DFL weight, and by computing the share of each class over the counterfactual sample. Because, fortunately, injuries are relatively rare events, the wide majority of our sample concentrates in the lowest risk class. For instance, in 1994, 96.02% of all natives were assigned to the lowest risk class, while 93.73% of all foreigners. Hence, to ensure statistical power in the higher risk classes, we pooled the data over the 18 years and dropped all classes above 10 (i.e. above an injury risk of 3 injuries per person-year); the yearly distributions closely resemble the pooled distribution. The results are reported in Fig. 2, where panels (a) and (b) report the whole distribution for all injuries and severe injuries only; while panels (c) and (d) zoom on the non-zero risk classes.

In all cases, the distribution of immigrants by risk classes is right-shifted with respect to the natives'; foreigners are less concentrated than natives in the lowest risk class, and more frequently observed in the immediately higher risk classes. The counterfactual distribution shows that, if natives had the same characteristics as foreigners, the distribution of natives' risk would also be more right-skewed and we would observe an higher average risk of injuries among natives. Interestingly, however, the difference in characteristics is useful in explaining the greater concentration of immigrants in moderately high risk classes (2-3 for all injuries and 2 for IC injuries). The concentration of immigrants in risk classes higher than 3 is instead to be attributed to the effect of being an immigrant (the difference between the figures for natives and for the counterfactual goes to zero in higher risk classes).

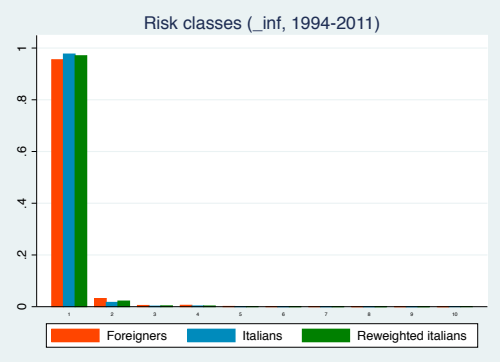
Once we can compare the observed distribution with the reweighted distribution, we can also compute the mean of the those distributions; comparing the mean injury rates for immigrants with the mean injury rates of the counterfactual population would provide a measure of the average treatment effect - i.e. the effect that immigrant status has on immigrants' injury rates (Hirano et al., 2003; DiNardo, 2002). As it is standard in the epidemiological literature, we opt to compare means by computing relative risks (RR) for the three considered subsamples.

	Average wage (EUR)			Wage gap (%)		
year	HMP	ADC	Cfactual	Overall	Explained	Residual
1994	10,639.79	17,029.78	11,722.29	37.52	31.17	6.36
1995	10,682.25	17,712.23	11,969.85	39.69	32.42	7.27
1996	9,709.81	17,627.08	11,397.48	44.92	35.34	9.57
1997	10,320.04	18,378.03	11,906.30	43.85	35.21	8.63
1998	10,069.33	16,223.09	11,724.20	37.93	27.73	10.20
1999	9,710.54	15,754.93	11,627.95	38.37	26.19	12.17
2000	9,338.54	15,904.52	11,363.31	41.28	28.55	12.73
2001	9,683.55	16,242.71	11,719.85	40.38	27.85	12.54
2002	8,841.27	16,742.58	11,782.87	47.19	29.62	17.57
2003	9,972.77	17,260.33	12,261.08	42.22	28.96	13.26
2004	10,521.80	17,793.99	12,798.59	40.87	28.07	12.80
2005	10,649.90	17,935.74	12,952.40	40.62	27.78	12.84
2006	11,042.50	18,551.23	13,303.90	40.48	28.29	12.19
2007	10,925.05	18,704.17	13,251.63	41.59	29.15	12.44
2008	11,665.51	19,757.29	14,138.76	40.96	28.44	12.52
2009	11,695.35	20,162.36	14,584.10	41.99	27.67	14.33
2010	12,185.56	20,576.20	14,744.51	40.78	28.34	12.44
2011	12,554.69	21,046.75	15,163.18	40.35	27.95	12.39
2012	12,856.19	2,1521.46	15,645.20	40.26	27.30	12.96

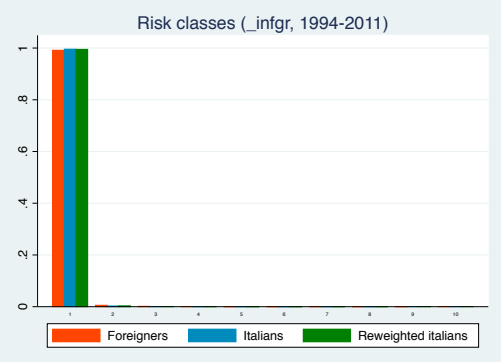
Table 1: Wages and wage gaps
Source: own computations on WHIP 2015

Table 2 reports the trends in injury rates for the foreigners, natives, and counterfactual subsamples. According to our calculations, as regards all injuries, injury rates of foreign workers are higher than those of natives. For both subsamples, the injury rates have increased remarkably during the 1998-2001 period, with foreigners experiencing a much steeper increase. Afterwards, both subsamples have seen a gradual reduction in injury rates which became even more marked during the years of the economic crisis, due to the strong pro-cyclical nature of injuries (**??**Boone and van Ours, 2006). The injury rates of the counterfactual locate in between the two subsamples and follow a similar hump-shaped trend peaking in 2000.

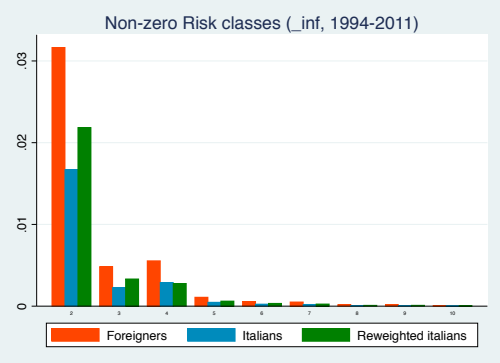
Relative risk trends of immigrants versus natives follow a similar trend, showing a marked increase up to 2000, and a relatively constant decline afterwards, suggesting that, while the increase in injury rates up to 2000 has affected both subsamples, foreign workers have been much more strongly affected, as shown graphically in fig. 3 (see also Table A.5 in the Appendix). This trend remains largely unexplained by the observable characteristics. Indeed, the component that is explained by the observable characteristics (the red dashed line) of the workers has remained relatively stable over time - between 1.35 and 1.47 - and has only slightly been declining in recent years due to the economic crisis. The trends in the observed gap between foreigners and natives (the green solid line) are mainly due to the dynamics of the unexplained component (the blue dotted line), which, while smaller in magnitude (ranging from 1.09 to 1.37), as followed a more volatile path: the unexplained component has dramatically increased in the late nineties up to 2000, after which it has been slightly declining. Currently, about 30% of the increased risk of injury faced by foreigners is attributable to the immigrant status. The decline in the relative risk of immigrants with respect to natives in recent years is attributable to both to



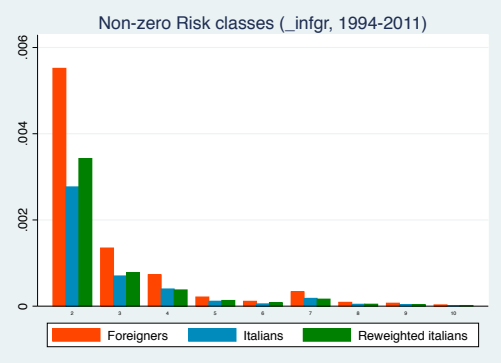
(a) All injuries



(b) Severe injuries

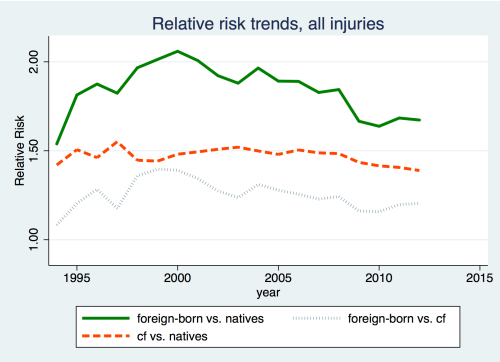


(c) Non-zero risk classes, all injuries



(d) Non-zero risk classes, severe injuries

Figure 2: Distribution of foreigners, natives and counterfactual by classes of risk
Source: own computations on WHIP 2015



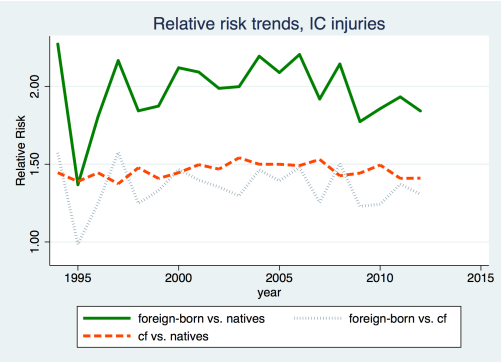


Figure 3: Relative risk trends, 1994-2012.
Source: own computations on WHIP 2015.

	All injuries			Immediate-care injuries		
Year	Foreigners	Italians	Cfactual	Foreigners	Italians	Cfactual
1994	7.52	5.12	6.91	0.76	0.42	0.56
1995	7.81	4.80	6.92	0.53	0.42	0.56
1996	7.73	4.69	6.64	0.79	0.40	0.53
1997	7.96	4.60	6.75	0.75	0.40	0.53
1998	10.73	5.82	8.06	0.88	0.51	0.71
1999	11.24	5.96	8.23	0.92	0.53	0.71
2000	11.48	5.93	8.39	1.06	0.53	0.73
2001	11.09	5.83	8.35	1.05	0.53	0.76
2002	10.11	5.47	7.98	0.98	0.51	0.71
2003	9.50	5.24	7.68	0.92	0.47	0.70
2004	9.58	5.06	7.34	1.00	0.47	0.69
2005	9.02	4.91	7.02	0.90	0.45	0.65
2006	8.90	4.88	7.10	0.95	0.45	0.64
2007	8.05	4.55	6.57	0.84	0.45	0.66
2008	7.63	4.26	6.15	0.85	0.41	0.58
2009	6.37	3.92	5.47	0.66	0.38	0.53
2010	6.23	3.91	5.39	0.64	0.36	0.51
2011	5.92	3.61	4.94	0.65	0.35	0.48
2012	5.28	3.28	4.45	0.59	0.33	0.45

Table 2: Injury rates, %(1994-2012)
Source: own computations on WHIP 2015

a more similar distribution by characteristics and to a less important role of the unexplained component. Both can be attributed partially to the effects of the global economic downturn which has restructured the sectoral distribution of natives in those jobs which, before the crisis, were mainly left to immigrant workers. The reduction in the unexplained component may also be attributed to the change in the composition of the immigrant population by nationality. Over the 2000s, the immigrant population has seen an increasing share of workers to originate from Eastern European countries, who are reported to display particularly low injury rates (Bena and Giraudo, 2014). The trends in immediate-care injuries suggest a very different dynamic than the overall declining trend in relative risks for the aggregate of injuries. Indeed, with the exception of 1995, both the explained and the unexplained component remain largely constant over time. The plot is obviously less smooth due to the lower numerosity of immediate-care injuries, but no recognizable pattern can be identified, and a substantial excess of risk among foreigners can be observed, out of which about 45-50% can be attributed to immigrant-specific factors (a figure which is comparable to the findings in Bena and Giraudo (2014) for the stratified samples). Considering that the different dynamics between the aggregate of injuries and the immediate-care injuries can be attributed in part to underreporting, our results suggest that the decline in the immigrant-specific component of all injuries can be attributed, at least partially, to underreporting.

3.3 Concentration curves

Having considered the distributions of injury rates and wages separately, we now turn to the analysis of the two jointly. A way to look at the distribution of injury

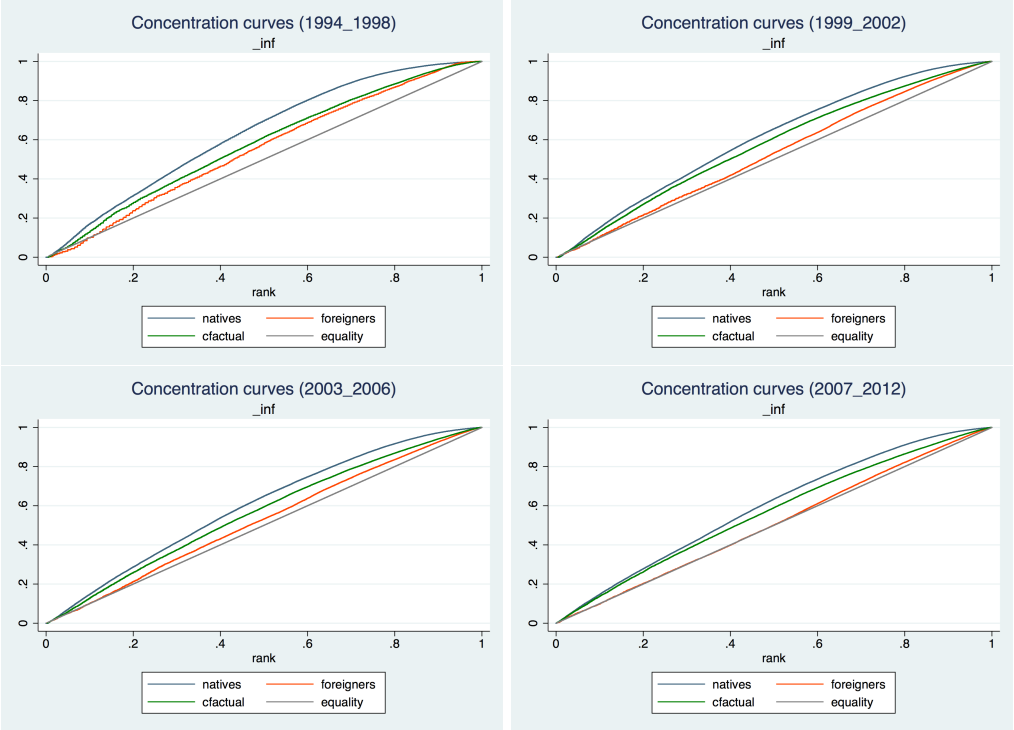


Figure 4: Concentration curves, all injuries
Source: own computations on WHIP 2015

rates by wage is to construct a concentration curve, which ranks individuals by wages and associates the cumulative share of injuries to the cumulative share of the individuals ranked by their wage[10]. Fig. 4 refers to all injuries and reports the concentration curves of the injury rates for the subsamples of natives, foreigners, and for the counterfactual over the four time periods that we consider: 1994-1998, 1999-2002, 2003-2006, and 2007-2012. Fig. 5 reports the same curves for severe injuries only. In all cases, the curves are located at or above the 45 ° line, which, unsurprisingly, implies that injuries are more concentrated among the lower salaries. The concentration curve of natives dominates the one of foreigners foreigners, indicating greater inequality in the distribution of injuries by wages in the native population; if natives had the same characteristics as the foreigners, they would show greater concentration - the concentration curve for the counterfactual also dominates the one of foreigners.

The dominance of the natives' curve with respect to the foreigners' decreases over time (cfr. also fig. 6. The concentration curve of foreigners gets closer and closer to diagonal. This suggests that the mechanism by which natives with higher salaries are able to avoid high injury rates does not apply to the relatively wealthier foreigners. In part, this is due to the characteristics of foreigners: the counterfactual curve is below the natives' in all cases, implying that sectoral and demographic characteristics in part contribute to a more rigid relationship between salaries and

[10]In order to compare wages across time, all wages are reported at constant 2012 prices.

injury rates, as could be expected. Comparing the counterfactual with the observed curve, however, it is apparent that the mechanism hindering the trade off between salaries and wages trade-off remains to a large extent due to the specificity of being a foreign worker, as the counterfactual curve is in turn neatly dominating the foreigners' in all cases.

A final insight offered by the concentration curves refers to the latter time slot: the increasing dominance of the natives' concentration curve with respect to that of foreigners is less and less due to differences in the observable characteristics of the foreign workers: indeed, the counterfactual concentration of injuries by salaries is quite similar, especially in the lower quantiles of the wage distributions, to the observed curve of natives. In other words, if in recent years natives had the same characteristics as foreigners... they would have a very similar concentration curve as the one we actually observe: this is likely because natives in the lower quantiles of wage have moved to the same sectors and work contracts which were previously reserved to immigrants. Hence, the difference in characteristics explains a relatively small portion of the difference in the two concentration curves and the residual difference increases.

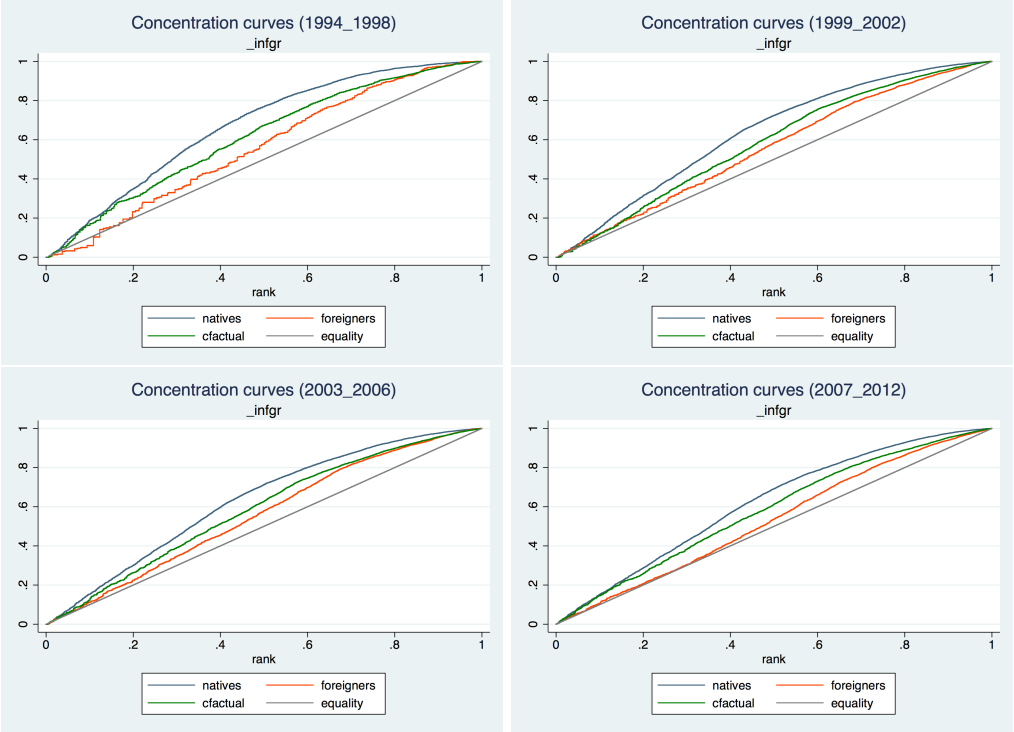
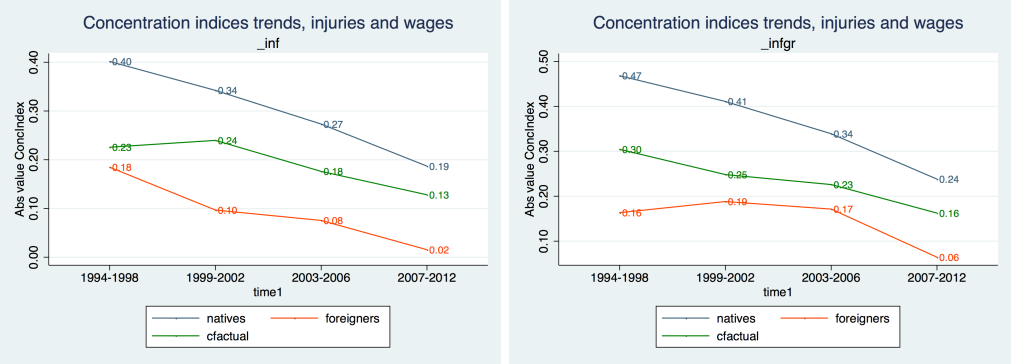


Figure 5: Concentration curves, severe injuries
Source: own computations on WHIP 2015

In Fig 5, we report the same pictures for immediate-care injuries. Comparing this with fig. 4, the foreigners' curve for severe injuries displays greater concentration than the curve for all injuries, suggesting that foreign workers with lower salaries may underreport less severe injuries. Still, the patterns sketched for the whole of



(a) All injuries

(b) Immediate-care injuries

Figure 6: Concentration indices trends
Source: own computations on WHIP 2015

injuries are observed also for immediate-care injuries.

Overall, the concentration curves as well as the concentration indices for the time slots in which we split our sample, (see fig. 6) show that inequalities in the injury distribution by wage have been noticeably decreasing over the 18 years of our sample.

A shortcoming of the concentration curves as an analytical tool lies in that each curve refers to within-group inequality and *per se* does not provide information about where the lower and upper tail of foreigners' salaries is located with respect to the natives' wage distributions. Indeed, if the range of salaries is substantially different between the natives and the foreigners' population, it could be misleading to draw conclusions solely on the basis of concentration curves; and the concentration index is insensitive to the mean level of salaries and injuries in each subpopulation. For this reason, in the next section, we add a set of plots of the injury rates by wage decile, as in Wagstaff et al. (1991).

3.4 Conditional distributions of wage by risk

In Fig. 7 and 8 we plot the injury rates for immediate-care injuries of the three subsamples (natives, foreigners and counterfactual) against the deciles of wage. These figures provide a number of insights. First of all, they show that in all cases, the schedule for foreigners lies above the schedule for natives. This means that, by the same level of wage, immigrants have higher injury rates. Second, the natives and foreigners' schedules show quite different socio-economic conditions of the two subsamples: just to make an example, in 2006, the 8th decile of the immigrants' wage distribution corresponded in absolute value to the 7th decile of the counterfactual, and to the 5th decile of the natives' wage distribution, with the foreigners' schedule always lying to the left of the natives' and counterfactuals' curve. Third, both figures show a negative relationship between wages and injury risk. However, and more markedly so for immediate-care injuries, at wage levels corresponding to roughly 18,000 euros yearly, we observe a marked decline in the injury rates for all three subsamples. Before this level, the injury rates are either constant or follow a chaotic non-recognisable path. After this level, instead, we observe a clear negative

relationship between wages and injury rates. This the threshold wage level, however, corresponds to a very different decile and a very different injury rate across subsamples. Fourth, with the exception of the first two deciles, the schedule for foreigners is located above and to the left with respect to the counterfactual schedule, suggesting that by the same level of wage, characteristics would predict lower injury rates than are observed. As regards the first two deciles, instead, there is no clear pattern distinguishing the dynamics of foreigners from the counterfactual. Fifth, the last panel of both figures which refers to the crisis times clearly shows a flattening of the curves, which can be attributed to the equalizing effect of the crisis.

Figure 7: Injury rates by wage decile.
Source: own computations on WHIP 2015

4 Discussion

The above-conducted analysis confirmed that the injury and wage gap faced by foreigners is not entirely due to differences in the observable characteristics, and that a non-negligible component in the wage and injury rate gap remains attributable to the specificities of being an immigrant - for instance, lower language mastery, lower bargaining power, discrimination, different cultural perception of the workplace risk.

Our results show that the foreign workers earning gap that is not explained by observable characteristics amounted in the more recent years to 12-13% of average wages, and that foreign workers face an overall risk of injury that is between 16% and 37% higher than that of natives. The picture is even more serious when looking at immediate-care injuries, for which immigrants are found to face a risk that is between 24 and 47% higher than natives and which is not attributable to observable characteristics.

Figure 8: Severe injury rates by wage decile.
Source: own computations on WHIP 2015.

Our analysis suggested that the residual component in the wage gap increased up to 2003, a year where it faced a peak, and stabilized afterwards, while the component attributable to observable characteristics was maximum up to 1997 and stabilized afterwards. Aggregate injury rates have followed an increasing trend until the early 2000s and then starting to decline, with a more marked drop in the years of the economic crisis. The component of the gap that is attributable to the specificities of immigrants is the main driver of this decline. The comparison with the trends for immediate-care injuries, however, which have remained substantially stable over the same period, suggests that this seemingly positive dynamic could actually be attributable to an increase in underreporting by immigrants. Indeed, the gap between all injuries and immediate-care injuries is considered in the literature as an indicator of underreporting. During the considered period, the two most important immigration reforms in Italian history were introduced - the so-called "Turco-Napolitano" and "Bossi-Fini" laws, which could be seen to increase the market pressure imposed to foreign workers. These reforms introduced restrictions to the conditions under which immigrants could obtain a regular stay permit, by imposing stricter controls on irregular immigration, by conditioning admission upon the availability of a job contract, and by introducing a stronger correspondence between the duration of the stay permit and the duration of the job contract (Einaudi, 2007; Salis, 2012). Furthermore, both reforms were accompanied by two massive immigration amnesties. On the whole, institutional factors having increased the need for immigrants to maintain their employment status may have de facto increased the incentives to underreport less severe injuries. The observation that, during the early years after these reforms, the unexplained component of the wage gap also increased, supports

this interpretation. An alternative explanation could attribute the decline in the unexplained component of the injury gap for all injuries to a change in the composition of the immigrant population, with an increasing component of Eastern Europeans, who are characterised by lower injury rates. We postpone a systematic analysis of the determinants of this gap to our future research agenda.

More generally, our results highlight some stylised facts regarding the joint distribution of wage and injury risk among foreign workers. First of all, immigrants' injury-by-wage schedule lies systematically above and left with respect to the natives, and to the counterfactual one. This confirms that, by the same level of wage, immigrants have higher injury rates. Furthermore, for all subsamples, the distribution of injury rates by wage changes radically around the value of an annual wage of ca. 18,000 euros. After this threshold, a clearly negative relationship can be identified - consistently with the interpretation in the literature that higher-paid and more skilled workers may trade-off part of their wage to "buy" more safety at work (see, for instance, Hamermesh, 1999a,b). Before this threshold, instead, no robust relationship can be identified, especially for severe injuries. This suggests that, by lower levels of salaries, workers are actually unable to do this trade-off, and have to undergo any level of risk that is entailed by their specific job. This general relationship, which seems to apply to foreign workers, to natives, as well as to our counterfactual, hides some important inequalities: indeed, comparing foreign and native workers' distributions, the empirical threshold we observed corresponds to a very different decile of the wage distribution: in most cases, the declining trend in injury risks does not appear before the 6th-7th decile of the wage distribution. This implies that only the wealthiest 30-40% of the immigrant population can "afford" less workplace risk. The negative relationship between injury rates and wages appears for natives at much smaller deciles, usually between the 3rd and the 4th (which implies that, quite differently, the wealthiest 60-70% of the native population can afford trading off wage for workplace safety). Interestingly, also our counterfactual distribution results sensitive to the empirical threshold: below the threshold, the results are mixed and the gap in injury rates cannot be straightforwardly attributed to differences in characteristics or to residual differences; above the threshold, the counterfactual distribution neatly locates in between the native and the foreigners' schedules, implying that, while a component of the excess of risk by similar wage levels is attributable to a difference in characteristics, still a non-negligible component remains attributable to immigrant-specific factors.

The insights gained from the analysis of the conditional distribution of wages by risk also clarify the findings of the concentration curves analysis. The large share of the immigrant population residing below the empirical threshold explains why immigrants' concentration curves of injuries by wages are quite close to perfect equality, especially in more recent years and for lower quantiles, and why one starts to observe some concentration of injuries after roughly the 40% percentile, and in some years ever later. The different distributions of wages and the convergence in the characteristics between immigrants and natives observed in section 2.1 explain that the counterfactual distribution of injuries in more recent years comes closer to the observed native concentration curve than to the immigrants' concentration curve: due to the labour market dynamics imposed by the global financial downturn, immigrants and natives result more similar to each other in the observable characteristics, but while such characteristics apply to most of the immigrant population, they only apply to natives with lower wages.

The overall decline in injury rates for all subsamples - foreigners, natives and counterfactual - is to a large extent responsible for the declining concentration indices over the considered time period. Interestingly, however, the trend of the counterfactual is much less steep than the observed trend, confirming that another important component of the decline in concentration indices is the less polarized distribution of characteristics within native workers. It is apparent, however, that immigrants' trends follow a distinct path compared to natives and to the counterfactual distribution. The very low concentration indices of the immigrant population, which as we showed is mainly to be attributed to the fact that for a majority of the foreign workers, wages are too low to allow for a trade-off between safety and wage, uncover the important question of the determinants of such disadvantage and of the relationship between in-group equality and between-group inequality.

5 Conclusions

The analysis has shown that, besides a substantial gap in wage and injury risk that cannot be attributed to differences in the characteristics, foreign workers face higher levels of risk by the same level of wages. For a majority of the foreign workers, wages are too low to allow for a trade-off between safety and wage, which leads to a fairly equal distribution of risk within this population. Hence, equality within the group arises from a condition of disadvantage with respect to the overall population. Due to the setting of the analysis, which was comparing natives and foreigners, we were not able to disentangle the determinants of this disadvantage, while the analysis showed that in some critical years during which market pressure increased, the gaps were more marked, while in more recent years, marked by the massive inflows of workers from Central and Eastern European countries and particular Romanians, the gaps decreased. A first follow up to this analysis should thus be an exploration of the determinants of the "residual" components of the gap that can be explained based on the characteristics of immigrants that are observable but not comparable with those of the native population - primarily immigrants' rights nationality, and their cultural closeness to the Italian, which can be seen as proxies of the mastery of the Italian language. Secondly, a more targeted exploration of the effects of institutional factors such as immigration reforms and EU enlargement in exerting or uplifting market pressure seems warranted: these institutional factors could affect the bargaining power of foreign workers on salaries as well as the workplace stress they face which are considered as risk factors for injuries.

Another stylised fact highlighted by the present paper is that recent dynamics associated with the global financial crisis have seen a convergence between the characteristics of the less wealthy natives and those of immigrants. It should be more closely addressed in order to examine whether the effect is temporary or more likely to bear long-lasting results, considering its potential implications for the post-crisis recovery and for the longer-term dynamics of labour markets.

Bibliography

Abella, M., Y. Park, and R. Boehning (1994). Adjustments to labour shortages and foreign workers in the Republic of Korea. International Migration Paper nro. 1.

Ahonen, E. and F. Benavides (2006). Risk of fatal and non-fatal occupational injury in foreign workers in Spain. *Journal of Epidemiology and Community Health*.

Allasino, E., E. Reyneri, A. Venturini, and G. Zincone (2004). Labour market discrimination against migrant workers in italy. Technical report. ILO International Migration Papers.

Antecol, H. and K. Bedard (2006). Unhealthy Assimilation: Why Do Immigrants Converge to American Health Status Levels? *Demography 43*, 337– 360.

Barsky, R., J. Bound, K. Charles, and J. Lupton (2002, September). Accounting for the Black-White Wealth Gap: A Nonparametric Approach. *Journal of the American Statistical Association 97*, 663–673.

Bauer, T. K., A. Million, R. Rotte, and K. F. Zimmermann (1998). Immigration Labor and Workplace Safety. Technical report. IZA Discussion Paper No. 16.

Bena, A., P. Berchialla, D. Quarta, O. Pasqualini, and G. Baffert (2007). Infortuni sul lavoro e percezione del rischio nei lavoratori stranieri impiegati nelle Grandi Opere in Italia. *Tendenze nuove*.

Bena, A. and M. Giraudo (2014). Rischio infortunistico nei lavoratori immigrati in italia: differenze per caratteristiche lavorative e per et‡. *Epidemiologia e Prevenzione 38*, 208–218.

Bena, A., R. Leombruni, M. Giraudo, and G. Costa (2012). A new italian surveillance system for occupational injuries: characteristics and initial results. *American Journal of Industrial Medicine 55*, 584–92.

Berger, M. C. and P. E. Gabriel (1991). Risk aversion and the earning of us immigrants and natives. *Applied Economics 23*(2), 311.

Biddle, J. and G. Zarkin (1988). Worker preference and market compensation for job risk. *The Review of Economics and Statistics 70*(4), 660–667.

Biewen, M. (2001, February). Measuring the Effects of Socio-Economic Variables on the Income Distribution: An Application to the East German Transition Process. *The Review of Economics and Statistics 83*(1), 185–190.

Blinder, A. (1973). Wage discrimination: Reduced form and structural estimates. *Journal of Human Resources 8*(4), 436–455.

Bonin, H., A. Constant, K. Tatsiramos, and K. F. Zimmermann (2009). Native-Migrant Differences in Risk Attitudes. *Applied Economics Letters 16*, 1581–1586.

Boone, J. and J. C. van Ours (2006). Are recessions good for workplace safety? *Journal of Health Economics 25*(6), 1069 – 1093.

Brunell, T. L. and J. DiNardo (2004). A propensity score reweighting approach to estimating the partisan effects of full turnout in american presidential elections. *Political Analysis 12*(1), 28–45.

Cangiano, A. (2014). Migration Policies and Migrant Employment Outcomes: Conceptual Analysis and Comparative Evidence for Europe. *Comparative Migration Studies 2*, 417–443.

Capacci, F., F. Carnevale, and N. Gazzano (2005). The health of foreign workers in italy. *International Journal of Occupational and Environmental Health 11*(1), 64–69. PMID: 15859193.

Clark, R. (2004). Significance of Perceived Racism: Toward Understanding Ethnic Group Disparities in Health, the Later Years. In N. Anderson, R. Bulatao, and B. Cohen (Eds.), *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*. Washington (DC): National Academies Press.

Dávila, A., M. T. Mora, and R. Gonz·lez (2011). English-Language Proficiency and Occupational Risk Among Hispanic Immigrant Men in the United States. *Industrial Relations 50*, 263–296.

Dehejia, R. H. and S. Wahba (2002, 2016/01/14). Propensity score-matching methods for nonexperimental causal studies. *Review of Economics and Statistics 84*(1), 151–161.

DiNardo, J., N. M. Fortin, and T. Lemieux (1996). Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. *Econometrica 64*(5), 1001–1044.

DiNardo, J. E. (2002). Propensity score reweighting and changes in wage distributions.

Einaudi, L. (2007). *Le politiche dell?immigrazione in Italia dall?Unit‡ a oggi*. Bari: Laterza.

Falzoni, A. M., A. Venturini, and C. Villosio (2004). Wage differentials and international trade in italy using individual micro data 1991-1996. IZA Discussion paper series 1204, Bonn.

Fortin, N., T. Lemieux, and S. Firpo (2011). *Decomposition Methods in Economics*, Volume 4 of *Handbook of Labor Economics*, Chapter 1, pp. 1–102. Elsevier.

FRA (2015). Severe labour exploitation: workers moving within or into the European Union. States' obligations and victims' rights. Technical report, FRA-European Union Agency for Fundamental Rights.

Hamermesh, D. S. (1997, September). Immigration and the quality of jobs. Working Paper 6195, National Bureau of Economic Research.

Hamermesh, D. S. (1999a). Changing inequality in markets for workplace amenities. *The Quarterly Journal of Economics 114*(4), 1085–1123.

Hamermesh, D. S. (1999b). Changing inequality in work injuries and work timing. *Monthly Labor Review 122*(10), 22–30.

Heckman, J. J., H. Ichimura, and P. Todd (1998). Matching As An Econometric Evaluation Estimator. *Review of Economic Studies 65*(2), 261–294.

Heckman, J. J., H. Ichimura, and P. E. Todd (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. *The Review of Economic Studies 64*(4), 605–654.

Hersch, J. and W. K. Viscusi (2010). Immigrant Status and the Value of Statistical Life. *Journal of Human Resources 45*(3).

Hirano, K., G. W. Imbens, and G. Ridder (2003). Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica 71*(4), 1161–1189.

Kakwani, N., A. Wagstaff, and E. van Doorslaer (1997, March). Socioeconomic inequalities in health: Measurement, computation, and statistical inference. *Journal of Econometrics 77*(1), 87–103.

Leombruni, R., T. Razzolini, and F. Serti (2013). The pecuniary and non-pecuniary costs of job displacement: ÄîThe risky job of being back to work. *European Economic Review 61*, 205 – 216.

Murray, L. R. (2003, 2016/03/21). Sick and tired of being sick and tired: Scientific evidence, methods, and research implications for racial and ethnic disparities in occupational health. *American Journal of Public Health 93*(2), 221–226.

Oaxaca, R. (1973, October). Male-Female Wage Differentials in Urban Labor Markets. *International Economic Review 14*(3), 693–709.

Orrenius, P. and M. Zavodny (2009, August). Do immigrants work in riskier jobs? *Demography 46*(3), 535–551.

Orrenius, P. M. and M. Zavodny (2013, March). Immigrants in risky occupations. In *International Handbook on the Economics of Migration*, Chapters, Chapter 11, pp. 214–226. Edward Elgar.

Piazzalunga, D. (2015). Is there a double-negative effect? gender and ethnic wage differentials in italy. *LABOUR 29*(3), 243–269.

Razzolini, T., R. Leombruni, G. Mastrobuoni, and M. Pagliero (2014, 10). Beneath the surface: The decline in gender injury gap. *Labour Economics 30*, 282–288.

Rosen, S. (1987). The theory of equalizing differences. In O. Ashenfelter and R. Layard (Eds.), *Handbook of Labor Economics*, Volume 1 of *Handbook of Labor Economics*, Chapter 12, pp. 641–692. Elsevier.

Salis, E. (2012). Labour migration governance in contemporary europe ? the case of italy. Technical report. Country Report for the LAB-MIG-GOV Project ?Which labour migration governance for a more dynamic and inclusive Europe?? FIERI Working Paper.

Salminen, S. (2009). Occupational Injuries of immigrant and Finnish bus drivers. *Journal of Safety Research*.

Starren, A., J. Hornikx, and K. Luijters (2013). Occupational safety in multicultural teams and organizations: A research agenda . *Safety Science 52*, 43 – 49. Selected Papers from the 1st International Safety and Crisis Management in the Construction, Tourism and {SME} Sectors.

Venturini, A. and C. Villosio (2002, April). Are Immigrants Competing with Natives in the Italian Labour Market? The Employment Effect. IZA Discussion Papers 467, Institute for the Study of Labor (IZA).

Wagstaff, A., P. Paci, and E. van Doorslaer (1991). On the measurement of inequalities in health. *Soc Sci Med 33*(5), 545–557.

A Appendix

	Native			Foreign-born		
year	1994	2003	2012	1994	2003	2012
Annual Wage (avg.)	16954.09	17120.11	21441.39	11528.06	10432.38	13444.52
Injuries						
Injury rate: all injuries	6.47	6.52	3.78	9.30	10.97	5.47
Injury rate: immediate-care injuries	0.57	0.67	0.42	1.10	1.15	0.67
Lost days of work (avg.)	1.57	2.24	1.38	2.15	3.37	1.90
Sector (%)						
Mining & quarrying	0.46	0.41	0.36	0.65	0.29	0.22
Manufacturing	40.65	40.84	35.62	40.41	37.76	33.63
Electricity, gas, water supply	4.68	1.41	1.25	1.31	0.09	0.09
Construction	12.68	15.08	12.73	16.32	25.04	19.20
Wholesale & retail trade; repair	9.40	14.11	16.23	8.22	7.16	8.91
Accommodation & food service	2.96	4.22	5.82	13.16	7.00	10.85
Transporting & storage	11.55	7.98	7.93	7.02	7.27	7.99
Financial & insurance	10.74	9.56	12.77	5.43	11.51	14.28
Real estate, ICT, professional, scientific	1.64	1.35	1.12	2.79	1.48	1.43
Education	0.77	1.04	1.63	0.67	0.48	0.81
Human health & social work	1.20	1.20	1.42	0.94	0.55	0.71
Administration	2.23	1.96	2.27	2.22	1.06	1.50
Age (avg.)	39.11	37.61	40.86	34.44	34.57	37.91
Tenure (avg.)	5.40	5.52	7.14	2.63	1.63	3.37
Firm age (avg.)	0.19	3.44	3.61	3.46	2.83	3.00
Type of contract (%)						
10	95.87	84.04	80.18	94.68	79.51	72.86
21		0.82	0.70		1.01	1.20
22		6.41	12.98		10.96	18.51
23	2.12	1.70		3.53	0.86	
24		1.50	1.69		3.94	2.83
25	2.00	5.53	4.44	1.79	3.71	4.60
Firm size (%)						
0-9	16.78	27.67	28.19	31.99	40.58	37.41
10-19	6.92	12.63	12.32	11.60	15.03	15.42
20-199	21.41	31.24	30.46	26.80	30.46	32.24
200-999	15.24	13.42	13.55	11.85	6.93	8.28
>=1000	39.65	15.04	15.49	17.76	7.00	6.65
Region of work (%)						
North	36.38	44.15	43.06	50.26	60.59	56.67
Centre	28.41	27.22	27.43	32.39	31.06	32.80
South and Islands	35.21	28.63	29.51	17.36	8.35	10.53

Qualification (%)						
Apprentice	2.00	5.53	4.44	1.79	3.71	4.60
Blue collar	60.90	66.68	65.30	79.95	92.32	90.96
White collar	37.10	27.80	30.26	18.26	3.97	4.45
Nro. of observations	120634	470343	434505	5098	111085	135292
(% of the sample)	95.95	80.89	76.26	4.05	19.11	23.74

Table A.3: Descriptive Statistics
Source: WHIP 2015

Table A.4: Relative risk (1994-2012)

	All injuries			Immediate-care injuries		
Year	Foreigners-natives	Foreigners-cf.	Cf.-Natives	Foreigners-natives	Foreigners-cf.	Cf.-Natives
1994	1.47	1.09	1.35	1.35	1.79	1.32
1995	1.63	1.13	1.44	0.95	1.26	1.33
1996	1.65	1.16	1.42	1.50	2.00	1.33
1997	1.73	1.18	1.47	1.41	1.87	1.32
1998	1.85	1.33	1.39	1.24	1.73	1.39
1999	1.88	1.37	1.38	1.29	1.74	1.35
2000	1.93	1.37	1.41	1.45	1.99	1.37
2001	1.90	1.33	1.43	1.38	1.97	1.43
2002	1.85	1.27	1.46	1.37	1.94	1.41
2003	1.81	1.24	1.46	1.31	1.93	1.47
2004	1.89	1.30	1.45	1.46	2.11	1.45
2005	1.84	1.29	1.43	1.38	1.98	1.43
2006	1.82	1.25	1.46	1.47	2.11	1.43
2007	1.77	1.23	1.44	1.26	1.85	1.46
2008	1.79	1.24	1.44	1.47	2.06	1.40
2009	1.63	1.17	1.40	1.25	1.74	1.40
2010	1.59	1.16	1.38	1.25	1.80	1.44
2011	1.64	1.20	1.37	1.37	1.88	1.37
2012	1.61	1.19	1.36	1.30	1.79	1.37

Table A.5: Trends in injury rates and relative risks.
Source: own computations on WHIP 2015

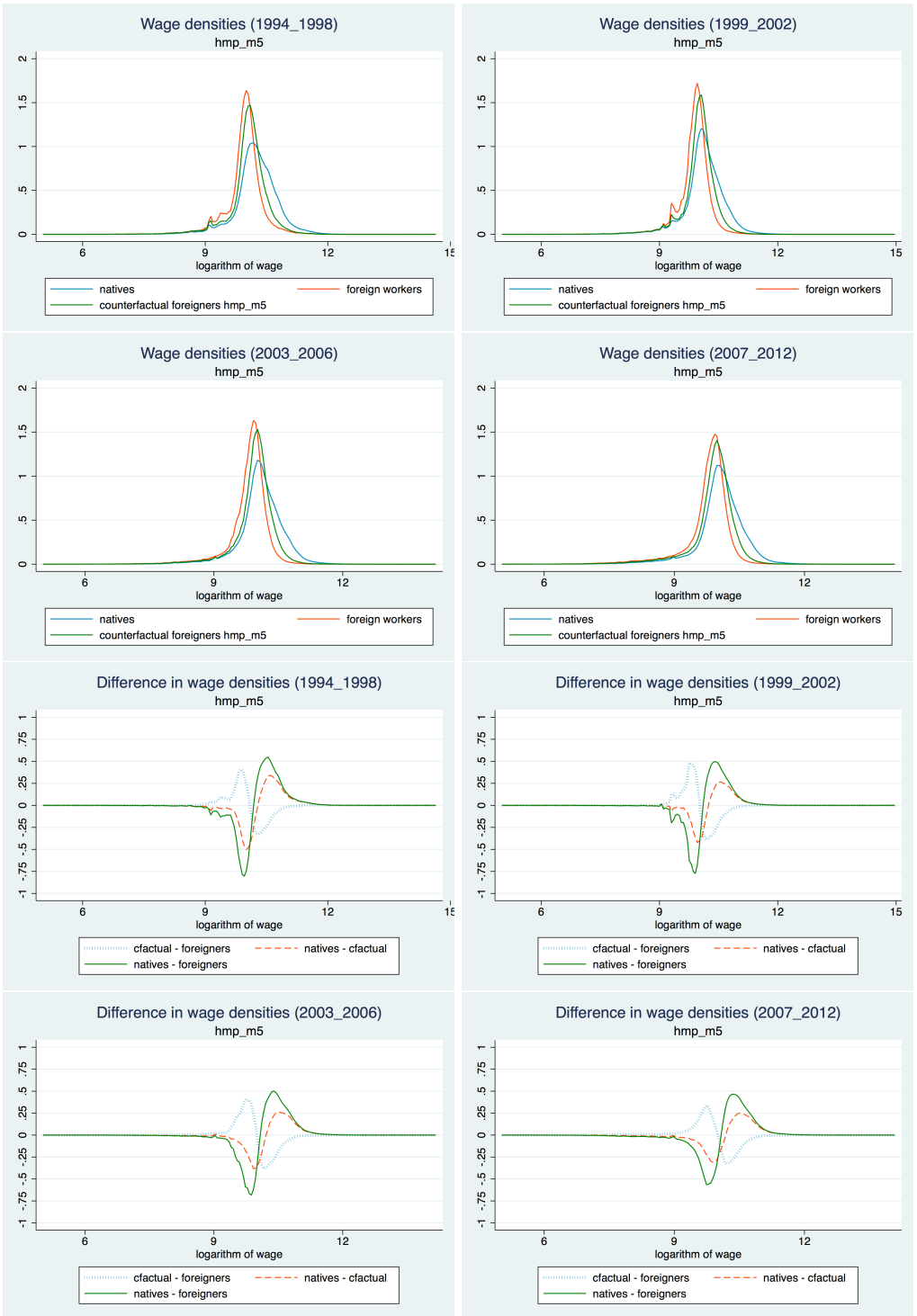


Figure A.9: Wage densities and differences in wage densities