Breaking Barriers

The Impact of Employer Exposure to Immigrants

Steven Lehrer, Louis-Pierre Lepage and Nuno Sousa Pereira

Stockholm University

SAMMANFATTNING AV SOFI WORKING PAPER 2/2024

Den här studien tar en närmare titt på hur arbetsgivares möten med invandrare påverkar invandrarnas möjligheter på arbetsmarknaden. Genom att använda Portugal, där immigration ökade kraftigt i slutet av 1990-talet, som exempel, undersöker studien hur arbetsgivares initiala tveksamhet eller fördomar mot invandrare kan minska när de lär känna dessa nya arbetstagare bättre.

Resultaten visar att ju mer arbetsgivare kommer i kontakt med invandrare, desto bättre blir invandrarnas chanser att lyckas ekonomiskt. Denna studie fann att ökad kontakt med invandrare kan förklara upp till en fjärdedel av minskningen i skillnaden i lön mellan personer födda i landet och de som immigrerat under de senaste tjugo åren. Speciellt viktigt verkar det vara när en arbetsgivare har positiva erfarenheter med invandrare från en viss region, vilket kan leda till att de är mer benägna att anställa fler från samma område i framtiden.

Studien pekar på att lagar och regler som gör det lättare för arbetsgivare att lära känna och anställa invandrare, till exempel genom subventionerade jobb, provanställningar eller kvotering, kan göra en stor skillnad för invandrarnas framgång på arbetsmarknaden. Den lyfter även fram hur viktigt det är för arbetsgivare att öppna sina sinnen och anpassa sina attityder, vilket kan bidra till att minska löneskillnaderna mellan inrikes- och utrikesfödda.

Breaking Barriers: The Impacts of Employer Exposure to Immigrants

Steven Lehrer

Queen's University and NBER

Louis-Pierre Lepage

Stockholm University

Nuno Sousa Pereira*

University of Porto

March 2024

Abstract

We study how exposure of employers to immigrants, both at the market and at the individual firm level, mitigates immigrant-native disparities. We use administrative employee-employer matched data from Portugal, which provides a unique setting given that it experienced almost no immigration until the early 2000s followed by substantial immigration waves. Focusing on the evolution of market wages across successive immigration cohorts, we find that increased employer exposure to immigrant groups can account for up to 25% of the wage convergence between immigrants and natives over the last two decades. We also document that individual-level exposure of firms to immigrants plays an important role, influencing future hiring and remuneration of immigrants. Our results provide new insights into how barriers to hiring different worker groups shape economic inequality, with novel implications for integration policies.

Large immigrant-native labor market disparities, along with challenges linked to immigrant integration, spark important political and policy debates in much of the Western world (Mayda et al., 2022). At the individual level, a large literature inspired by Allport (1954) studies how intergroup exposure shapes attitudes, including recent evidence on contact between natives and immigrants (Bursztyn et al., 2022). However, within a labor market context, an important question emerges: how does exposure of employers to immigrants influence economic disparities between natives and immigrants? As immigrants gradually integrate to the host labor market, not only could employer attitudes towards them evolve, but employers may also learn more about their productivity. Indeed, immigrants may differ from natives along several dimensions relevant for performance (e.g. language), generating uncertainty which is frequently reported in surveys as being an important barrier to hiring immigrants (MacKenzie and Forde, 2009; Lundborg and Skedinger, 2016; Farashah and Blomquist, 2019). In this paper, we study how the labor market outcomes of immigrants evolve as employers become increasingly exposed to them.

We consider an empirical setting in which employers had little to no prior exposure to immigrants and were suddenly faced with large immigration waves. Specifically, we use administrative employee-employer matched data from Portugal, a country with minimal immigration until the late 1990s followed by a rapid influx of immigrants, including from regions without evident cultural or historical ties to Portugal. Thus, Portugal provides a unique setting to study how exposure of employers to new groups mitigates immigrant-native disparities.

We provide evidence that employer exposure, beyond factors previously documented in the immigration literature, appears to play an important role in the economic integration of immigrants. We focus on the evolution of wages obtained *upon labor market entry* across successive immigrant cohorts from a given region over time, shutting down any source of economic integration that operates as immigrants spend time and gain experience in their host country. We document three novel facts indicative of exposure effects and find that growing exposure can account for up to 25% of the wage convergence between natives and immigrants in Portugal over the past two decades.

First, the wage of immigrants when they enter the labor market is lower than that of natives, but this gap decreases for each subsequent immigrant cohort from the same origin region. That is, immigrants have increasingly better initial labor market outcomes as their

group becomes more established in the host country, consistent with new immigrants facing progressively more favorable conditions.

Second, the conditional variance in the wage of immigrants when they enter the labor market exceeds that of natives, but this gap decreases for each subsequent immigrant cohort from the same origin region. In relative terms, immigrants with similar characteristics are treated more homogeneously by the labor market after their group has been established for longer, consistent with employer perceptions of immigrant groups converging over time.

Third, individual employer experiences with immigrant workers shape their subsequent hiring of immigrants and the compensation they receive. Employers are more inclined to hire immigrants when they have prior experience hiring immigrants, both from the same and other origin regions, suggesting the presence of exposure spillovers across immigrant groups. Furthermore, immigrants' wages upon entering the labor market are both higher and exhibit less variance at firms with more prior experience hiring immigrants, particularly positive experience as proxied by lower turnover of past hires.

Strikingly, using detailed information on job titles, we also find that HR managers seem to carry their experiences with them when they transition to new establishments. After the arrival of an HR manager with more experience hiring immigrants at their first establishment, immigrant hiring increases at the new establishment.[1] Taken together, our results demonstrate that individual-level exposure of employers to immigrants creates idiosyncratic differences in their hiring and compensation.

Our empirical results are consistent with changes in perceptions and information on the side of employers shaping the labor market outcomes of immigrants. In contrast, we find little support for alternative explanations that would operate through changes in immigrant characteristics or productivity, institutional features of the Portuguese labor market, the types of jobs immigrants do, or the types of firms they work at. Additionally, we explore immigrant networks as another potential alternative explanation for some of our results, but continue to find evidence of substantial wage convergence between immigrants and natives consistent with exposure effects.

---

[1]We do not claim that manager moves across establishments are exogenous to the new establishment's attitudes or plans for immigrant hiring. For example, suppose that some HR managers are specifically chosen by their new establishment because of their experience hiring immigrants. This would indicate that establishments themselves expect that having managers with experience is valuable for hiring and managing immigrants in the future, which is consistent with our primary proposition.

This paper contributes to the immigration literature by studying labor market disparities between immigrants and natives through a new lens. The literature has often focused on human capital, networks, and institutional policies to explain economic disparities. We instead focus on employer-side dynamics relating to shifting attitudes towards immigrants and learning about their productivity by studying a large exposure shock to a labor market with little prior immigration. Isolating similar mechanisms in countries like the US or the UK would be challenging, because employers likely have substantial previous exposure to various immigrant groups. Still, the exposure effects we document likely apply broadly across immigration contexts. Over recent decades, Western countries have received immigration from regions of Asia, the Middle-East, and Africa, which previously accounted for small shares of their population. Within these Western countries, progressively more immigrants also locate in regions with traditionally little immigration (Jensen and Yang, 2016).[2]

Since the relative wage of immigrants upon labor market entry increases across arrival cohorts, our results suggest that initial lack of exposure of employers to immigrants disadvantages immigrants, for example because employers underestimate their performance or are averse to ambiguity. This disadvantage decreases with exposure, highlighting that time for employers to assess immigrants and interact with them is itself important. These results are consistent with the contact hypothesis helping to explain labor market disparities between immigrants and natives, as well as with recent work in the employer learning and discrimination literature studying how employers face uncertainty about the productivity distribution of minority groups (Li et al., 2020; Lepage, 2023).

This paper also relates to an emerging literature on the role of employers in contributing to the immigrant-native earnings gap. Dostie et al. (2023) use the switcher design of Card et al. (2016) to conclude that firm pay policies account for roughly 20 percent of the gap in Canada. Arellano-Bover and San (2023) examine a mass migration of Jews from the Soviet Union to Israel in the 1990s, concluding that variation in firms' pay premiums accounts for 10–27% of the gap. In Portugal, Damas de Matos (2017) presents suggestive evidence that 30% of the immigrant-native wage convergence in the first years arises from immigrants

---

[2]Even within regions with a substantial immigrant population, our results suggest that the distribution of immigrants across firms matters; individual-level exposure of a firm to immigrants affects both the firm and its workers. Indeed, evidence from employer surveys referenced above and that on policy implications discussed below originate both from countries with recent immigration waves as well as countries with established immigration histories.

moving to firms with higher wage premiums. We propose employer exposure as a new channel through which firms dynamically shape the economic integration of immigrants.

Our findings regarding the importance of individual-level exposure provide a motivation for variation in pay premiums across firms. Previous work has documented that immigrants concentrate across certain firms (Brinatti and Morales, 2021), which we propose arises in part through gradual individual-level exposure of employers to immigrants. This finding is also consistent with growing evidence on experience effects in hiring, which we extend to an immigration setting (Leung, 2017; Benson and Lepage, 2023). Prior immigrant hires generate a spillover effect by influencing employers' subsequent hiring of these workers. One channel through which these spillover effects could operate is changing employers' perceptions of immigrants, consistent with evidence that employers are more willing to hire immigrants again if they perceive their initial experience as positive (Lundborg and Skedinger, 2016; Kubiciel-Lodzinska and Maj, 2017).

Lastly, our results have key implications for the design of effective integration policies. Policies which increase exposure to immigrants could be particularly effective, consistent with evidence that policies such as employment subsidies, trials, as well as pre-employment testing are particularly effective in improving labor market outcomes of immigrants (Butschek and Walter, 2014; Calmfors and Gassen, 2019; Loiacono and Silva-Vargas, 2023). Similarly, other policies which increase exposure and facilitate learning, some of which have been shown to be effective in decreasing disparities in the context of gender or race, could play a similar role for immigrants. These include affirmative action, hiring algorithms, hiring centralization, and policies incentivizing mobility across firms and regions (Miller, 2017; Li et al, 2020).

1 Institutional Background

1.1 Immigration to Portugal

Our research design is motivated by Portugal's distinct immigration history. Prior to 2000, foreign nationals constituted less than 2% of the population and an even smaller fraction of the workforce (Dias et al., 2002).[3] The top left panel of Figure 1 shows that there was a sharp increase in the fraction of immigrants beginning in 2000, from 1 to 5%, aided by

---

[3]See Carrington and de Lima (1996) for an analysis of early migration flows to Portugal.

reforms facilitating the immigration process.

In particular, legislation in 2001 shifted from giving preferential treatment to migrants from Portuguese-speaking countries to a universal approach covering different immigrant groups (Marques and Góis, 2007). The top right panel documents how immigration flows increased from several origin regions, some without a direct cultural or historical link to Portugal.[4] In particular, a substantial share of immigrants arrived from Eastern European countries. By 2008, Brazilian nationals were the major immigrant community in Portugal, accounting for more than 24 percent of total immigrants, followed by Cape Verde and Ukraine, both with shares of nearly 12 percent.

This sharp expansion of immigration provides a unique opportunity to investigate employer exposure to immigrants as a mechanism contributing to the immigrant-native wage gap. Prior to 2000, very few Portuguese employers would have been exposed to foreign workers, or were immigrants themselves.[5] This is in stark contrast to many countries including the US where immigrants not only account for over 14% of the population, but have been arriving in waves since the country's foundation (Abramitzky and Boustan, 2017).

As immigrants from a given region spend time in the labor market, they should interact with a growing number of employers, increasing their exposure to immigrants. For example, they may transit from entry positions at immigrant-intensive firms, providing an opportunity for more employers to become familiar with hiring them (Damas de Matos, 2017; Dostie et al., 2023). The bottom left panel of Figure 1 documents that firm-level exposure to immigrants increased steadily over our sample period, with a 30 percentage point increase in the share of firms having ever hired an immigrant. The bottom right panel shows that firm-level segregation calculated using the Duncan segregation index also fell sharply.

Figure 2 presents the log wage gap between natives and immigrants and the log wage gap between natives and new immigrants when they enter the Portuguese labor market (both unadjusted). Both gaps steadily decreased over our sample period, consistent with evidence from other European countries and the US (Chiswick, 1978; Lubotsky, 2007; Algan et al., 2010). The decreasing gap in the bottom panel suggests that factors at the immigrant group level, potentially including changing employer perceptions and learning, also played a role.

---

[4] Flows into Portugal from regions not shown in Table A1 were negligible and are excluded from the analysis.

[5] Carneiro et al. (2012) presents evidence that immigrants to Portugal were also highly concentrated in a relatively small number of establishments.

Moreover, the gains of immigrants in Figure 2 were realized over much of the sample period and not driven by a specific event.

1.2 Wage setting in Portugal's labor market

Beyond immigration history, some institutional features of Portugal play a role in the interpretation of our results. Nearly 90% of workers in the private sector are covered by collective bargaining agreements that operate within industry-specific occupations rather than firms. Each collective bargaining agreement focuses on establishing a wage floor for each industry-specific occupation, but firms can tailor compensation to individual workers above the floor. As such, there is clear scope for exposure effects to be reflected through changes in wages. Portugal also has a national minimum wage that can and sometimes does exceed the wage floor set under sectoral bargaining, covering roughly 1/6 of all workers.

In our analysis, we can rule out that increases in wage floors or the minimum wage over time are driving the wage convergence we document. Specifically, we present evidence of wage convergence both within and across sectors and occupations, across different age and education groups, and for both low and higher-wage workers. We are not aware of other features of the labor market or changes in market or immigration policies which could be driving the patterns we document, especially since we document economic convergence over our entire sample period. Moreover, we document impacts of exposure at both the market and the individual employer level below, supporting a mechanism also operating at the level of firms rather than solely at the broader market level.

2 Data

The Quadros de Pessoal matched employee-employer database provides a snapshot of the Portuguese labor market from a mandatory annual survey of all private sector firms with wage earners. The Quadros de Pessoal contains measures on various firm and establishment characteristics, as well as information on their workers. Information on worker nationality has been collected since 2000, when immigration started to increase rapidly. Our working sample contains the years 2000 to 2018, excluding 2001 since the annual survey was not undertaken that year. Our sample comprises 42,298,093 worker-year observations, drawn

from 667,797 firms and 6,109,333 workers.

Immigrants, like natives, enter our data once their labor market activities commence and not upon entry to Portugal. We define a new immigrant as an immigrant's initial appearance in the data coinciding with having no tenure with their employer. We are unable to identify if an immigrant held employment with other firms before 2000. Any misclassification of new immigrants should be minimal since there were very few immigrants pre-2000. If an immigrant spends time in Portugal prior to joining the labor force, it should pose little threat to our results, so long as this tendency did not vary sharply across immigrant cohorts from a given region. For example, one of our robustness checks allows us to rule out the possibility that changes in the propensity of immigrants to obtain education in Portugal before joining the labor market can account for our findings.

We define the log of the hourly wage including all wage payments received by a worker divided by the total number of hours worked, including overtime, and exclude wages in the top and bottom 1%. For workers with more than one employment spell in a given year, we keep the spell with the most hours worked. We also restrict our sample to workers with permanent contracts to avoid our results being influenced by temporary migrants who typically work in highly specific jobs and firms. Table A1 presents summary statistics on native and immigrant workers. Immigrants on average earn a lower wage, are younger and more likely to be male, less likely to have more than a high school education, and unsurprisingly have lower tenure with their employer and potential years of experience in the Portuguese labor market.

3   Empirical Specification

To estimate the impact of increasing market-level exposure of employers to immigrant groups, we consider the following empirical specification:

$$Y_{iorft} = \beta_1 Immigrant_{io} + \beta_2\ Years\ of\ immigration_t + \beta_3 Immigrant_{io}\ X\ Years\ of\ immigration_t +$$

$$\beta_4 Worker_{it} + \beta_5 Firm_{ft} + \beta_6 Network_{ort} + FE_{Region} + FE_{Firm} + FE_{Occupation} + FE_{Year} + \varepsilon_{irft}$$

$$(1)$$

where Y_{iorft} denotes the log hourly wage of worker i from origin o in region r at firm f and time t. $Immigrant_{io}$ is an indicator for immigrant status, $Years\ of\ immigration_t$ denotes the number of years since 2000, when large immigration waves began.[6] $Worker_{it}$ includes worker characteristics, namely experience, tenure, education, gender, and age. $Firm_{ft}$ includes time-varying firm and establishment characteristics, namely age, size, number of establishments, and sales volume. $Network_{ort}$ denotes the number of immigrants from origin region o in the regional labor market at year t. We also include region-of-Portugal, firm, occupation or job title (50 or 167 distinct categories), and year fixed effects.[7] Our coefficient of interest β_3 captures the change in the wage of immigrants relative to natives with the amount of time since Portugal opened to immigration. To conduct statistical inference, standard errors are clustered at the firm level throughout.

To help isolate the impact of increased exposure, we hold constant individual, firm, and market characteristics. In particular, we estimate Equation (1) using only new immigrants who enter the labor market every year. This focuses on changing conditions of immigrant groups at arrival over time, shutting down mechanisms that operate as immigrants spend time in the host country. Another advantage is sidestepping challenges of selective emigration of immigrants (Lubotsky, 2007).

To investigate the effects of individual employer exposure, we consider similar specifications as equation (1), but augmented with indicators of experience hiring immigrants at a given establishment. We consider as outcomes not only the wage received by immigrants at the establishment, but also how likely the establishment is to hire immigrants again in the future.

---

[6]Given Portugal's immigration history and graphical evidence presented above, we define the year 2000 as the beginning of immigration from all origin regions, corresponding to the onset of immigration waves to Portugal. If immigration from a given origin region did arise in sufficient numbers for employers to be exposed to them before 2000, this would bias our estimates downwards. The $Years\ of\ immigration_t$ term takes the same value for immigrants and natives since it denotes the start of immigration waves to the Portuguese labor market, which could also affect natives.

[7]It is important to examine within-firm effects since Dostie et al. (2023) find that immigrants are more likely to sort to less productive firms.

4 Results

4.1 Market-level exposure and immigrant-native wage convergence

Panel A of Table 1 presents estimates of the evolution of immigrant wages relative to native wages as a function of the number of years since immigration waves started following 2000. The first column shows estimates of Equation (1) for the full sample, while estimates in the remaining columns are restricted to immigrants in their first year in the Portuguese labor market. This restriction rules out any mechanism for wage convergence that operates after an immigrant's entry in the labor market, including human capital investments and differential returns to experience.

Our preferred estimates are presented in the third column. They show that immigrants receive a lower wage when they enter the labor market, but the gap falls by 1.5% for each successive immigrant cohort. The next three columns consider additional specifications shedding light on possible mechanisms. The fourth column excludes firms with experience employing immigrants in previous years of our sample period or that have had an immigrant in a management or ownership position. The estimate shows that there were wage gains for immigrants even at firms without experience hiring them, consistent with a market-wide change in outcomes following the integration of immigrant groups to the labor market. The fifth column excludes firms employing immigrants in the previous year, including in management and ownership. The convergence is similar, suggesting that the estimated effect is not driven by immigrant employers, referrals from incumbent workers, or a subset of firms specializing in hiring immigrants. Column 6 includes firm fixed effects to show that the relative wage of immigrants at entry increased even within firms, ruling out mechanisms such as new immigrants working at higher-paying firms over time.[8] Across Columns 3 to 7, we find a statistically significant increase of 0.9-1.5% in the relative wage of immigrants upon entering the labor market for each additional year after immigration waves began. These estimates account for 18-24% of the initial wage gap in Column 1. The results are similar if we control for detailed job titles, job title by firm fixed effects, region of origin fixed effects, or compare new immigrants to newly-hired natives specifically, although the baseline native-immigrant wage gap is smaller among new hires (Table A2).

---

[8]Estimated convergence is stronger without excluding firms employing immigrants in the previous year (Table A2).

Panel B of Table 1 presents estimates of Equation (1) with the variance in the log wage as the outcome variable. The variance in wages of immigrants when they enter the labor market exceeds that of natives. However, estimates of the interaction term between a worker being an immigrant and time since the immigration waves began indicate that the gap decreases across immigrant cohorts. That is, conditional on worker, job, and firm characteristics, wages of immigrants become more concentrated relative to natives (0.7% differential decrease in variance per year in Column 3). This suggests a more homogeneous treatment of, or perception of immigrants by employers across immigration cohorts. Similarly, the relative dispersion between the 10th and 90th wage percentiles decreased for immigrants across cohorts (Table A3).

Perceptions of immigrants and information about their productivity likely vary based on their origin region. For example, immigrants from Western Europe are geographical neighbors and highly educated compared to natives and other immigrants, while immigrants from Brazil share the same language. In Table 2, we investigate how wage convergence differed based on origin region. We document substantial and statistically significant convergence for immigrants from all regions except Western Europe, consistent with prior perceptions of employers being more favorable or stable towards this group. For other regions, the findings are consistent with larger initial gaps but increased speed of convergence for regions with fewer ties to Portugal and lower pre-2000 immigration.[9] These results rule out that compositional changes in the origin region of immigrants across arrival cohorts drive our findings, since convergence was substantial for all regions with the exception of Western Europe.

Additional analyses across geography, firm size and worker characteristics are presented in the Appendix. There was more wage convergence in regions of Portugal with a higher proportion of immigrants and at larger firms, consistent with convergence being influenced by intensity of exposure (Table A4). Still, wage convergence is far from entirely driven by a few regions with more immigrants, as shown by excluding Lisbon and Algarve, the two regions with the largest shares of immigrants (Table A2).[10] Wage convergence operated broadly across education levels, age, and gender as well as for low and higher wage workers (Table A5). Results examining age subgroups suggest that our main findings are not driven by

---

[9]The results for Africa are similar whether we include or exclude former Portuguese colonies.

[10]This exercise also shows that our results are not driven by regions which had more immigration before 2000, since most immigrant workers were in Lisbon and Algarve in 2000 and less than 0.5% of workers in other regions were immigrants.

changes in immigrants arriving to study in Portugal before entering the labor market. Those regarding higher-wage workers suggest that our main findings are not driven by increases in the minimum wage or bargained wage floors that are more likely to bind for immigrants. Lastly, convergence is similar when excluding cohorts that entered Portugal between 2010 and 2014 – a period of increased emigration of natives from Portugal due to the recession and European debt crisis (Table A2).

Thus, even for similar immigrants in the same position at the same firm, wages evolve as a function of how long their group has been established in the labor market. However, assignment of new immigrants to higher-paying initial jobs or occupations could also serve as a mechanism through which exposure operates. Indeed, evidence suggests that the average log wage of jobs and occupations assigned to new immigrants increased across arrival cohorts (Table A6). As we discuss below, other factors could also contribute to these increases in initial job and/or occupation quality, but to the extent that exposure improves the jobs and occupations of new immigrants, our main estimates could constitute a lower bound on its role in shaping immigrant outcomes.

4.2   Individual-level exposure of employers to immigrants

The previous subsection focused on market-level exposure to immigrants driven by large immigration waves. We next investigate individual-level exposure, namely whether an establishment's prior experience hiring immigrants influences its subsequent hiring decisions. To account for the heavily-skewed distribution of hiring across establishments, we restrict the analysis to the bottom 99% of Portuguese establishments in terms of total number of hires.[11] These establishments generally hired fewer than 20 immigrants over our sample period, as opposed to the largest 1% that typically hired several hundreds. Motivating this sampling restriction is the notion that exposure may be particularly important for employers that hire less frequently.

The first column of Table 3 presents estimates from a linear probability model showing how the cumulative number of previous immigrants hired by an establishment affects their subsequent likelihood of hiring an immigrant. The probability of hiring an immigrant statistically significantly increases by 0.002 percentage point or 4% for each additional pre-

---

[11]Results are similar when restricting based on firm size, rather than number of hires.

vious immigrant hire. Columns 2 to 7 decompose the analysis by whether hiring experiences involved immigrants from the same origin region or not. We focus on the three largest immigrant groups to have enough data to investigate spillovers on subsequent hiring rates. As expected, experience hiring immigrants from the same region is a strong predictor of hiring a new immigrant from that region. Yet, experience hiring immigrants from other regions also increases hiring of immigrants from the target region, albeit to a lesser degree – 10-20% of the impact from the same region.

Since we only have information on broad geographical regions, except for one region corresponding to the metropolitan area of Lisbon, one concern is that time persistence in immigrant hiring for certain firms partly reflects time persistence in sorting patterns of immigrants to specific cities within regions. To show that this concern is unlikely to explain our results, Table A10 shows similar results restricted to the region of Lisbon, which constitutes a single local labor market. Therefore, our results are particularly in line with an employer-side response to previous experience hiring immigrants.

Results from Table 3 help explain why immigrants concentrate across firms and underscore the influence of firm-side factors on immigrant outcomes. Exposure could impact subsequent hiring through several channels (e.g. changing perceptions and uncertainty, investments in screening technology or production methods complimentary to immigrant labor). In contrast, it seems improbable that immigrant networks from a given origin region facilitate hiring of immigrants from other regions as documented in Table 3.

Column 8 of Table 3 tests a novel auxiliary hypothesis. Given that we observe detailed job titles, we can identify HR managers, who likely play an important role in the hiring process for their establishment. If HR managers learn about immigrants or develop more positive perceptions of them through individual experience and interaction, then those with more experience at their first establishment may hire more immigrants even after moving to a new establishment. Column 8 indeed indicates that immigrant hiring at an establishment increases after the arrival of an HR manager with more experience hiring immigrants in their first establishment. Each additional immigrant hire at the manager's first establishment is associated with a 2% increase in immigrant hiring at the current establishment.[12] To be clear, we do not claim that manager moves are necessarily exogenous as part of this analysis:

---

[12]We exclude workers from the first establishment in our hiring analysis to exclude managers hiring their former immigrant coworkers.

these new establishments could select those managers precisely due to their past experience with immigrants. This would suggest that firms understand the knowledge and expertise that managers gain from their personal past experience with immigrants, supporting our main hypothesis.

Panel B of Table 3 explores the relative wage of new immigrants when they enter the labor market as a function of the establishment's experience hiring immigrants. The wage gap is smaller at establishments with more experience and better past experiences, as proxied by longer average tenure with previous immigrant hires. Specifically, the relative wage of new immigrants upon entering the labor market increases by 0.2% for each additional immigrant previously hired by their establishment, and by 0.7% for each additional year of average tenure for these previous hires. Furthermore, the variance in the entry wage of new immigrants also decreases with these two experience measures. In Table A7, we present similar results using an alternative measure of prior experience, namely when an establishment hired its first immigrant, to capture the notion that employers who started hiring immigrants earlier likely have had more exposure to immigrant workers.

5   Discussion and mechanisms

In summary, we document evidence of convergence over time in the wage of new immigrants relative to natives upon their entry in the labor market (increased mean and decreased variance). This convergence operates at a broad market level, but is also influenced by idiosyncratic experiences of employers and HR managers with immigrants. Since we document that exposure systematically improves average immigrant outcomes, our results are consistent with employers initially undervaluing immigrant workers.

Exposure could generate these patterns through at least two broad channels: changing attitudes and learning. First, consistent with the literature on intergroup contact between individuals (Paluck et al., 2019), employers and native workers may initially be prejudiced and hold negative views which decrease over time as they are exposed to immigrants. While the literature on contact and prejudice often focuses on lower-stakes outcomes like self-reported attitudes and is frequently restricted to relatively short time windows, our results suggest that these forces could also play a role in shaping labor market outcomes over sustained periods of time. Our findings also suggest that the effects of taste-based discrimination

as studied in labor markets may not be static over time but rather evolve with exposure (Becker, 1957).

Second, employers may face initial uncertainty when hiring immigrants or hold inaccurate perceptions about their productivity. If employers are averse to risk or ambiguity, then exposure could directly benefit immigrants by mitigating this uncertainty. Alternatively, relating to the statistical discrimination literature, if employers hold negative stereotypes or biased priors about the productivity of immigrants, then additional learning through exposure could again systematically benefit immigrants.

Ultimately, separating the two channels is difficult, because exposure typically involves contact, and contact inherently provides information. Evidence of relative wage convergence even at firms with no direct experience with immigrants and few immigrants in the region suggests that the effects we document do not result only from direct labor market contact between employers and immigrants. At the same time, we do document stronger convergence at employers with individual-level exposure to immigrants, so our results do not only reflect a market-level change in attitudes or information sets.

5.1 Potential alternative explanations

Our results are unlikely to be driven by any mechanism operating as individual immigrants spend time in the host labor market, changes in the jobs and firms of new immigrants over time, or demand and referrals from other immigrants. They are also unlikely to be driven by structural or policy changes in the Portuguese labor market, the minimum wage, or shifts in the composition of immigrant origin regions over time. Last, they are unlikely to be due to changes in immigrant behavior prior to entering the Portuguese labor market.

We next discuss remaining potential alternative explanations for some of our findings. First, immigrant networks may act as an information channel, providing information to later arrivals regarding the Portuguese labor market. Theoretically, it is unclear whether the use of informal networks to find employment would even increase the relative wages of immigrants, and some empirical evidence indicates that it does not (Battisti et al., 2022).[13] The scope for networks is also reduced since our results are robust to considering only within-firm variation

---

[13]The findings from Battisti et al. (2022) also suggest that the impacts of networks on the initial labor market outcomes of immigrants are largely concentrated to lower-skilled immigrants. In contrast, we document evidence of convergence across education and income levels.

and we directly control for the number of immigrants from the same origin region in a given region-year of the Portuguese labor market.

Moreover, while networks may yield comparable benefits to immigrants from a given group at similar employers, exposure is expected to create variation at the individual employer level. Consistent with this idea and with networks being unlikely to drive our results, spillover effects of experiences across immigrant groups and the influence of HR managers' past experiences with immigrants strongly indicate a mechanism originating from the employer rather than the worker side. For example, another worker-side alternative explanation for some of our findings is that immigrants over time become better at searching for jobs due to changes in technology of transitions to a more globalized economy with increased worker flows across countries. Yet, these alternatives are not consistent with our results regarding individual exposure effects and the movement of HR managers, they would instead predict homogeneous gains across similar groups of employers, for example within a region and industry. To be clear, we do not claim that networks or worker search do not play a potentially important role in determining immigrant outcomes, but rather that we identify novel evidence of a distinct mechanism which has received little attention in the literature.

Second, within origin regions, there could be changes in the composition of immigrant workers over time. To generate the patterns we document, workers arriving later would need to be positively-selected and more homogeneous within origin regions. However, the economics of discrimination literature consistently finds the opposite pattern: later arrivals face reduced migration and assimilation costs, yielding negative selection and more diversity (Borjas, 1987; McKenzie and Rapoport, 2010). This finding is corroborated by results in Table A8. We document small relative decreases in the education level, age, and likelihood of being male for immigrant workers across cohorts. Thus, more recent cohorts are more likely to consist of workers with observable characteristics associated with lower earnings, inconsistent with compositional changes driving our results. Table A9 summarizes observable characteristics across region and year for natives and immigrants. It shows that native workers became older, more educated, and more female over time. Immigrant workers followed the same trends, but for most regions, age and education didn't increase as much, while the proportion of female workers increased by more for some regions and less for others. Overall, there is little systematic evidence of a convergence in observable characteristics between immigrants and natives. Combined with the fact that our results hold within individual regions

with the exception of Western Europe, it appears implausible that our results are driven by compositional changes. It would require a relative increase in unobservables that increase earnings at a time where observables that increase earnings are decreasing. In addition, our results on the role of individual-level exposure clearly support a mechanism which does not only operate at the immigrant group level, but also at the level of individual employers.

6   Conclusion

We use matched employee-employer data from Portugal to investigate the role of employer exposure to immigrant groups as a new mechanism to understand disparities between immigrants and natives. Portugal is uniquely well suited for this exercise: minimal immigration prior to 2000 followed by large inflows. Our research design is new to the literature and yields novel insights applicable to both countries with established immigration histories as well as those rapidly opening to immigration, including Japan and South Korea. In addition, our analysis regarding HR managers moving across establishments provides rare evidence on the within-firm determinants of immigrant hiring.

We present evidence that exposure contributes to wage convergence between immigrants and natives, both in terms of mean and variance. Namely, it can explain up to 24% of the relative increase in mean immigrant wages in Portugal between 2000 and 2018. Moreover, we find that the prior hiring experiences of individual employers with immigrants influence their subsequent decisions to hire immigrants and the wages they receive.

Our findings suggest that exposure to members of other ethnic or cultural groups, namely immigrants, can shape attitudes. These results are consistent with the literature on the contact hypothesis (Allport, 1954; Paluck et al., 2019), including recent empirical evidence (Bursztyn et al., 2022; Lepage, 2023b). They are also consistent with exposure to different worker groups increasing employer learning, relating to another strand of recent empirical evidence in the discrimination literature (Miller, 2017; Li et al., 2020; Benson and Lepage, 2023). Further research would be required to delve into specific mechanisms through which individual experiences influence behavior towards immigrants, potentially offering insights into patterns of worker segregation across firms and inequality more broadly (Barth et al., 2016; Card et al., 2016; Card et al., 2018). These questions are particularly important in the context of immigration, given that integration policies frequently include hiring subsidies

and matching services between immigrants and firms.

References

[1] Abramitzky, R. and Boustan, L., 2017. Immigration in American economic history. Journal of economic literature, 55(4), pp.1311-1345.

[2] Algan, Y., C. Dustmann, A. Glitz and A. Manning (2010), "The economic situation of first and second generation immigrants in France, Germany and the United Kingdom," *Economic Journal* 120(1), F4-F30.

[3] Allport, G. (1954), *The nature of prejudice*, New York, NY: Basic Books.

[4] Arellano-Bover, J., and S. San (2023), "The role of firms in the assimilation of immigrants," *mimeo*, Tor Vergata University of Rome.

[5] Barth, E., A. Bryson, J. C. Davis,and R. Freeman (2016), "Its where you work: Increases in the dispersion of earnings across establishments and individuals in the United States," *Journal of Labor Economics* 34(S2), S67-S97.

[6] Battisti, M., Peri, G. and Romiti, A., 2022. Dynamic effects of co-ethnic networks on immigrants' economic success. The Economic Journal, 132(641), pp.58-88.

[7] Becker, G.S., 1957. The economics of discrimination. University of Chicago press.

[8] Benson, A., and L-P. Lepage (2023), "Learning to discriminate on the job," *mimeo*, Stockholm University.

[9] Borjas, G. J., (1987), "Self- selection and the earnings of immigrants," *American Economic Review* 77(4), 531– 553.

[10] Brinatti, A., and N. Morales (2021), "Firm heterogeneity and the impact of immigration: Evidence from German establishments," *Federal Reserve Bank of Richmond WP 21-16*.

[11] Bursztyn, L., Chaney, T., Hassan, T.A. and Rao, A., 2021. The immigrant next door: Long-term contact, generosity, and prejudice (No. w28448). National Bureau of Economic Research.

[12] Butschek, S., and T. Walter (2014), "What active labour market programmes work for immigrants in Europe? A meta-analysis of the evaluation literature," *IZA Journal of Migration 3*, Article 48.

[13] Calmfors, L., and N. Sánchez Gassen (2019), "Integrating immigrants into the Nordic labour markets," Copenhagen: Nordic Council of Ministers, Available at https://norden.diva-portal.org/smash/get/diva2:1317928/FULLTEXT01.pdf.

[14] Card, D., A. R. Cardoso, J. Heining and P. Kline (2018), "Firms and labor market in equality: Evidence and some theory," *Journal of Labor Economics* 36(S1), S13–S70.

[15] Card, D., A. R. Cardoso and P. Kline (2016), "Bargaining, sorting, and the gender wage gap: Quantifying the impact of firms on the relative pay of women," *The Quarterly Journal of Economics* 131(2), 633–686.

[16] Carneiro, A., N. Fortuna, and J. Varejao (2012), "Immigrants at new destinations: How they fare and why," *Journal of Population Economics* 25(3), 1165–1185.

[17] Carrington, W. J. and P. J.F. de Lima (1996), "The impact of 1970s repatriates from Africa on the Portuguese labor market," *Industrial and Labor Relations Review* 49(2), 330-347.

[18] Chiswick, B.R. (1978), "The effect of Americanization on the earnings of foreign-born men," *Journal of Political Economy* 86(5), 897-921.

[19] Damas de Matos, A., (2017), "Firm heterogeneity and immigrant wage assimilation," *Applied Economics Letters* 24 (9), 653–65

[20] Dias, B., Oliviera, C., Marques, J. C., & Góis, P. (2002). Migrants, minorities and employment in Portugal. Exclusion, discrimination and anti–discrimination. European Monitoring Centre on Racism and Xenophobia, Raxen 3 report.

[21] Dostie, B., J. Li, D. Card and D. Parent (2023), "Employer policies and the immigrant-native earnings gap," *Journal of Econometrics* 233(2), 544-567.

[22] Farashah, A. D., and T. Blomquist (2019), "Exploring employer attitude towards migrant workers: Evidence from managers across Europe," in *Evidence-based HRM: A Global Forum for Empirical Scholarship*. Emerald Publishing Limited.

[23] Jensen, L. and Yang, T.C., 2016. "Taken by surprise: new immigrants in the rural United States." In *International Migration and Rural Areas* (pp. 33-58). Routledge.

[24] Kubiciel-Lodzinska, S., and J. Maj (2017), "The tendency of entrepreneurs to employ foreigners: Labour immigrants in the opinion of employers," *Central and Eastern European Migration Review* 6(2), 176-191.

[25] Lepage, L-P. (2023), "Experience-Based Discrimination," *mimeo*, Stockholm University.

[26] Lepage, L.P., 2023b. Discrimination and sorting in the real estate market: Evidence from terrorist attacks and mosques. European Economic Review, 153, p.104386.

[27] Leung, M. D., (2017), "Learning to hire? Hiring as a dynamic experiential learning process in an online market for contract labor," *Management Science* 64(12), 5651-5668.

[28] Li, D., Raymond, L.R. and Bergman, P., 2020. Hiring as exploration (No. w27736). National Bureau of Economic Research.

[29] Loiacono, F. and Silva-Vargas, M., 2023. Matching with the Right Attitude: The Effect of Matching Firms with Refugee Workers. Mimeo, Stockholm University.

[30] Lubotsky, D. (2007), "Chutes or ladders? A longitudinal analysis of immigrant earnings," *Journal of Political Economy* 115(5), 820-867.

[31] Lundborg, P., and P. Skedinger (2016), "Employer attitudes towards refugee immigrants: Findings from a Swedish survey," *International Labour Review* 155(2), 315-337.

[32] MacKenzie, R. and C. Forde (2009), "The rhetoric of the good worker 'versus the realities of employers' use and the experiences of migrant workers," *Work, Employment and Society* 23(1), 142-159.

[33] Marques, J. C., and P. Gois (2007), "Ukrainian migration to Portugal. From nonexistence to the top three immigrant groups," Prague: Multicultural Centre: Migration online.cz.

[34] Mayda, A.M., Peri, G. and Steingress, W., 2022. The political impact of immigration: Evidence from the United States. American Economic Journal: Applied Economics, 14(1), pp.358-389.

[35] McKenzie, D. J., and H. Rapoport (2010), "Self-selection patterns in Mexico–U.S. migration: the role of migration networks," *The Review of Economics and Statistics* 92(4), 811-821.

[36] Miller, C., (2017), "The persistent effect of temporary affirmative action," *American Economic Journal: Applied Economics* 9(3), 152-190.

[37] Paluck, E. L., S. A. Green and D. P. Green (2019), "The contact hypothesis re-evaluated," *Behavioural Public Policy* 3(2), 129-158.

Figure 1: Immigration and exposure to immigrants
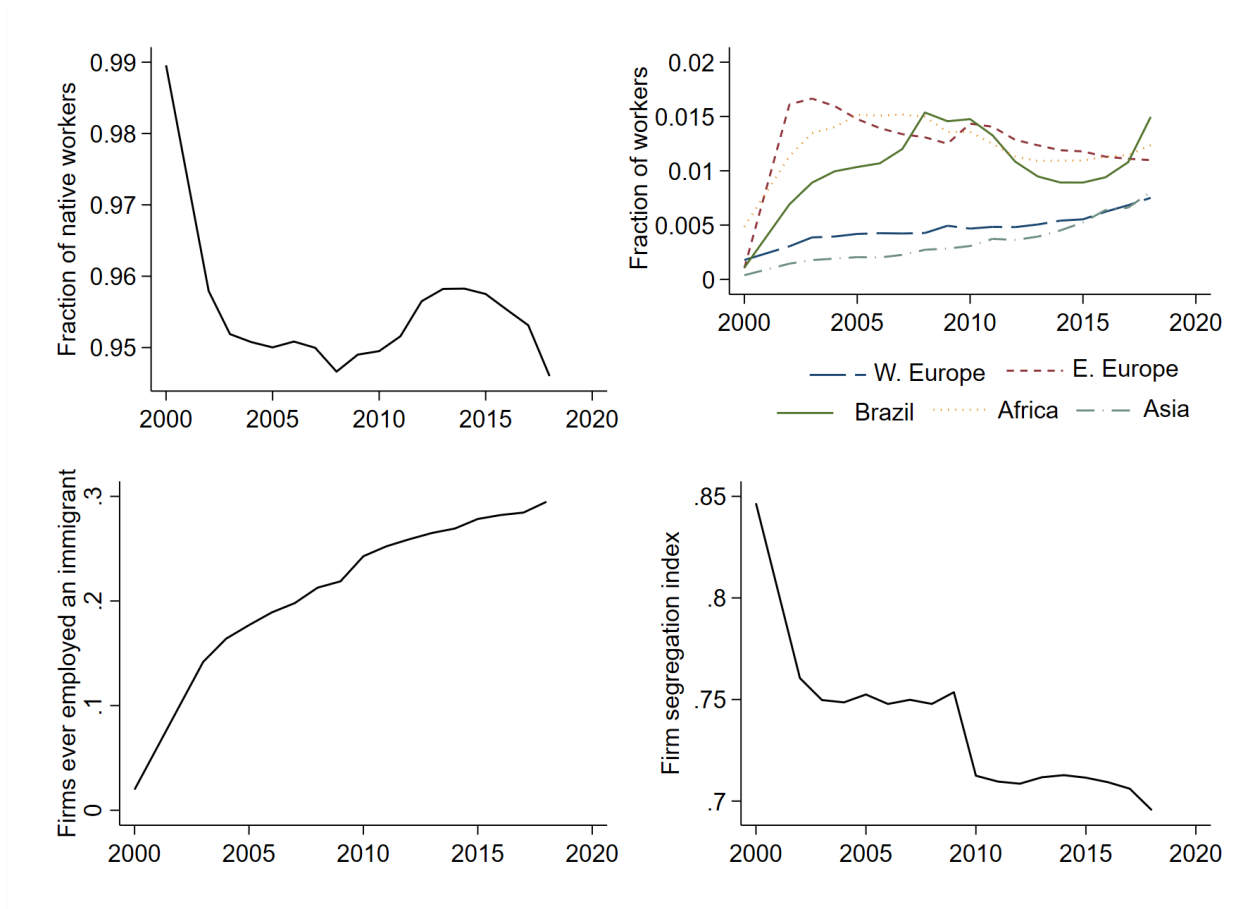
Note. The top left panel displays the fraction of native workers in Portugal over our sample period. The top right panel shows immigration waves to Portugal from the five biggest sending regions. Flows from other regions are negligible and excluded from the analysis. The bottom left panel shows the fraction of firms that are employing or have employed at least one immigrant in the past. The bottom right panel displays the Duncan segregation index at the firm level, showing the fraction of immigrant workers who would have to change firms for the distribution of immigrants and natives to be equal across firms.

Figure 2: Unadjusted immigrant-native wage gap
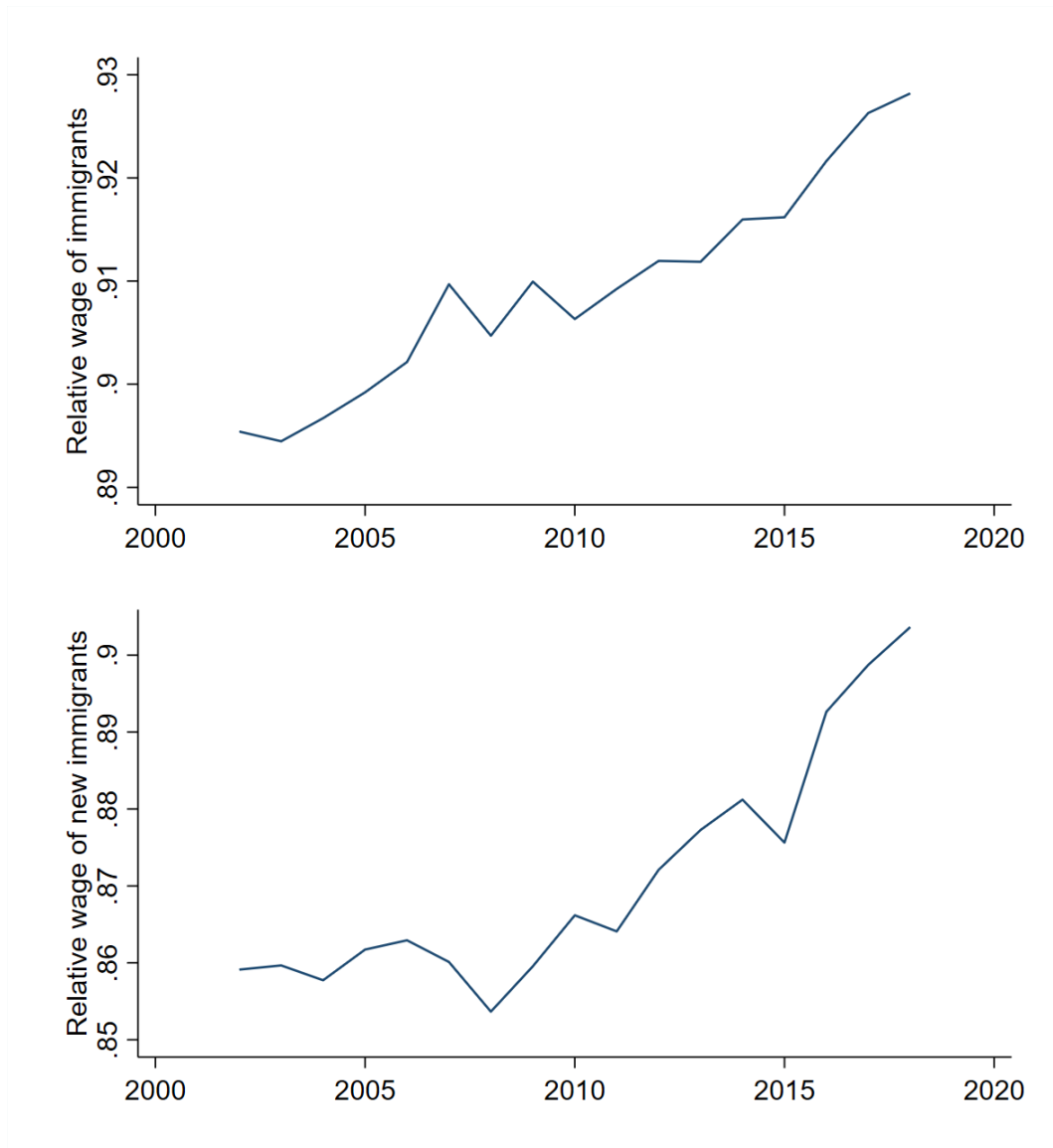
Note. The top panel displays the wage of immigrants relative to natives over our sample period. The bottom panel displays the wage of immigrants in their first year in the Portuguese labor market relative to the wage of natives over our sample period.

Table 1: Estimates of immigrants' wage convergence

| Panel A | | New immigrant workers | | | | |
| | | | | No previous immigrants | No current immigrants | No current immigrants |
Log hourly wage	(1)	(2)	(3)	(4)	(5)	(6)
Immigrant	-0.766	-0.648	-0.590	-0.624	-0.619	-0.315
	(0.024)	(0.019)	(0.013)	(0.010)	(0.010)	(0.005)
Imm. X Years of immigration	0.014	0.016	0.015	0.012	0.012	0.009
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0003)
Panel B						
Variance of Log hourly wage						
Immigrant	0.233	0.325	0.379	0.125	0.193	0.265
	(0.013)	(0.015)	(0.017)	(0.007)	(0.008)	(0.007)
Imm. X Years of immigration	-0.011	-0.004	-0.007	-0.001	-0.003	-0.003
	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.0004)
Worker controls	Y	Y	Y	Y	Y	Y
Firm controls			Y	Y	Y	Y
Network controls			Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y	Y	Y
Occupation FE		Y	Y	Y	Y	Y
Firm FE						Y
Observations	41,866,744	40,552,507	38,041,204	16,381,073	19,746,255	19,689,844

Note. The table displays estimates of Equation (1). The outcome variables are the log of the hourly wage in Panel A and the variance of the log of the hourly wage in Panel B. The independent variables are whether the worker is an immigrant and its interaction with the number of years since Portugal opened to immigration in 2000. Columns 2-6 restrict immigrant workers to their first year in the Portuguese labor market. Column 4 excludes firms that employed any immigrant worker in previous years of our sample period, including in management and ownership. Columns 5-6 exclude firms employing any immigrant worker in the previous year, including in management and ownership. Worker controls include years of tenure, years of experience (quadratic), whether the worker has no more than high school education, gender, and age (quadratic). Firm controls include age, sales volume, number of establishments, as well as establishment and firm size. Network controls include the number of immigrant workers from each origin region in each region of Portugal in a given year. Clustered standard errors at the firm level are presented in parentheses.

Table 2: Estimates of immigrants' wage convergence by region of origin

	New immigrant workers				
Panel A	Asia	Eastern Europe	Africa	Brazil	Western Europe
Log hourly wage	(1)	(2)	(3)	(4)	(5)
Immigrant	-1.0101	-0.7779	-0.7746	-0.6605	-0.3763
	(0.0176)	(0.0150)	(0.0162)	(0.0122)	(0.0458)
Imm. X Years of immigration	0.0307	0.0225	0.0202	0.0130	0.0008
	(0.0010)	(0.0009)	(0.0011)	(0.0006)	(0.0051)
Panel B					
Variance of log hourly wage					
Immigrant	0.525	0.365	0.356	0.385	0.347
	(0.020)	(0.019)	(0.018)	(0.017)	(0.046)
Imm. X Years of immigration	-0.013	-0.007	-0.008	-0.008	-0.008
	(0.001)	(0.001)	(0.001)	(0.000)	(0.006)
Worker controls	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y
Network controls	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y	Y
Occupation FE	Y	Y	Y	Y	Y
Observations	37,717,391	37,765,492	37,770,817	37,788,273	37,724,423

Note. See Table 1 for additional details.

Table 3: Estimates of wage convergence by previous experience of an establishment with immigrants

Panel A

Whether a new hire is an immigrant	New immigrant workers							HR managers changing establishments
	All Regions	Eastern European		Brazilian		African		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cum. number of imm. hires	0.0019							
	(0.0001)							
. . . from the same region		0.0027		0.0050		0.0041		
		(0.0001)		(0.0002)		(0.0002)		
. . . from other regions			0.0004		0.0005		0.0008	
			(0.0001)		(0.0001)		(0.0001)	
N. imm. hires at first esta. X After manager arrives at new esta.								0.0014
								(0.0003)
Outcome mean	0.044	0.010	0.010	0.015	0.015	0.010	0.010	0.076
Observations	3,784,222	3,665,120	3,665,120	3,681,931	3,681,931	3,665,336	3,665,336	12,275

Panel B

	New immigrant workers			
	Log hourly wage		Variance of log hourly wage	
	(1)	(2)	(3)	(4)
Imm. X Cum. number of imm. hires	0.0004		-0.0003	
	(0.0001)		(0.0001)	
Imm. X Cum. avg. tenure of imm. hires		0.0028		-0.0048
		(0.0010)		(0.0011)
Observations	25,836,812	14,359,954	25,836,812	14,359,954

Worker controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y	Y	Y
Network controls	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y	Y	Y	Y	Y
Occupation FE	Y	Y	Y	Y	Y	Y	Y	Y

Note. The outcome variable in Panel A is whether a new hire is an immigrant. The outcome variables in Panel B are the log of the hourly wage and the variance of the log of the hourly wage for employed workers. The independent variables in Panel A are the cumulative number of immigrants hired by an establishment in the past, the cumulative number of immigrants from the same origin region hired by an establishment in the past, the cumulative number of immigrants from other origin regions hired by an establishment in the past, and an interaction term between the cumulative number of immigrants hired at an HR manager's first establishment and the period after the manager has moved to a new establishment. The independent variables in Panel B are interaction terms between a worker being an immigrant and the cumulative number of immigrants hired by an establishment in the past or a worker being an immigrant and the cumulative average number of years of tenure achieved by an establishment's previous immigrant workers. Columns 1-7 of Panel A and Panel B restrict immigrant workers to their first year in the Portuguese labor market. Column 8 restricts to new hires at establishments employing an HR manager who was first employed at another establishment, excluding workers at the first establishment from the pool of new hires at the new establishment. Establishments in the top 1% for the total number of hires over our sample period are excluded. Worker controls include years of tenure (Panel B only), years of experience (quadratic), whether the worker has no more than high school education, gender, and age (quadratic). Firm controls include age, sales volume, number of establishments, as well as establishment and firm size. Network controls include the number of immigrant workers from each origin region for each region of Portugal in a given year. Clustered standard errors at the firm level are presented in parentheses.

Online Appendix - Additional evidence and robustness

Table A1: Summary statistics on immigrant and native workers

	Immigrants (1)	Natives (2)
Wage	8.808	11.074
	(5.964)	(7.629)
Age	36.539	38.864
	(9.996)	(11.088)
Male	0.578	0.540
	(0.494)	(0.498)
High school	0.907	0.857
	(0.290)	(0.350)
Tenure	2.725	7.779
	(4.285)	(8.619)
Experience	3.297	24.963
	(3.739)	(12.330)
Africa	0.249	
	(0.432)	
Brazil	0.241	
	(0.428)	
Eastern Europe	0.289	
	(0.453)	
Western Europe	0.093	
	(0.291)	
Asia	0.069	
	(0.253)	
Observations	1,823,739	40,474,343

Note. High school is an indicator for having completed high school education or less. Flows into Portugal from regions not shown above were negligible and are excluded from the analysis.

Table A2: Additional estimates of wage convergence

	New immigrant workers						
	Job title FE (1)	Origin region FE (2)	New native hires (3)	Excluding 2010-2014 (4)	Excluding Lisbon and Algarve (5)	Firm FE (6)	Firm X Job FE (7)
Immigrant	-0.529		-0.256	-0.597	-0.587	-0.263	-0.126
	(0.011)		(0.008)	(0.012)	(0.013)	(0.007)	(0.006)
Imm. X Years of immigration	0.014	0.015	0.007	0.014	0.013	0.011	0.007
	(0.001)	(0.001)	(0.0004)	(0.001)	(0.001)	(0.001)	(0.0007)
Worker controls	Y	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y	Y
Network controls	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y	Y	Y	Y
Occupation FE	Y	Y	Y	Y	Y	Y	Y
Job title FE	Y						
Origin region FE		Y					
Firm FE						Y	
Firm X Job title FE							Y
Observations	38,041,227	38,019,442	7,127,198	29,340,324	25,345,167	37,960,770	37,297,508

Note. Column 1 includes detailed job title fixed effects. Column 1 includes fixed effects for the region of origin of each worker (native, Eastern Europe, Western Europe, Asia, Africa, Brazil). Column 3 restricts the analysis to newly-hired natives, comparing natives and immigrants who are both in their first year at a given firm. Column 4 excludes the years from 2010 to 2014 from the analysis, which had higher emigration of natives from Portugal and a recession from the European debt crisis. Column 5 excludes the regions of Lisbon and Algarve from the analysis, which had the most exposure to immigrants before 2000. See Table 1 for additional details.

Table A3: Convergence in wage dispersion between the 10th and 90th percentiles

Log hourly wage	New immigrant workers					
Range 90th - 10th percentile	(1)	(2)	(3)	(4)	(5)	(6)
Immigrant	0.534	0.887	1.102	0.173	0.540	0.790
	(0.053)	(0.050)	(0.049)	(0.025)	(0.029)	(0.024)
Imm. X Years of immigration	-0.033	-0.017	-0.027	-0.007	-0.016	-0.015
	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)
Worker controls	Y	Y	Y	Y	Y	Y
Firm controls			Y	Y	Y	Y
Network controls			Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y	Y	Y
Occupation FE		Y	Y	Y	Y	Y
Firm FE						Y
Observations	41,866,794	40,552,606	38,041,279	16,381,099	19,746,380	19,689,938

Note. See Table 1 for additional details.

Table A4: Wage convergence by firm size and regional immigration

Log hourly wage	New immigrant workers			
	Low immig. region (1)	High immig. region (2)	Smaller firm (3)	Larger firm (4)
Immigrant	-0.560	-0.567	-0.470	-0.644
	(0.014)	(0.015)	(0.004)	(0.021)
Imm. X Years of immigration	0.013	0.016	0.010	0.020
	(0.001)	(0.001)	(0.000)	(0.002)
Worker controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Network controls			Y	Y
Year FE	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y
Occupation FE	Y	Y	Y	Y
Observations	19,069,393	18,123,116	18,795,276	19,109,179

Note. Column 1 (2) restricts to regions of Portugal with below- (above-) median total number of immigrant workers. Column 3 (4) restricts to firms with below- (above-) median number of workers. See Table 1 for additional details.

Table A5: Wage convergence by worker characteristics

	New immigrant workers							
							Bottom	Top
	High school	College	Under 30	Over 30	Male	Female	25% wage	75% wage
Log hourly wage	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Immigrant	-0.652	-0.414	-0.416	-1.010	-0.620	-0.500	-0.087	-0.317
	(0.014)	(0.029)	(0.010)	(0.021)	(0.017)	(0.011)	(0.003)	(0.016)
Imm. X Years of immigration	0.014	0.012	0.012	0.015	0.015	0.014	0.002	0.006
	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Worker controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y	Y	Y
Network controls	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Region of Portugal FE	Y	Y	Y	Y	Y	Y	Y	Y
Occupation FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	32,600,350	5,440,929	10,165,761	27,875,518	20,552,563	17,488,664	9,366,166	28,675,113

Note. Column 1 restricts to workers with no more than a high school education while column 2 restricts to those with more than a high school education. Column 3 (4) restricts to workers (below) above 30 years of age. Columns 7 (8) restricts to workers in the bottom (top three) quartile(s) of the wage distribution. See Table 1 for additional details.

Table A6: Higher-wage jobs and occupations for new immigrants across immigration cohorts

	New immigrant workers	
	Log of average job wage	Log of average occupation wage
	(1)	(2)
Immigrant	-0.111	-0.804
	(0.007)	(0.011)
Imm. X Years of immigration	0.002	0.014
	(0.001)	(0.002)
Worker controls	Y	Y
Firm controls	Y	Y
Network controls	Y	Y
Year FE	Y	Y
Region of Portugal FE	Y	Y
Occupation FE	Y	
Observations	38,041,227	38,041,227

Note. The outcome variables are the log of the average wage earned by workers in a job or occupation. See Table 1 for additional details.

Table A7: Alternative measure of previous experience of an establishment with immigrants

	New immigrant workers		
	Whether a new hire is an immigrant (1)	Log hourly wage (2)	Variance of log hourly wage (3)
Years since first imm. hire	0.0006 (0.0001)		
Imm. X Years since first imm. hire		0.0096 (0.0007)	-0.0046 (0.0005)
Worker controls	Y	Y	Y
Firm controls	Y	Y	Y
Network controls	Y	Y	Y
Year FE	Y	Y	Y
Region of Portugal FE	Y	Y	Y
Occupation FE	Y	Y	Y
Outcome mean	0.044		
Observations	3,784,545	23,452,529	23,452,529

Note. The independent variables are the number of years since an establishment hired its first immigrant and its interaction with whether a given worker currently employed at the establishment is an immigrant. See Table 3 for additional details.

Table A8: Changes in education, age, and gender for immigrant relative to native workers

	New immigrant workers		
	No more than high school (1)	Age (2)	Male (3)
Immigrant	0.038	-2.926	0.070
	(0.005)	(0.165)	(0.009)
Imm. X Years of immigration	0.001	-0.348	-0.003
	(0.0001)	(0.020)	(0.001)
Year FE	Y	Y	Y
Outcome mean	0.858	38.80	0.541
Observations	40,723,696	40,784,218	40,881,866

Note. The outcome variable in Column 1 is whether a worker has no more than a high school education. The outcome variable in Column 2 is a worker's age. The outcome variable in Column 3 is whether a worker is male. See Table 1 for additional details.

Table A9: Worker characteristics by region and year

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Natives	Age	36.5	37	37.2	37.2	37.5	37.8	38	38.4	38.7	39.1	39.5	40	40.3	40.6	40.8	41.1	41.3
	No more than high school	0.92	0.91	0.91	0.9	0.91	0.9	0.89	0.88	0.85	0.84	0.83	0.82	0.82	0.81	0.81	0.81	0.8
	Male	0.58	0.57	0.57	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.52	0.52	0.52	0.52	0.51	0.52	0.52
Asia	Age	32.7	33.8	34.6	34.6	35.1	35.2	35.3	35.1	34.9	34.3	34.7	35	35.1	34.68	34.6	34.6	34.1
	No more than high school	0.96	0.95	0.96	0.95	0.97	0.97	0.96	0.95	0.96	0.97	0.96	0.96	0.95	0.95	0.96	0.95	0.95
	Male	0.78	0.77	0.77	0.74	0.74	0.74	0.75	0.74	0.71	0.73	0.71	0.73	0.73	0.75	0.76	0.75	0.76
Eastern Europe	Age	34.4	35.2	35.8	36.3	36.7	37.1	37.3	37.6	38.1	38.4	39	39.4	39.9	40.3	40.6	40.9	41
	No more than high school	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.95	0.93	0.92	0.92	0.91	0.91	0.9	0.9	0.89	0.89
	Male	0.8	0.79	0.77	0.74	0.72	0.71	0.68	0.66	0.63	0.61	0.59	0.58	0.58	0.58	0.57	0.56	0.56
Africa	Age	35.1	35.6	36.1	36.3	36.7	36.9	37.1	37.4	37.2	37.4	37.8	38.2	38	38.1	38.2	38.2	38
	No more than high school	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.96	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.93
	Male	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.48	0.46	0.44	0.4	0.4	0.41	0.42	0.43	0.44	0.46
Brazil	Age	31.1	31.9	32.3	32.7	33.1	33.2	32.8	33.3	33.8	34.5	35.3	36.2	36.7	36.9	37.2	36.8	36.1
	No more than high school	0.95	0.95	0.95	0.95	0.96	0.96	0.97	0.97	0.94	0.94	0.93	0.93	0.93	0.92	0.91	0.9	0.88
	Male	0.63	0.62	0.61	0.61	0.6	0.59	0.58	0.56	0.53	0.51	0.5	0.49	0.49	0.48	0.48	0.49	0.51
Western Europe	Age	34.6	35.2	36.2	36.7	36.7	37.2	37.6	38.7	38.2	38.5	39	39	38.9	39	37.8	37.1	37
	No more than high school	0.7	0.69	0.7	0.71	0.78	0.77	0.74	0.78	0.62	0.58	0.56	0.56	0.58	0.58	0.6	0.6	0.61
	Male	0.53	0.52	0.54	0.54	0.52	0.53	0.53	0.61	0.53	0.51	0.51	0.5	0.53	0.51	0.51	0.51	0.52

Table A10: Estimates of wage convergence by previous experience of an establishment with immigrants, restricted to Lisbon

Panel A	New immigrant workers							HR Managers Changing
Whether a new hire is an immigrant	All Immigrants	Eastern European		Brazilian		African		Establishments
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cum. number of imm. hires	0.0018							
	(0.000)							
. . . from the Same Region		0.0042		0.0051		0.0033		
		(0.000)		(0.000)		(0.000)		
. . . from Other Regions			0.0003		0.0003		0.0010	
			(0.000)		(0.000)		(0.000)	
N. Imm. Hires at Previous Esta. X								0.0014
After Manager Arrives at New Esta.								0.0003
Outcome Mean	0.075	0.012	0.012	0.028	0.028	0.024	0.024	0.120
N. Obs.	1,089,927	1,025,679	1,025,679	1,041,677	1,041,677	1,038,303	1,038,303	8,020

Panel B	Log hourly wage		Variance of Log hourly wage	
	(1)	(2)	(3)	(4)
Imm. X cum. no. of imm. hires	0.0055		-0.0039	
	(0.001)		(0.001)	
Imm. X cum. avg. tenure of imm. hires		0.0078		-0.0214
		(0.002)		(0.002)
N. Obs.	6,395,763	4,035,520	6,395,763	4,035,520

Worker Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Occupation FE	Y	Y	Y	Y	Y	Y	Y	Y

Note. See Table 3 for details.