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Are Skeie Hermansen^{1,2✉}, Andrew Penner³, István Boza⁴, Marta M. Elvira⁵, Olivier Godechot^{6,7}, Martin Hällsten^{2,8}, Lasse Folke Henriksen⁹, Feng Hou¹⁰, Zoltán Lippényi¹¹, Trond Petersen¹², Malte Reichelt^{13,14,15}, Halil Sabanci¹⁶, Mirna Safi⁶, Donald Tomaskovic-Devey¹⁷ & Erik Vickstrom¹⁸

Immigrants to high-income countries often face considerable and persistent difficulties in the labour market^{1–6}, whereas their native-born children typically experience economic progress^{6–9}. However, little is known about the extent to which these immigrant–native earnings differences stem from unequal pay when doing the same work for the same employer versus labour market processes that sort immigrants into lower-paid jobs. Here, using data from nine European and North American countries, we show that the segregation of workers with immigrant backgrounds into lower-paying jobs accounts for about three-quarters of overall immigrant–native earnings differences. Although within-job pay inequality remains notable for immigrants in several countries, our results demonstrate that unequal access to higher-paying jobs is the primary driver of the immigrant–native pay gap across a range of institutionally and demographically diverse contexts. These findings highlight the importance of policies aimed at reducing between-job segregation, such as language training^{10–13}, job training^{13–15}, job search assistance programmes^{13,15}, improving access to domestic education^{13,16,17}, recognizing foreign qualifications^{18,19}, and settlement programmes aimed at enhancing access to job-relevant information and networks^{13,20,21}. Policies that target employer bias in hiring and promotion decisions are also likely to be effective, whereas measures aimed at ensuring equal pay for equal work may have more limited scope for further progress in closing the immigrant–native pay gap^{22–28}.

Global migration from lower-income countries has made the societal incorporation of successive immigrant flows a pressing challenge for high-income countries in Europe and North America^{29–32}. Identifying the magnitude and sources of labour market disadvantages of immigrants and the policies needed to alleviate them remains the subject of intense academic and political debate. Immigrants—particularly those arriving from low-income origin countries—tend to earn less than natives upon arrival; although these gaps tend to narrow over time, they often persist across the life course^{1–6}. Many policies target differences in pay between immigrants and natives in the same job (for example, equal pay legislation), whereas others aim to improve access to higher-paying jobs. Yet the relative contributions of within-job pay inequality versus sorting into different jobs to overall earnings disparities remain poorly understood.

The earnings disadvantages of immigrants are often attributed to deficits in country-specific human and social capital—such as limited language proficiency, cultural and institutional knowledge, access to job-relevant networks, and restricted international transferability of

educational qualifications acquired abroad—which can directly depress wages and productivity and contribute to sorting into lower-paying jobs^{3,33,34}. By contrast, native-born children of immigrants often achieve intergenerational progress towards the earnings levels of non-migrant natives^{7–9}. This assimilation process is often attributed to the acquisition of native-level language proficiency and other country-specific skills, completion of domestic education, and improved access to networks, factors that together increase productivity and reduce barriers to accessing higher-paying jobs^{6–9}.

Substantial variation in pay across firms and establishments in advanced Western economies^{35–39} suggests that widespread ethnic workplace segregation and differences in employers' wage-setting practices are likely to be key factors in shaping how immigrants fare in the labour market^{40–45}. Previous research documents that the gradual narrowing of the wage gap between immigrants and natives in the years following their arrival often results from gaining access to higher-paying firms^{46–51}. However, despite an extensive literature on discrimination based on ethnicity and race in hiring^{22,23}, only a few studies

¹Department of Sociology and Human Geography, University of Oslo, Oslo, Norway. ²Swedish Institute for Social Research, Stockholm University, Stockholm, Sweden. ³Department of Sociology, University of California, Irvine, Irvine, CA, USA. ⁴HUN-REN Centre for Economic and Regional Studies, Budapest, Hungary. ⁵IESE Business School, University of Navarra, Barcelona, Spain. ⁶Sciences Po, CRIS, CNRS, Paris, France. ⁷Sciences Po, AxPo, Paris, France. ⁸Department of Sociology, Stockholm University, Stockholm, Sweden. ⁹Department of Organization, Copenhagen Business School, Copenhagen, Denmark. ¹⁰Statistics Canada, Ottawa, Ontario, Canada. ¹¹Department of Sociology, University of Groningen, Groningen, The Netherlands. ¹²Department of Sociology, University of California, Berkeley, Berkeley, CA, USA. ¹³School of Business, Economics and Society, University of Erlangen-Nuremberg, Nuremberg, Germany. ¹⁴Institute for Employment Research, Nuremberg, Germany. ¹⁵Leibniz Institute for Educational Trajectories, Bamberg, Germany. ¹⁶Management Department, Frankfurt School of Finance and Management, Frankfurt, Germany. ¹⁷Department of Sociology, University of Massachusetts Amherst, Amherst, MA, USA. ¹⁸Center for Economic Studies, United States Census Bureau, Suitland, MD, USA. ✉e-mail: a.s.hermansen@sosgeo.uio.no

have examined whether immigrants earn less than observably similar natives employed in the same workplace, or quantified the influence of workplace segregation on immigrant–native earnings disparities^{46–55}.

Here we study whether immigrants earn less than non-migrant natives when doing the same work for the same employer (within-job inequality) or whether immigrant–native earnings gaps are driven by the sorting of immigrants into lower-paying jobs (between-job segregation) in nine European and North American countries. We explore whether immigrants receive similar earnings to non-migrant natives who work in the same occupations in the same establishments and whether the native-born children of immigrants earn wages comparable to those of the children of non-migrant natives working in the same job.

The answers to these questions have far-reaching implications for policy and society at large. If inequalities arise because immigrants and their native-born children are paid less than non-immigrants for doing the same work for the same employer, policies that promote equal pay for equal work have an important role in creating an egalitarian society. Conversely, if immigrants and their children earn similar wages to the non-migrant natives they work next to but have lower overall earnings because they are sorted into different jobs, policies should prioritize skill development, the recognition of foreign educational credentials, extending access to job-relevant social networks, and eliminating employer bias in hiring and promotion.

We present cross-national evidence that addresses these questions by reporting the degree to which these pay gaps are driven by differences in annual earnings between workers with immigrant backgrounds and native workers with the same occupation and employer (that is, the same job) and documenting the relative contribution of segregation by industry, occupation, workplace and job. We also analyse how the contribution of processes related to between-job segregation and within-job pay inequality vary across immigrant generations and between immigrant minorities with backgrounds from different world regions (Asia; Europe, North America and other Western countries; Latin America; Middle East and North Africa; and Sub-Saharan Africa).

Using administrative records that combine detailed information on immigrant status and links between individuals who work for the same employer (linked employer–employee data) for 13.5 million workers across 9 countries (Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden and the USA), we create a dataset that quantifies the contributions of within-job inequality and between-job segregation to the earnings gaps experienced by immigrants and children of immigrants relative to natives. We study high-income countries characterized by widely different labour market institutions and immigrant populations, and show that the relative importance of between-job sorting and within-job pay inequality operates similarly across diverse national contexts.

On the basis of harmonized country-level estimates that adjust for education, age, sex and geographic region of employment, we examine immigrant–native earnings differences within industries, occupations, establishments and jobs (Extended Data Table 1 and Methods). Our analysis proceeds in three steps. First, we use a meta-analytic approach to summarize the average contributions of within-job inequality and between-job segregation to immigrant–native earnings gaps across these nine countries⁵⁶. Second, we describe variation between destination countries in the magnitude of immigrant–native earnings differences and the relative contribution of within-job inequality and between-job segregation in each of the countries. Third, we examine differences in between-job segregation and within-job inequality among immigrants and children of immigrants from different world regions of origin.

Our results reveal that on average, three-quarters of the total immigrant–native earnings differences are attributable to immigrants' limited access to high-paying jobs, and the remaining gap reflects differences in pay between immigrants and natives who work in the same occupation and for the same employer. In countries with information

on immigrants' native-born children, both total and within-job earnings differences relative to natives are substantially reduced in the second generation. Although the sizes of immigrant–native earnings gaps vary substantially between countries, between-job segregation drives these differences in all nine countries. These patterns are found among immigrants and native-born children of immigrants from Asia, Latin America, the Middle East and North Africa, and Sub-Saharan Africa. Earnings differences relative to natives are less pronounced among immigrants from Europe, North America and other Western countries.

Supplementary analyses from countries with information on years since migration reveal that recent immigrants experience larger total and within-job earnings gaps than established immigrants and immigrants who arrived as children, but between-job segregation accounts for the majority of the immigrant–native earnings differences for all groups (Extended Data Fig. 1 and Supplementary Tables 10–12). Moreover, the overall patterns are similar for men and women (Extended Data Figs. 2 and 3 and Supplementary Tables 13–18), and high- and low-skill workers (Extended Data Figs. 4 and 5 and Supplementary Tables 19–24). Analyses using hourly wages instead of annual earnings in the countries where this information is available also align with our main findings (Extended Data Fig. 6 and Supplementary Tables 25–27). Our results are robust to using alternative job measures, sample restrictions and covariate adjustments (Extended Data Figs. 7 and 8, Supplementary Fig. 3 and Supplementary Tables 28–39). In countries where administrative records track workers as they change jobs over time, panel data analyses show that immigrants' lack of access to high-paying jobs is attributable to segregation both in the job-level earnings premiums that employers pay and segregation based on worker skill (see Supplementary Information, section 5 for details; Supplementary Figs. 4–7 and Supplementary Tables 40 and 41).

Overall, the key conclusion from our analysis is that immigrant–native earnings differences are driven primarily by limited access to high paying occupations and employers (between-job segregation), and to a lesser extent arise from differences in pay between immigrants, children of immigrants and natives who work in the same occupation for the same employer (within-job inequality).

Differences across immigrant generations

Figure 1a shows the primary contribution of between-job segregation to immigrants' disadvantage in earnings relative to natives, but also reveals a non-trivial contribution of within-job pay inequality. These results summarize average differences in annual earnings between immigrants and natives (and separately, between the children of immigrants and natives) on the basis of pooled estimates across all countries. Our figures report differences in logged earnings, and we use the standard transformation ($[e^{\text{coefficient}} - 1] \times 100$) to discuss the immigrant–native pay gaps as percentages in our exposition (details provided in Methods and Supplementary Tables 2–4; see also ref. 57). On average, after adjusting for education, age, sex and geographic region of employment, immigrants earn 17.9% less per year than natives (-0.197 log points; 95% confidence interval = $-0.271, -0.123$; $P < 0.001$). The influence of labour market segregation is evident in immigrants reduced pay gaps relative to natives when comparing employees within the same industry (13.0%; -0.139 log points; 95% confidence interval: $-0.188, -0.090$; $P < 0.001$), occupation (8.6%; -0.090 log points; 95% confidence interval: $-0.132, -0.049$; $P = 0.001$), establishment (8.9%; -0.093 log points; 95% confidence interval: $-0.130, -0.056$; $P < 0.001$) and job (4.6%; -0.047 log points; 95% confidence interval: $-0.072, -0.022$; $P = 0.002$). Comparing the within-job pay difference to the basic adjustments gap, we find that 26% of the baseline earnings gap is attributable to within-job inequality, and differential sorting into jobs (that is, occupation–establishment units) correspondingly accounts for 74% of the earnings differences between immigrants and natives. Thus, differential job sorting emerges as the key driver of immigrants'

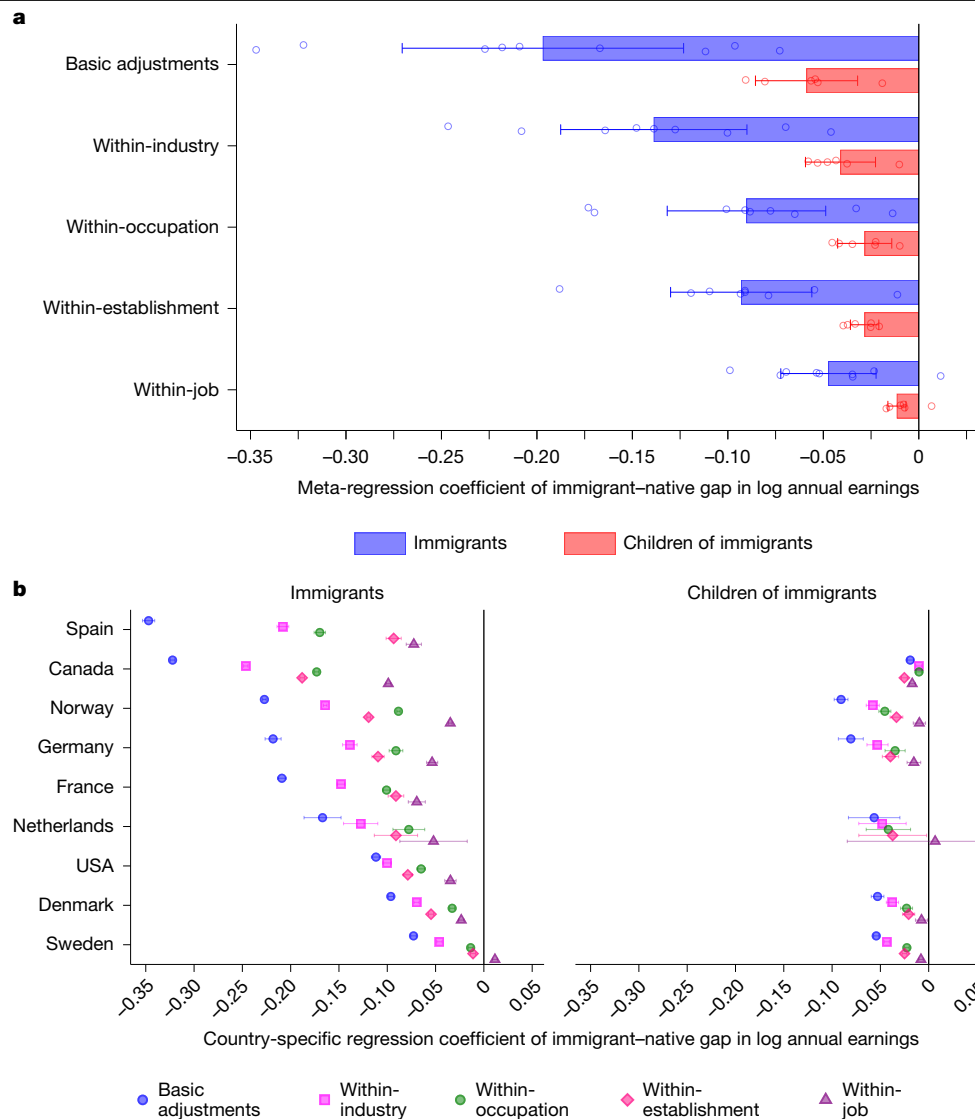


Fig. 1 | Immigrant–native earnings differences after basic adjustments and within industry, occupation, establishment and job. **a**, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment and job (that is, occupation–establishment units) for immigrants and children of immigrants from all world regions of origin, averaged across all countries using a random-effects meta-analysis of the pooled country-specific estimates. For each of the five model specifications, the meta-analysis includes country-specific estimates for immigrants ($n = 9$; Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden and the USA) and children of immigrants ($n = 6$; Canada, Denmark, Germany, the Netherlands, Norway and Sweden). Dots show the country-specific data points for the immigrant–native earnings differences; error bars indicate 95% confidence intervals for the pooled average immigrant–native earnings

difference from the meta-analysis. Supplementary Table 2 provides additional information. **b**, Country-specific differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment and job for immigrants and children of immigrants from all world regions of origin obtained from ordinary least squares (OLS) regressions on country-specific administrative records for workers aged 25–60 years (across administrative records for all countries, basic adjustments $n = 13,518,105$; within-industry $n = 13,485,006$; within-occupation $n = 13,229,226$; within-establishment $n = 9,338,619$; within-job $n = 6,147,204$; see Supplementary Table 3 for country-specific information), and error bars indicate the 95% confidence intervals for the country-specific immigrant–native earnings differences. Supplementary Table 3 provides additional information. In **a**, **b**, the line at $x = 0$ represents the reference category of native workers.

earnings disadvantages, although immigrants also earn less than native coworkers with the same job.

For children of immigrants, Fig. 1a shows that both total and within-job earnings differences relative to natives are significantly smaller than those observed among immigrants. After basic adjustments, children of immigrants earn, on average, 5.7% (-0.059 log points; 95% confidence interval: $-0.083, -0.035$; $P = 0.002$) less than natives. This earnings gap narrows further when comparing children of immigrants with children of native-born parents who work in the same industry (4.0%; -0.041 log points; 95% confidence interval: $-0.057, -0.025$; $P = 0.002$), occupation (2.8%; -0.028 log points; 95% confidence

interval: $-0.041, -0.0016$; $P = 0.004$) and establishment (2.8%; -0.028 log points; 95% confidence interval: $-0.035, -0.022$; $P < 0.001$). When comparing coworkers in the same occupation and with the same employer, the within-job earnings gap is approximately 1.1% (-0.011 log points; 95% confidence interval: $-0.016, -0.007$; $P = 0.002$). Thus, for children of immigrants, sorting into jobs accounts for 80% of the total earnings difference compared to natives. The results also show that the gaps between the children of immigrants and natives are 68–75% smaller than the gaps between immigrants and natives (total: 68%; within-industry: 69%; within-occupation: 68%; within-establishment: 69%; within-job: 75%).

Overall, the processes that generate between-job segregation and within-job earnings differences appear to be similar across immigrant generations but are significantly reduced in magnitude among the native-born children of immigrants. Within-job earnings differences between children of immigrants and natives are, on average, very small, whereas within-job inequality remains consequential for foreign-born immigrants. However, these aggregate patterns mask considerable variation across countries and between immigrant populations from different world regions of origin.

Differences across destination countries

Figure 1b shows the differences in earnings relative to natives for immigrants and native-born children of immigrants separately for the nine countries. The largest total earnings differences after basic adjustments are observed in Spain (-0.347 log points; 95% confidence interval: $-0.353, -0.341$; $P < 0.001$) and Canada (-0.322 log points; 95% confidence interval: $-0.325, -0.320$; $P < 0.001$), where immigrants, on average, earn 28–29% less than natives. In Norway (-0.227 log points; 95% confidence interval: $-0.229, -0.225$; $P < 0.001$), Germany (-0.218 log points; 95% confidence interval: $-0.226, -0.210$; $P < 0.001$), France (-0.209 log points; 95% confidence interval: $-0.214, -0.205$; $P < 0.001$) and the Netherlands (-0.167 log points; 95% confidence interval: $-0.186, -0.148$; $P < 0.001$), immigrants earn 15–20% less than natives. The smallest immigrant–native differences are found in the USA (-0.112 log points; 95% confidence interval: $-0.116, -0.107$; $P < 0.001$), Denmark (-0.096 log points; 95% confidence interval: $-0.099, -0.094$; $P < 0.001$), and Sweden (-0.073 log points; 95% confidence interval: $-0.076, -0.070$; $P < 0.001$), where immigrants earn 7–11% less than natives. Although these cross-country differences are less pronounced for the within-job pay gap, there are still notable cross-national differences. In France (-0.069 log points; 95% confidence interval: $-0.078, -0.061$; $P < 0.001$), Spain (-0.073 log points; 95% confidence interval: $-0.080, -0.065$; $P < 0.001$) and Canada (-0.099 log points; 95% confidence interval: $-0.101, -0.096$; $P < 0.001$), immigrants earn 7–9% less than natives who have the same occupation and employer, compared with 2–5% in Denmark (-0.023 log points; 95% confidence interval: $-0.026, -0.021$; $P < 0.001$), Norway (-0.035 log points; 95% confidence interval: $-0.037, -0.033$; $P < 0.001$), the USA (-0.035 log points; 95% confidence interval: $-0.040, -0.029$; $P < 0.001$), the Netherlands (-0.052 log points; 95% confidence interval: $-0.087, -0.017$; $P = 0.003$) and Germany (-0.054 log points; 95% confidence interval: $-0.059, -0.048$; $P < 0.001$). In Sweden (0.011 log points; 95% confidence interval: $0.009, 0.014$; $P < 0.001$), no within-job pay disadvantage for immigrants relative to natives is observed. Across all countries except Sweden (where sorting accounts for all of the total earnings gap), sorting into lower-paying jobs generates between 64–83% of the total earnings differences (Supplementary Table 3). The estimated within-industry, within-occupation and within-establishment immigrant–native earnings gaps further highlight how sorting into lower-paying industries, occupations and workplaces constitute key sources of immigrants' earnings disparities relative to natives.

Figure 1b reveals reduced earnings disadvantages among native-born children of immigrants across countries where information on this population is available (Canada, Denmark, Germany, the Netherlands, Norway and Sweden). Within-job pay differences between natives and children of immigrants are uniformly very small, at less than 2% in all countries (detailed estimates reported in Supplementary Table 3). The total earnings differences relative to natives after basic adjustments are also considerably smaller among children of immigrants compared with immigrants, ranging from approximately 2% in Canada (-0.019 log points; 95% confidence interval: $-0.022, -0.016$; $P < 0.001$) to 8–9% in Germany (-0.081 log points; 95% confidence interval: $-0.094, -0.030$; $P < 0.001$) and Norway (-0.091 log points; 95% confidence interval: $-0.098, -0.084$; $P < 0.001$). Although total earnings differences relative

to natives are consistently lower in the second generation across all countries, Fig. 1b shows that differential sorting into lower-paying jobs makes a relative contribution to total earnings differences that is similar to that found among immigrants. However, across these six countries, there is notable labour market progress across the immigrant generations, and only very small earnings differences remain between children of immigrants and natives who are doing the same work for the same employer.

Differences across regions of origin

Figure 2a presents earnings differences for immigrants and children of immigrants separately for five world regions of origin, averaged across all destination countries using the meta-analytic summaries of country-specific estimates for each region of origin (Supplementary Figs. 8–16 and Supplementary Tables 42–52 report the estimates for each region of origin separately by destination country). Among immigrants, the largest earnings disadvantages after basic adjustments are observed for foreign-born workers from Sub-Saharan Africa (-0.302 log points; 95% confidence interval: $-0.382, -0.222$; $P < 0.001$) and the Middle East and North Africa (-0.270 log points; 95% confidence interval: $-0.350, -0.191$; $P < 0.001$), with gaps ranging from 24–26%. Immigrants from Asia (-0.225 log points; 95% confidence interval: $-0.305, -0.145$; $P < 0.001$) and Latin America (-0.205 log points; 95% confidence interval: $-0.284, -0.125$; $P < 0.001$) earn, on average, between 19–20% less than natives, whereas those from Europe, North America and other Western countries (-0.094 log points; 95% confidence interval: $-0.174, -0.014$; $P = 0.022$) experience smaller disadvantages, earning approximately 9% less than natives.

Variation in within-job earnings differences based on region of origin follows a similar pattern. Immigrants from Sub-Saharan Africa (-0.086 log points; 95% confidence interval: $-0.117, -0.055$; $P < 0.001$) and the Middle East and North Africa (-0.079 log points; 95% confidence interval: $-0.108, -0.049$; $P < 0.001$) earn approximately 8% less than their native coworkers in the same job, and immigrants from Latin America (-0.066 log points; 95% confidence interval: $-0.096, -0.036$; $P < 0.001$) and Asia (-0.048 log points; 95% confidence interval: $-0.079, -0.018$; $P = 0.003$) experience slightly smaller within-job gaps of 5–6%. By contrast, immigrants from Western countries (-0.017 log points; 95% confidence interval: $-0.047, 0.012$; $P = 0.246$) experience a statistically non-significant average within-job earnings gap of only 2%. Across all regions of origin, differential sorting into jobs accounts for 66–81% of the total earnings disparities relative to natives. These findings underscore how sorting across jobs—along with industries, occupations and workplaces—remains the primary driver of immigrants' earnings disadvantages regardless of world region of origin. However, Fig. 2a also shows that immigrants, except for those from Western origins, often earn considerably less than natives who do the same work for the same employer.

Figure 2a also reveals reduced earnings disadvantages among children of immigrants across all world regions, averaged across countries. The largest total earnings differences relative to natives are observed among children of Sub-Saharan African immigrants (12%; -0.126 log points; 95% confidence interval: $-0.166, -0.086$; $P < 0.001$), followed by children of Latin American (10%; -0.109 log points; 95% confidence interval: $-0.147, -0.072$; $P < 0.001$), Middle Eastern and North African (8%; -0.081 log points; 95% confidence interval: $-0.117, -0.046$; $P < 0.001$), Asian (6%; -0.063 log points; 95% confidence interval: $-0.098, -0.027$; $P = 0.002$), and European and North American (3%; -0.026 log points; 95% confidence interval: $-0.062, 0.010$; $P = 0.164$) origins.

The within-job earnings gaps are considerably smaller. Children of Sub-Saharan African (-0.036 log points; 95% confidence interval: $-0.057, -0.015$; $P < 0.001$), Latin American (-0.033 log points; 95% confidence interval: $-0.053, -0.013$; $P = 0.004$), and Asian (-0.032 log

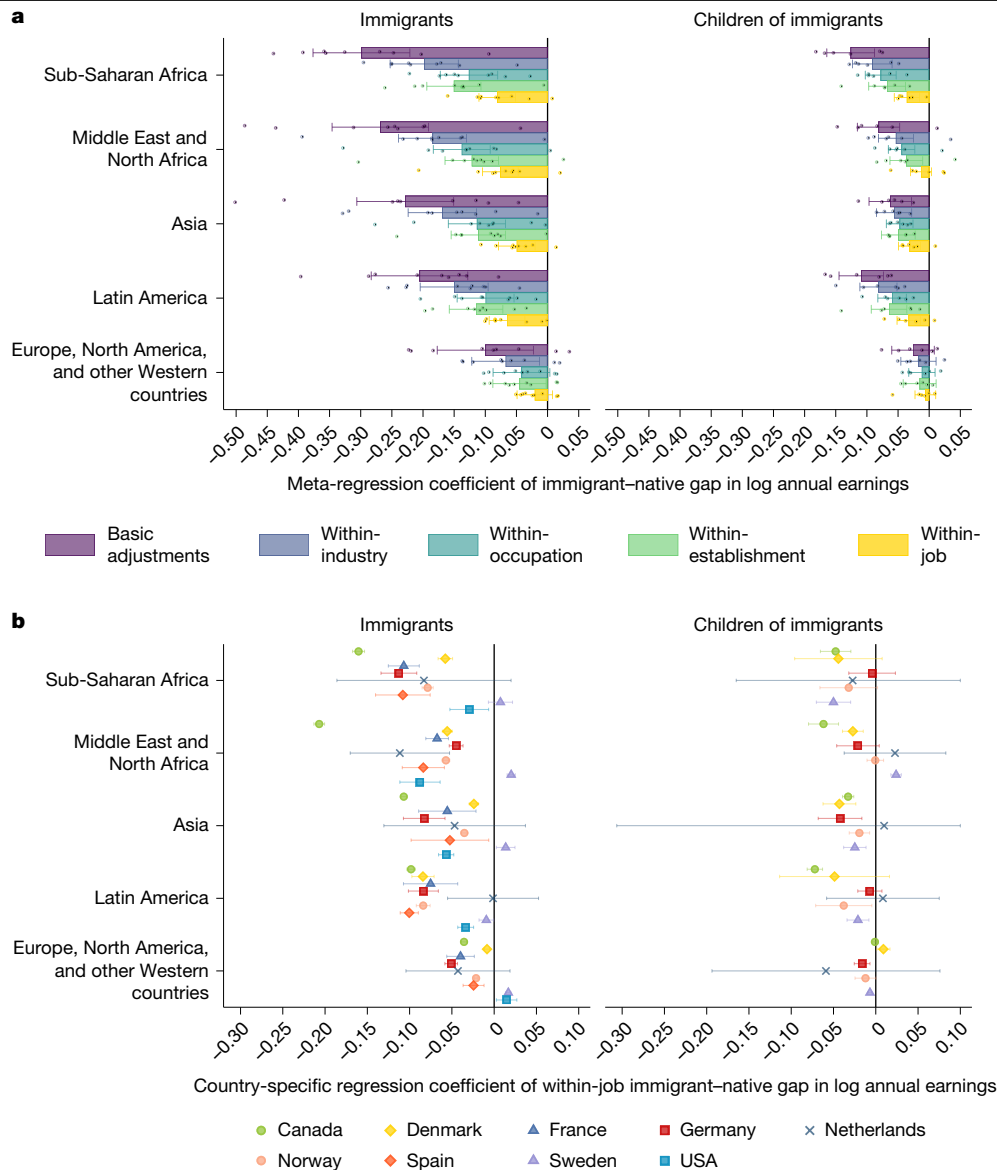


Fig. 2 | Immigrant-native earnings differences after basic adjustments and within industry, occupation, establishment and job by world region of origin. a, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment and job (that is, occupation-establishment units) for immigrants and children of immigrants separately by world region of origin, averaged across all countries using a random-effects meta-analysis of the pooled country-origin-specific estimates. For each of the five model specifications, the meta-analysis includes country-origin-specific estimates for immigrants ($n = 45$, 9 countries \times 5 models; Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden and the USA) and children of immigrants ($n = 30$, 6 countries \times 5 models; Canada, Denmark, Germany, the Netherlands, Norway, and Sweden) from each of the five world regions. Dots show the country-specific data points for the

immigrant-native earnings differences; error bars indicate the 95% confidence intervals for the pooled average immigrant-native earnings difference from the meta-analysis. Supplementary Table 4 provides additional information. **b**, Country-specific within-job differences in log annual earnings relative to natives for immigrants and children of immigrants separately by world region of origin obtained from OLS regressions on country-specific administrative records for workers aged 25–60 years (across administrative records for all countries, $n = 6,147,204$; see Supplementary Table 3 for country-specific information), and error bars indicate the 95% confidence intervals for the country-specific immigrant-native earnings differences. Supplementary Table 5 provides additional information. In **a, b**, the line at $x = 0$ represents the reference category of native workers.

points; 95% confidence interval: $-0.050, -0.013$; $P = 0.001$) immigrants earn, on average, 3–4% less than native coworkers in the job. Children of Middle Eastern and North African immigrants (-0.013 log points; 95% confidence interval: $-0.031, 0.005$; $P = 0.074$) earn, on average, only about 1% less than natives who have the same job, and this estimate is not statistically significant. The within-job earnings differences for children of European and North American immigrant origins are negligible and also not statistically significant (-0.006 log points; 95% confidence interval: $-0.024, 0.011$; $P = 0.385$). Differential sorting across jobs explains between 69–83% of the total earnings differences across

all but one region of origin (Supplementary Table 2). Children of Asian immigrants are the exception, as within-job inequality accounts for half of the total earnings differences from natives, although the overall pay gap is relatively modest for this group.

Figure 2b demonstrates that the pattern of within-job earnings differences by world region of origin, averaged across countries, is broadly consistent with the country-specific estimates for immigrants and children of immigrants from each world region of origin (for detailed estimates, see Supplementary Table 5). Although the size of region-specific within-job earnings gaps relative to natives varies across countries

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for both immigrant generations, a consistent pattern emerges. When immigrants from a given world region face relatively large within-job pay differences (for example, 5% or more), the corresponding gap among children of immigrants from the same region is at least 40% smaller. The exceptions to this pattern are children of Latin American immigrants in Canada and children of Sub-Saharan African immigrants in Denmark, whose earnings gaps with natives narrow less markedly across generations. Overall, within-job inequality is substantially lower for children of immigrants compared with immigrants from the same world region within the same destination country.

Discussion

The successful economic integration of immigrants and their native-born children is a key policy objective in immigrant-receiving societies. However, before this study, little was known about the extent to which immigrants and their children in high-income countries earn the same pay as native-born workers doing the same work for the same employer, and the degree to which these within job differences contributed to overall differences was unclear.

Here, using data from nine high-income countries in Europe and North America, we find that immigrants earn on average 18% less than natives after basic adjustments for human capital, and that most of this gap is driven by differential sorting into industries, occupations, workplaces and jobs. Unequal pay between immigrants and natives who do the same work for the same employer is less pronounced, but still, on average, accounts for about one-quarter of the overall earnings gap that immigrants experience relative to natives. We also document a clear pattern of intergenerational economic assimilation among immigrants' native-born children, with both overall and within-job earnings disparities relative to natives generally smaller than those observed among immigrants from the same world region of origin in the same destination country.

Although the relative contributions of between-job segregation and within-job pay inequality are broadly consistent across countries, the magnitude of earnings disadvantages faced by immigrant-background workers varies substantially by world region of origin and destination country. For immigrants from some regions in some countries, within-job pay disadvantages also remain notable. These differences in magnitude likely reflect a range of factors, including labour market institutions, immigration policies, employer biases and the selectivity of immigrant flows. However, our findings demonstrate that unequal access to higher-paying jobs is the primary driver of the immigrant-native pay gap across these diverse institutional and demographic contexts.

The central role of job-sorting processes in driving the immigrant pay gap highlights a set of mechanisms that policies aimed at reducing job-level segregation can effectively target. This includes language training^{10–13}, job training^{13–15}, job search assistance programmes that directly connect workers to employers^{13,15}, improved access to domestic education^{13,16,17}, recognition of foreign qualifications^{18,19} and settlement programmes aimed at improving access to job-relevant information and social networks^{13,20,21}. Such measures must be tailored to different categories of migrants—for example, high-skilled versus low-skilled immigrants and refugees versus labour migrants—and to country-specific institutional contexts, but prior research has shown that such policies can be cost-effective tools for improving immigrants' labour market outcomes across a broad array of contexts^{10–15,18–21}. By addressing barriers that limit access to higher-paying jobs, these interventions target the key job-sorting process identified in our analysis.

Policies that address employer bias in hiring, promotion and other job-allocation decisions that employers make are also highly relevant^{22–28}. Initiatives aimed at enhancing managerial accountability and organizational transparency have proved to be effective against workplace inequality^{24–27}. Although immigrants' within-job earnings

disadvantages relative to natives underscore the continued relevance of workplace and government policies that monitor and enforce equal pay for equal work^{24,26}, our findings suggest that the overall potential of such policies to close the immigrant-native pay gap may be more limited than those that are aimed at addressing unequal access to higher-paying jobs.

Online content

Any methods, additional references, Nature Portfolio reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at <https://doi.org/10.1038/s41586-025-09259-6>.

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Article

Methods

Data and measures

Linked employer–employee administrative records and meta-analytic data. We used recent linked employer–employee administrative records (administrative records that link individual employees directly to their employers and coworkers) from nine countries in Europe and North America (Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden and the USA). These linked employer–employee administrative records can be used for approved research purposes by individuals with the proper authorizations from the relevant national statistical agencies. We use these administrative records to create a dataset that contains immigrant–native pay differences net of human capital within the same job, occupation, establishment, industry, and in the labour market as a whole. We subsequently analyse these differences using a random effects meta-regression model and report the results of this meta-analysis in our paper. When meta-analysis is conducted on results from the same model across different samples (as is the case here), it is in principle equivalent to running one model for all countries.

Key features and reliability of administrative records. A summary of the key features of the administrative records across countries is provided in Extended Data Table 1. Below, we provide a general description of the measurement of key variables used in the analysis. The administrative records used in our analysis are of high quality, enabling detailed comparisons of workers within the same occupation and employer. However, harmonizing administrative records across countries presents inherent challenges due to variation in sources, definitions, and variable measurements. Extended Data Table 1 highlights cross-national differences in sample size, information sources and key variables such as immigrant background, industry, occupation, employer and job (defined as unique combinations of occupation and employer identifiers) across our nine countries. Given the unique nature of each country's administrative records infrastructure, we include additional details in the Supplementary Information (Section 6), covering variable measurement, relevant country-specific supplementary analyses and a brief overview of the immigration context in each country.

To address potential biases related to cross-national comparability and the reliability of our findings, we conducted extensive sensitivity analyses, summarized in Extended Data Figs. 6–8 and described in detail in Supplementary Information, section 4 and Supplementary Tables 25–39. These analyses assess the robustness of our results to different methodological choices, including alternative measures of pay (annual earnings versus hourly wages; Extended Data Fig. 6 and Supplementary Table 25–27), varying levels of occupational granularity (four-digit codes versus coarser classifications; Extended Data Fig. 7 and Supplementary Tables 29–31), different methods of identifying employers (establishment-level versus firm-level identifiers; Extended Data Fig. 7 and Supplementary Table 32), the exclusion of control variables (education, geographic region, age; Extended Data Fig. 8 and Supplementary Tables 33–36), varying the age restrictions defining the sample; Extended Data Fig. 8 and Supplementary Table 37, and the inclusion of additional control variables (seniority, part-time/full-time employment; Extended Data Fig. 8 and Supplementary Tables 38–39).

Each sensitivity analysis is discussed below in relation to the specific measurement issue it addresses, with comprehensive descriptions provided in Supplementary Information, section 4. Collectively, these analyses confirm the robustness of our findings to variations in variable definitions, measurement approaches, and modelling specifications.

Earnings and wages. We use the natural logarithm of annual earnings as our dependent variable. The measure of annual earnings is based on pre-tax earnings and is a function of hourly wages, annual hours worked and additional compensation such as overtime pay,

performance bonuses and other wage components contributing to take home pay. For the countries where we can isolate hourly wage on contractual hours (Denmark, the Netherlands and Norway) or hourly earnings (France, Spain and the USA), we report estimates using these alternative wage and earnings measures to capture compensation per hour worked (Supplementary Tables 25–27).

Immigrant background. In five countries (Canada, Denmark, the Netherlands, Norway and Sweden), we can identify the country of birth of individuals and their parents. Immigrants are defined as persons who were born abroad, while children of immigrants are defined as persons who were born in their current country of residence to two foreign-born parents; both groups are compared to natives, defined as individuals who were born in their country of residence to native-born parents. In three countries (France, Spain and the USA), only an individual's country of birth is available (that is, information on their parents' country of birth is not available), allowing us to compare immigrants (those born abroad) to natives (in this case, those born in their country of residence). For Germany, information on the country of birth is unavailable, and so we identify immigrants and children of immigrants using longitudinal data on citizenship status, nationality and name-based information derived from social security records (details provided in Supplementary Information, section 6.4.2).

World region of origin. For analyses examining differences by world region of origin, immigrants and children of immigrants are grouped into five broad world regions: Asia; Europe, North America, and other Western countries; Latin America; Middle East and North Africa; and Sub-Saharan Africa (Supplementary Table 1 provides a detailed list of countries within each region). For Canada, Denmark, France, the Netherlands, Norway, Spain, Sweden and the USA, region of origin is determined by country of birth for immigrants and parental country of birth for children of immigrants, prioritizing the mother's country of birth when immigrant parents differ. Information on country of birth is unavailable in Germany, so we use information on nationality upon labour market entry for immigrants and information on first names for children of immigrants to provide a precise categorization for region of origin (details provided in Supplementary Information, section 6.4.2).

Duration of stay. Supplementary analyses (Extended Data Fig. 1 and Supplementary Tables 10–12) report results for immigrants disaggregated by duration of stay in seven countries (Canada, Denmark, France, Germany, Norway, Sweden and the USA). Immigrants are categorized as: recent immigrants (less than 10 years since arrival); established immigrants (10 or more years since arrival); and childhood immigrants (individuals who immigrated at 17 years old or younger).

Industry. Industry refers to the primary economic activity of the establishment where an individual is employed, defined by the type of goods and services it produces. For Denmark, France, the Netherlands and Norway, industry is classified using the four-digit nomenclature of the Statistical Classification of Economic Activities in the European Community (NACE), while Germany and Sweden are classified using three-digit NACE codes. For Spain, we rely on two-digit codes from the National Classification of Economic Activities (CNAE). For Canada and the USA, industry is classified using three-digit codes from the North American Industrial Classification (NAICS).

Establishment. Employers are identified using unique establishment identifiers in Denmark, France, Germany, the Netherlands, Norway, Spain and Sweden. Establishments typically refer to distinct workplaces, often defined by a unique postal address, and are distinct from firms except in cases of single-establishment firms. In Canada and the USA, employers are identified using unique firm-level identifiers, which can encompass multiple establishments across geographic locations.

For countries with information on both establishments and firms (Denmark, France, the Netherlands, Norway, Spain and Sweden), we report additional results using firm identifiers to assess the robustness of our findings to this alternative employer measure (Supplementary Table 32).

Occupation. We use four-digit codes from national adaptations of the International Standard Classification of Occupations (ISCO) to measure occupations for Denmark, Germany, Norway and Sweden. In Canada, the three-digit Canadian National Occupational Classification system (NOC) is used, while in the USA, occupations are measured using three-digit categories from the Standard Occupation Classification (SOC) system. For the Netherlands, we use ISCO codes measured at the two-digit level due to small sample sizes at the job level (occupation–establishment level). In France, where job-level sample sizes are also small, we use two-digit occupation codes from a coarsened version of *Nomenclature des Professions et Catégories Socio-Professionnelles* (CSP) with 30 occupational categories. For Spain, occupation is classified using the employer-reported one-digit *grupo de cotización* (10 categories) system. To evaluate the impact of occupational granularity for our results, we provide sensitivity analyses coarsening occupational measures to one-, two- and three-digit levels for countries with detailed occupational information (Supplementary Tables 29–31).

Occupation–establishment units. Jobs are defined as the intersection of occupation and establishment (or firms), with the occupation–establishment units representing unique job cells⁵⁸. Within-job pay gaps refer to the estimated pay differences within these occupation–establishment units. This conceptualization of jobs aligns with the understanding of jobs as settings where individuals are hired to do specific tasks—often within the same work group—in the same workplace or company. However, highly detailed occupational and job titles may just reflect wage level indicators instead of distinguishing the actual content of work performed⁵⁸. To address this, we provide results using coarsened definitions of jobs based on one-, two- and three-digit occupational codes when defining occupation–establishment units (Supplementary Tables 29–31). For countries with information on both firms and establishments, we also report results where jobs are defined as occupation–firm units (Supplementary Table 32). We also report results where we restrict the sample in all models to only include individuals working in immigrant–native integrated job cells (that is, excluding workers in jobs occupied only by natives or only by immigrants and their children; Supplementary Table 28).

Covariates. Our main analyses adjust for sex, educational attainment, geographic region, and age. Sex is coded as a binary variable distinguishing men and women (Extended Data Figs. 2 and 3 and Supplementary Tables 13–18 present results from separate analyses for men and women). Educational attainment is categorized into four or five levels: less than upper-secondary education; completed upper-secondary education; short tertiary education (for example, Bachelor’s degrees or equivalent); long tertiary education (for example, Master’s degrees or equivalent); and, where available, doctoral degrees (see Extended Data Figs. 4 and 5 and Supplementary Tables 19–24 for results from separate analyses for highly educated workers and workers with less education). A separate indicator is included for individuals with missing educational information. Geographic region is captured using a set of dummy variables for local labour markets (for example, municipalities or counties; see country-specific descriptions in Supplementary Information, section 6). Age is modelled using both linear and quadratic terms.

Sample restrictions. We use the most recent information available to us, which ranges from 2016 to 2019, depending on the country. We restrict our main samples to workers between ages 25 and 60. For each worker, we select the job observation with the highest annual earnings

in the year of observation if the worker is observed with multiple job spells. We exclude workers in marginal jobs, defined as observations with annual earnings below 50% of the lowest decile cutoff.

Statistical analysis

Our analysis is conducted in two steps. First, to create our dataset, we estimate a series of OLS regression models for each country separately, which report earnings differences of immigrants and children of immigrants relative to natives, considering all world regions of origin combined and separately by world region of origin. Second, we use a meta-analytic approach to summarize the average of these country-specific estimates of immigrant–native earnings differences across all countries and separately by world region of origin. We describe this approach in detail below.

Country-specific regressions. To create our meta-analytic dataset, we estimate a series of OLS regression models using five sequential specifications, following the framework of Penner et al.⁵⁸. These models are estimated separately for each country; this allows us to examine country-specific variation in earnings gaps relative to natives among immigrants and children of immigrants at different levels in the labour market.

The first model adjusts only for a set of basic covariates (Model 1), providing a baseline estimate of pay gaps between immigrants and natives, and between the native-born children of immigrants and natives. These covariates include educational attainment level, sex, age, and geographic region of employment. This specification provides estimates for the immigrant–native pay gap comparing all workers at the population level, net of basic adjustments for standard human capital controls and unobserved regional labour market characteristics (for example, differences in wage levels between geographic regions). In the subsequent models, we introduce fixed effects that allow us to compare immigrants, children of immigrants, and natives who work in the same industry (Model 2), the same occupation (Model 3), the same establishment (Model 4), and the same job (that is, occupation–establishment unit; Model 5). All models include the basic covariates from Model 1, and comparing the results across these five models enables us to quantify the extent to which immigrant–native differences in earnings are attributable to sorting across industries, occupations, establishments, and specific jobs (occupation–establishment units), relative to within-job pay inequality (that is, different pay for the same job).

The equations estimated for our five core models follow the same general form, using five different specifications:

$$\ln(\text{earnings}_i) = \gamma_{\text{BASE}} I_i + \theta_{\text{BASE}} \mathbf{x}_i + \varepsilon_i, \quad (1)$$

$$\ln(\text{earnings}_i) = \gamma_{\text{IND}} I_i + \theta_{\text{IND}} \mathbf{x}_i + \eta_{\text{ind}} + \varepsilon_i, \quad (2)$$

$$\ln(\text{earnings}_i) = \gamma_{\text{OCC}} I_i + \theta_{\text{OCC}} \mathbf{x}_i + \eta_{\text{occ}} + \varepsilon_i, \quad (3)$$

$$\ln(\text{earnings}_i) = \gamma_{\text{EST}} I_i + \theta_{\text{EST}} \mathbf{x}_i + \eta_{\text{est}} + \varepsilon_i, \quad (4)$$

$$\ln(\text{earnings}_i) = \gamma_{\text{OCCEST}} I_i + \theta_{\text{OCCEST}} \mathbf{x}_i + \eta_{\text{occest}} + \varepsilon_i, \quad (5)$$

where the subscripts denote i for individuals, ind for industries, occ for occupations, est for establishments, and occest for occupation–establishment units. The dependent variable is the logarithm of annual earnings ($\ln(\text{earnings}_i)$) for individual i and the independent variable I_i is an indicator variable for immigrant background of individual i (coding detailed below), while other covariates are contained in the vector \mathbf{x}_i . This vector includes a constant term; the sex, age and age squared of individual i ; and a series of indicator variables capturing educational attainment level and geographic region of individual i . The fixed effects

η_{ind} , η_{occ} , η_{est} , and η_{occest} refer to fixed effects for industry, occupation, establishment, and occupation–establishment units, respectively. Our measure of immigrant background (I_i) distinguishes between native workers (the reference category), immigrants, and children of immigrants. In models where we differentiate between the world region of origin of immigrants and children of immigrants, the immigrant background indicators are extended to include categories for world region of origin separately for immigrants and children of immigrants: Asia; Europe, North America, and Other Western; Latin America; Middle East and North Africa; Sub-Saharan Africa.

Model 1 thus provides estimates of the immigrant–native differences in earnings after basic adjustments for sex, age and age squared, education, and geographic region. Model 2 includes these same covariates as well as the fixed effects η_{ind} representing the industry indicators. Thus, Model 2 provides estimates of immigrant–native differences in earnings obtained from comparing immigrants and children of immigrants to natives who work in the same industry. Intuitively, these results can be thought of as estimating the immigrant–native difference in earnings separately for each industry unit and then taking a weighted average of these immigrant–native differences across all industries. Models 3, 4 and 5 are analogous to Model 2, but contain the fixed effects η_{occ} , η_{est} , and η_{occest} that refer to the unique occupation (η_{occ}), establishment (η_{est}), or occupation–establishment (η_{occest}) unit. The analytic sample for each model is restricted to fixed effect units that are integrated by immigrant background (that is, units that include at least one immigrant or child of immigrants alongside at least one native worker). The subscripts to the γ and θ parameters indicate that these are different coefficients, pertaining to different levels, basic adjustments (BASE), industry (IND), occupation (OCC), establishment (EST) and occupation–establishment (OCCEST).

We use the natural logarithm of earnings as our dependent variable. Following standard conventions, these coefficients on I_i are interpreted as the relative difference on average earnings for immigrants and children of immigrants compared to natives. More formally, our estimates reflect the differences in relative geometric means of unlogged earnings, corresponding to the absolute differences in the arithmetic means of logged earnings⁵⁷.

The country-specific estimates from the five model specifications are presented for immigrants and children of immigrants, both for all groups combined and by world region of origin, separately for each country in the Supplementary Information, section 6 and Supplementary Tables 42–52). The reported coefficients and their corresponding standard errors for each country form the aggregated dataset used in the subsequent meta-analysis.

Meta-analysis of the country-specific regression estimates. Having created our aggregated dataset, we use meta-analysis to analyse the immigrant–native pay gaps across the nine countries. We pool country-specific estimates of differences in earnings between natives and immigrants (and separately, the differences between natives and the children of immigrants) for each of the five regression models described above (Models 1–5). This yields the average immigrant–native earnings difference across all countries, after basic adjustments and within industry, occupation, establishment, and job (occupation–establishment).

The meta-analysis serves two objectives. First, it provides average immigrant–native earnings differences using country-level estimates without differentiating by world region of origin. For each model specification, we include one estimate per country for immigrants (nine countries) and, where information is available, one estimate per country for the children of immigrants (six countries). Second, our meta-analysis provides information on how immigrant–native earnings differences vary by world region of origin, averaged across destination countries we use country-specific estimates differentiating by five world regions for immigrants (45 country–region

estimates per model) and for the children of immigrants (30 country–region estimates per model).

To capture sources of cross-country variability, we use a random-effects meta-analysis specification^{56,59,60}, incorporating a variance component that captures unobserved country-level factors. Random-effects meta-analysis is appropriate when the underlying effect sizes are likely to vary within the population of estimates (that is, we would not expect the country-specific immigrant–native earnings differences to all be identical), rather than representing a single underlying parameter. We specify the random-effects meta-regression models estimated by restricted maximum likelihood, where the general form of this equation is:

$$y_i = \alpha + \mu_i + \varepsilon_i, \text{ where } \mu_i \sim N(0, \tau^2) \text{ and } \varepsilon_i \sim N(0, \sigma_i^2) \quad (6)$$

where y_i is the immigrant–native difference in log annual earnings estimated for country i , α is the intercept, μ_i is the random effect for country i , where τ^2 is the residual between-country variance, and ε_i is the sampling error term with variance σ_i^2 .

To summarize variation in immigrant–native earnings differences by world region of origin averaged across countries, we use in the country–region-specific estimates of immigrant–native differences in log annual earnings. To achieve this, we extend equation (6) by including covariates for world regions, where the equation for the expanded model is:

$$Y_k = \beta x_k + \mu_k + \varepsilon_k, \text{ where } \mu_k \sim N(0, \tau^2) \text{ and } \varepsilon_k \sim N(0, \sigma_k^2) \quad (7)$$

where γ_k denotes the immigrant–native difference for country–region combination k ; β is a vector of coefficients; x_k is a vector of indicators for the five world regions; and μ_k and ε_k are defined analogously as in equation (6).

Figure 1a presents the results from the meta-analysis summarizing the overall pattern of immigrant–native earnings differences, averaged across countries, using the country-specific estimates to fit the model in equation (6). Similarly, Fig. 2a presents corresponding meta-analysis results for immigrant–native earnings differences by world region of origin, averaged across countries, using the country–region-specific estimates to fit the model in equation (7). For all results presented in Figs. 1b and 2b, models are fitted separately for immigrants and children of immigrants across estimates from the five regression specifications. Cochran's Q , I^2 and τ^2 heterogeneity statistics (Supplementary Tables 2 and 4) support the use of random-effects models for the meta-analyses.

Model sensitivity. We also estimated fixed-effect meta-analyses, which assume a common true effect size across studies, to assess the impact of model choice on our results (Supplementary Information, section 2, Supplementary Fig. 2 and Supplementary Tables 8 and 9). To assess whether differences by immigrant generation are sensitive to the sample of countries included, we restricted the random-effects model analysis to the six countries with information about both immigrants and children of immigrants (Supplementary Fig. 1 and Supplementary Tables 6 and 7). In both cases, the results were consistent with our main results.

Statistical software. All analysis was conducted and figures were created using Stata, versions 16–18.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

The data used in this study are available on the Open Science Framework repository (<https://doi.org/10.17605/osf.io/tjeun>).

Code availability

The code that supports the findings of this study is available on the Open Science Framework repository (<https://doi.org/10.17605/osf.io/tjeun>).

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publicly available meta-analytic data. Access to country-specific administrative records was authorized by: Statistics Canada (Canada); Statistics Denmark (Denmark); the French Comité du Secret Statistique (France); the German Institute for Employment Research (Germany); the Central Bureau of Statistics of the Netherlands (Netherlands); Statistics Norway (Norway); the Ministry of Labor, Migration and Social Security of Spain (Spain); Statistics Sweden (Sweden); and the U.S. Census Bureau (USA). Any opinions and conclusions expressed herein are those of the authors and do not represent the views of the U.S. Census Bureau. The Census Bureau has ensured appropriate access and use of confidential data and has reviewed these results for disclosure avoidance protection (project 7526852: CBDRB-FY2022-CES010-014, CBDRB-FY23-CES014-017, CBDRB-FY25-CES005-004).

Author contributions A.S.H. was principal investigator on this project, conducted the meta-analysis and supervised all analyses. A.S.H. and A.P. designed the study and wrote the paper. A.S.H., A.P. and I.B. wrote code. A.S.H., A.P., I.B. and T.P. developed the methodology. A.S.H., A.P., I.B., M.M.E., O.G., M.H., L.F.H., F.H., Z.L., T.P., M.R., H.S., M.S., D.T.-D. and E.V. conceptualized the analyses, provided intellectual input, interpreted the results and edited drafts of the manuscript. A.S.H. produced estimates from the Norwegian administrative records; M.M.E. and H.S. produced estimates from the Spanish administrative records; O.G. and M.S. produced estimates from the French administrative records; M.H. produced estimates from the Swedish administrative records; L.F.H. produced estimates from the Danish administrative records; F.H. produced estimates from the Canadian administrative records; Z.L. produced estimates from the Dutch administrative records; M.R. produced estimates from the German administrative records; and E.V. produced estimates from the U.S. administrative records.

Competing interests The authors declare no competing interests.

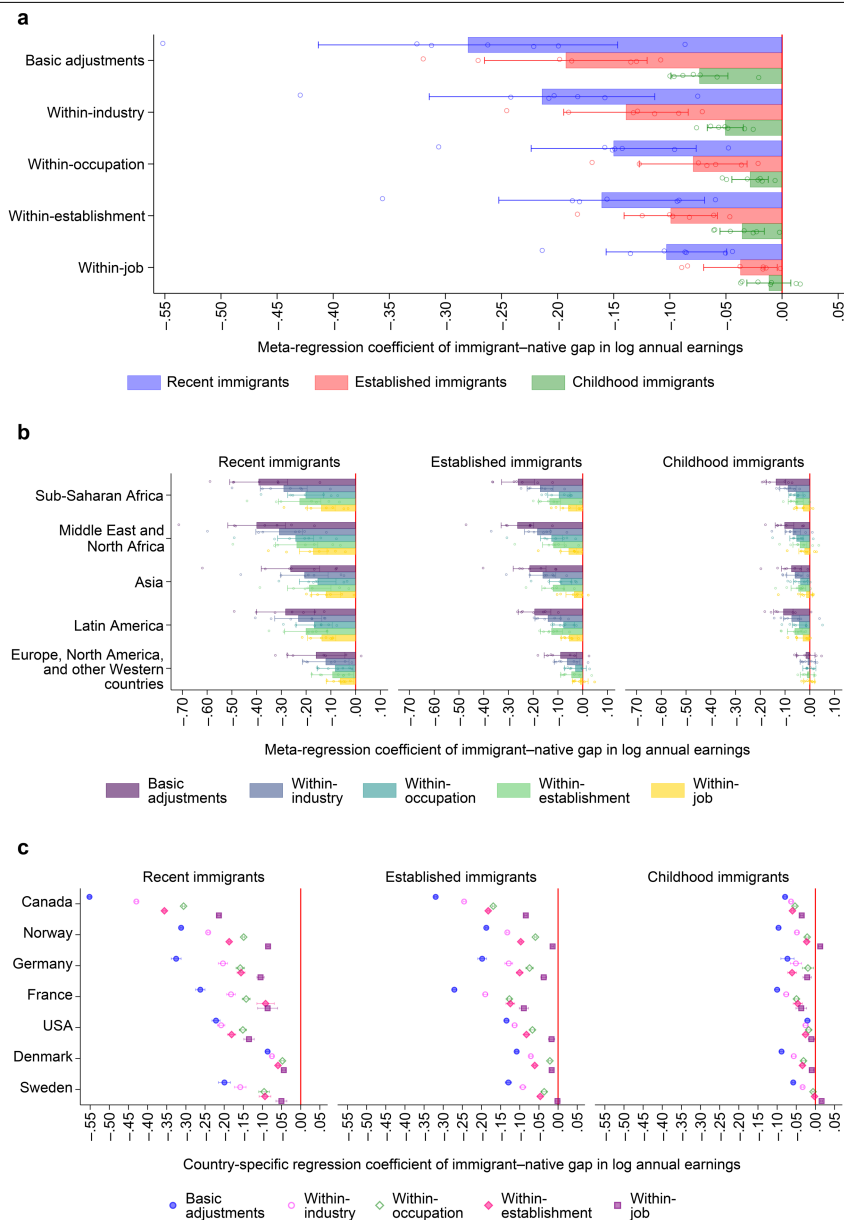
Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1038/s41586-025-09259-6>.

Correspondence and requests for materials should be addressed to Are Skeie Hermansen.

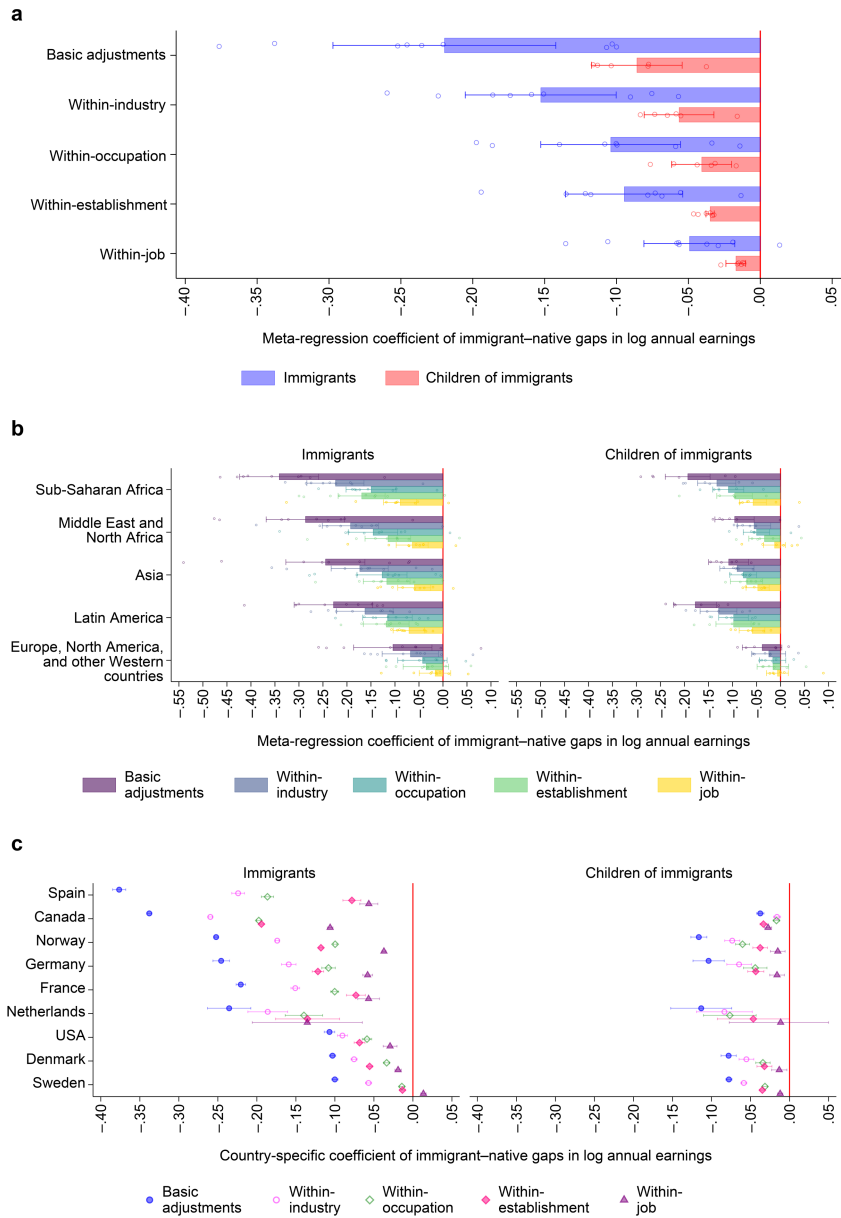
Peer review information *Nature* thanks Yuxiang Luan and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.

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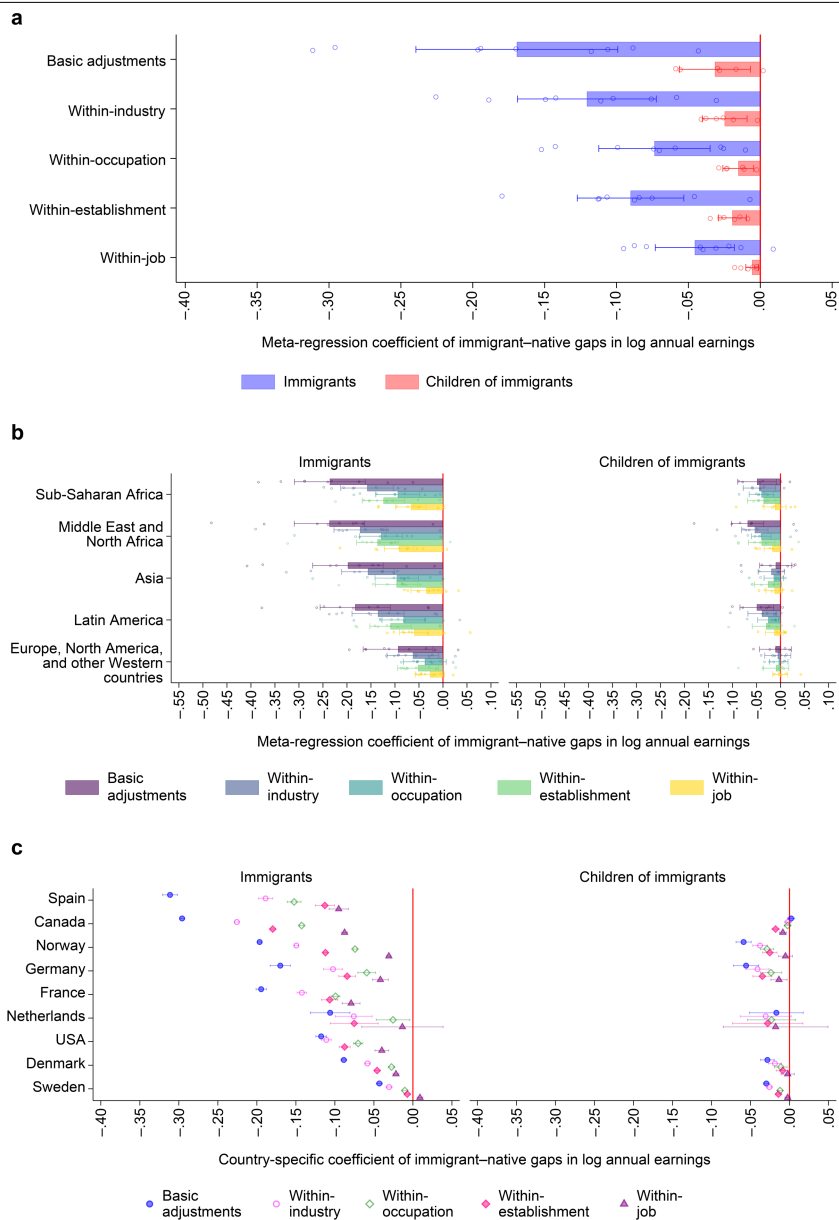
Extended Data Fig. 1 | Immigrant-native differences in annual earnings for recent immigrants, established immigrants, and childhood immigrants after basic adjustments and within industry, occupation, establishment, and job. a, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for recent immigrants, established immigrants, and childhood immigrants from all world regions of origin, averaged across countries with information on years since arrival using a random-effects meta-analysis of the pooled country-specific estimates for each model ($n = 7$; Canada, Denmark, France, Germany, Norway, Sweden, and the United States). **b**, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for recent immigrants, established immigrants, and childhood immigrants separately by world region of origin, averaged across countries using a random-effects meta-analysis of the pooled country-origin-specific

estimates for each model ($n = 35$; five origin-estimates for each destination country). In panels **a** and **b**, dots show the country-specific data points for the immigrant-native earnings differences; the error bars indicate the 95% confidence intervals of the pooled average immigrant-native earnings difference from the meta-analyses. **c**, Country-specific differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for recent immigrants, established immigrants, and childhood immigrants from all world regions of origin estimated from OLS regressions from administrative records on country-specific samples of workers aged 25–60 years, and the error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In all panels, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 10–12 provides additional information.



Extended Data Fig. 2 | Immigrant-native differences in annual earnings for male immigrants and children of immigrants after basic adjustments and within industry, occupation, establishment, and job. a, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin, averaged across countries using a random-effects meta-analysis of the pooled country-specific estimates for each model (immigrants: $n = 9$; Canada, Denmark, France, Germany, Netherlands, Norway, Spain, Sweden, and the United States; children of immigrants: $n = 6$; Canada, Denmark, Germany, Netherlands, Norway, and Sweden). **b**, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants separately by world region of origin, averaged across countries using a random-effects meta-analysis of the pooled country-origin-specific estimates for each

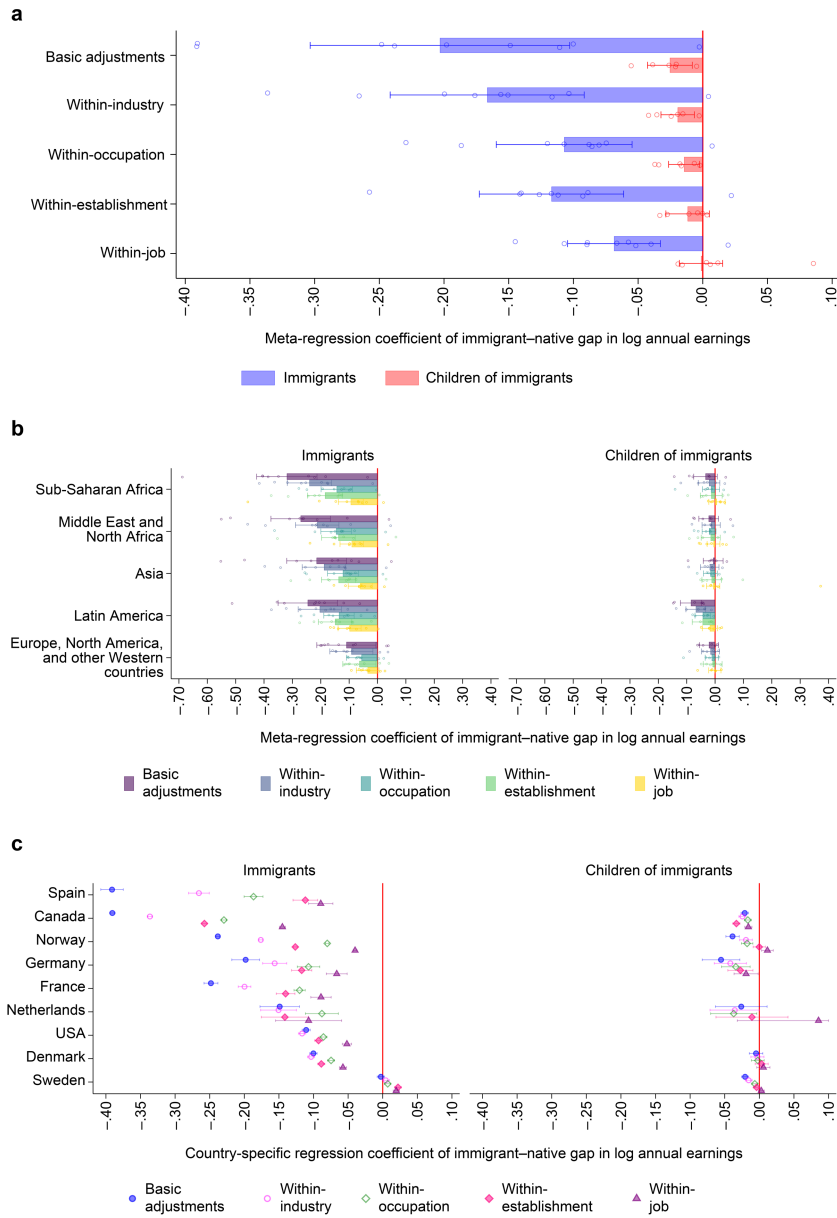
model (immigrants $n = 45$; children of immigrants $n = 30$; five origin-estimates for each destination country). In panels **a** and **b**, dots show the country-specific data points for the immigrant-native earnings differences; the error bars indicate the 95% confidence intervals of the pooled average immigrant-native earnings difference from the meta-analyses. **c**, Country-specific differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin estimated from OLS regressions from administrative records on country-specific samples of male workers aged 25–60 years, and the error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In all panels, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 13–15 provides additional information.



Extended Data Fig. 3 | Immigrant-native differences for women in annual earnings for female immigrants and children of immigrants after basic adjustments and within industry, occupation, establishment, and job.

a. Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin, averaged across countries using a random-effects meta-analysis of the pooled country-specific estimates for each model (immigrants: $n = 9$; Canada, Denmark, France, Germany, Netherlands, Norway, Spain, Sweden, and the United States; children of immigrants: $n = 6$; Canada, Denmark, Germany, Netherlands, Norway, and Sweden). **b.** Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants separately by world region of origin, averaged across countries using a random-effects meta-analysis of the pooled

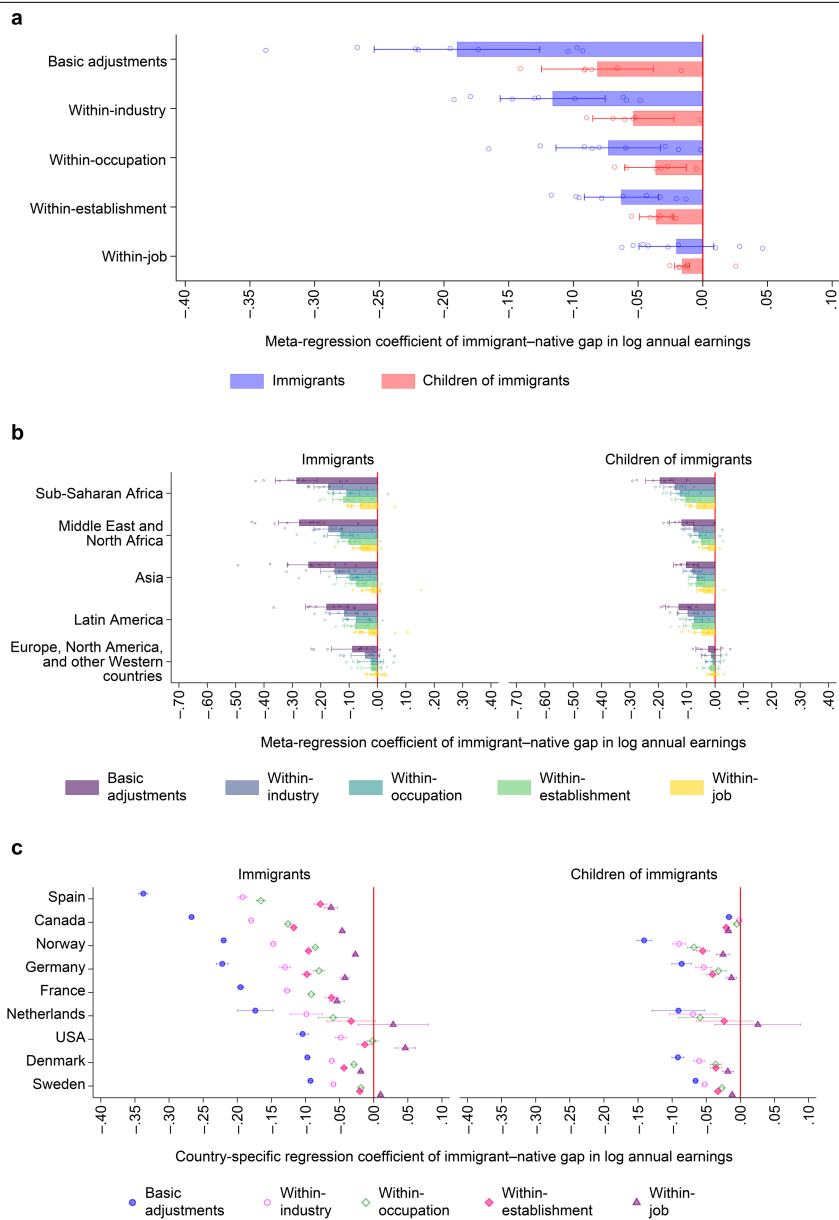
country-origin-specific estimates for each model (immigrants $n = 45$; children of immigrants $n = 30$; five origin-estimates for each destination country). In panels **a** and **b**, dots show the country-specific data points for the immigrant-native earnings differences; the error bars indicate the 95% confidence intervals of the pooled average immigrant-native earnings difference from the meta-analyses. **c.** Country-specific differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin estimated from OLS regressions from administrative records on country-specific samples of female workers aged 25–60 years, and the error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In all panels, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 16–18 provides additional information.



Extended Data Fig. 4 | Immigrant-native differences in annual earnings for immigrants and children of immigrants with tertiary education after basic adjustments and within industry, occupation, establishment, and job.

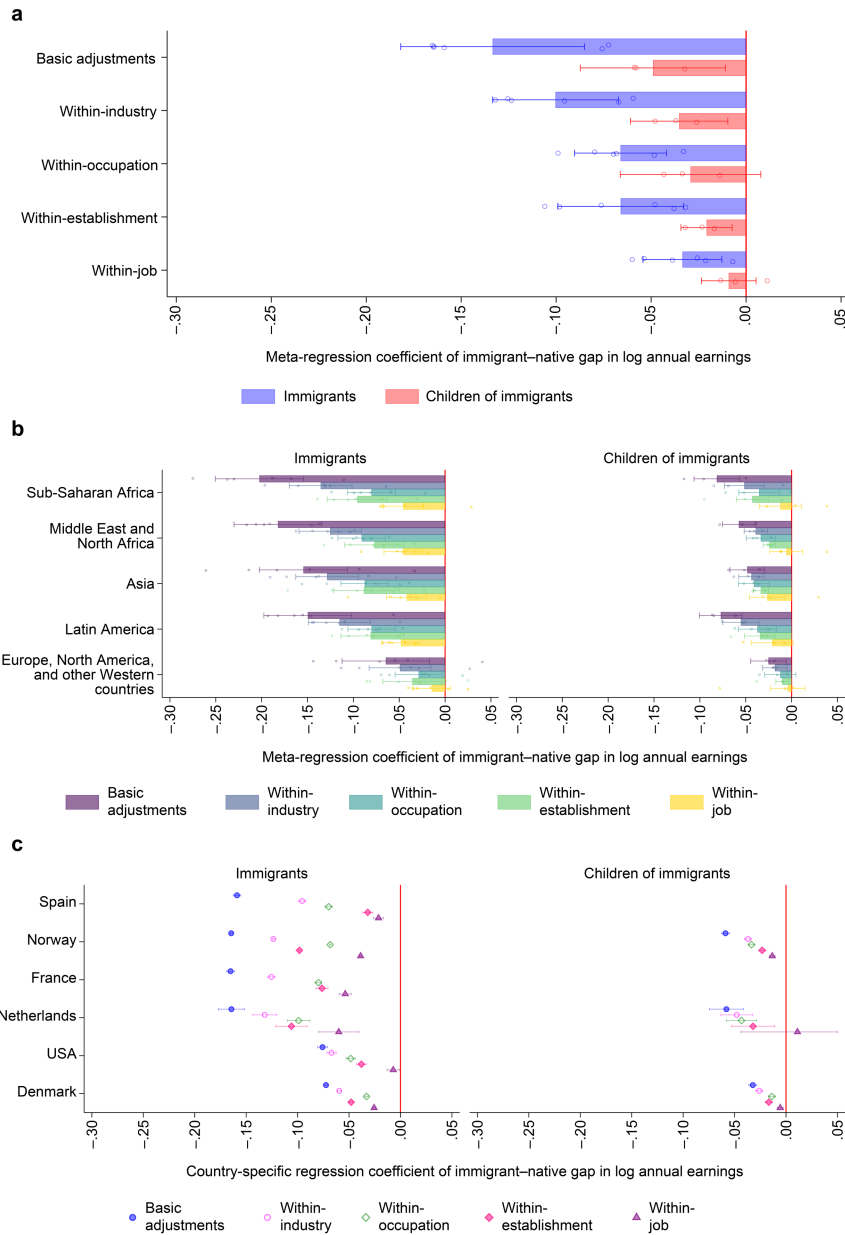
a, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin, averaged across countries using a random-effects meta-analysis of the pooled country-specific estimates for each model (immigrants: $n = 9$; Canada, Denmark, France, Germany, Netherlands, Norway, Spain, Sweden, and the United States; children of immigrants: $n = 6$; Canada, Denmark, Germany, Netherlands, Norway, and Sweden). **b**, Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants separately by world region of origin, averaged across countries using a random-effects meta-analysis of the pooled

country-origin-specific estimates for each model (immigrants $n = 45$; children of immigrants $n = 30$; five origin-estimates for each destination country). In panels **a** and **b**, dots show the country-specific data points for the immigrant-native earnings differences; the error bars indicate the 95% confidence intervals of the pooled average immigrant-native earnings difference from the meta-analyses. **c**, Country-specific differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin estimated from OLS regressions from administrative records on country-specific samples of workers, aged 25–60 years, with tertiary education, and the error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In all panels, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 19–21 provides additional information.



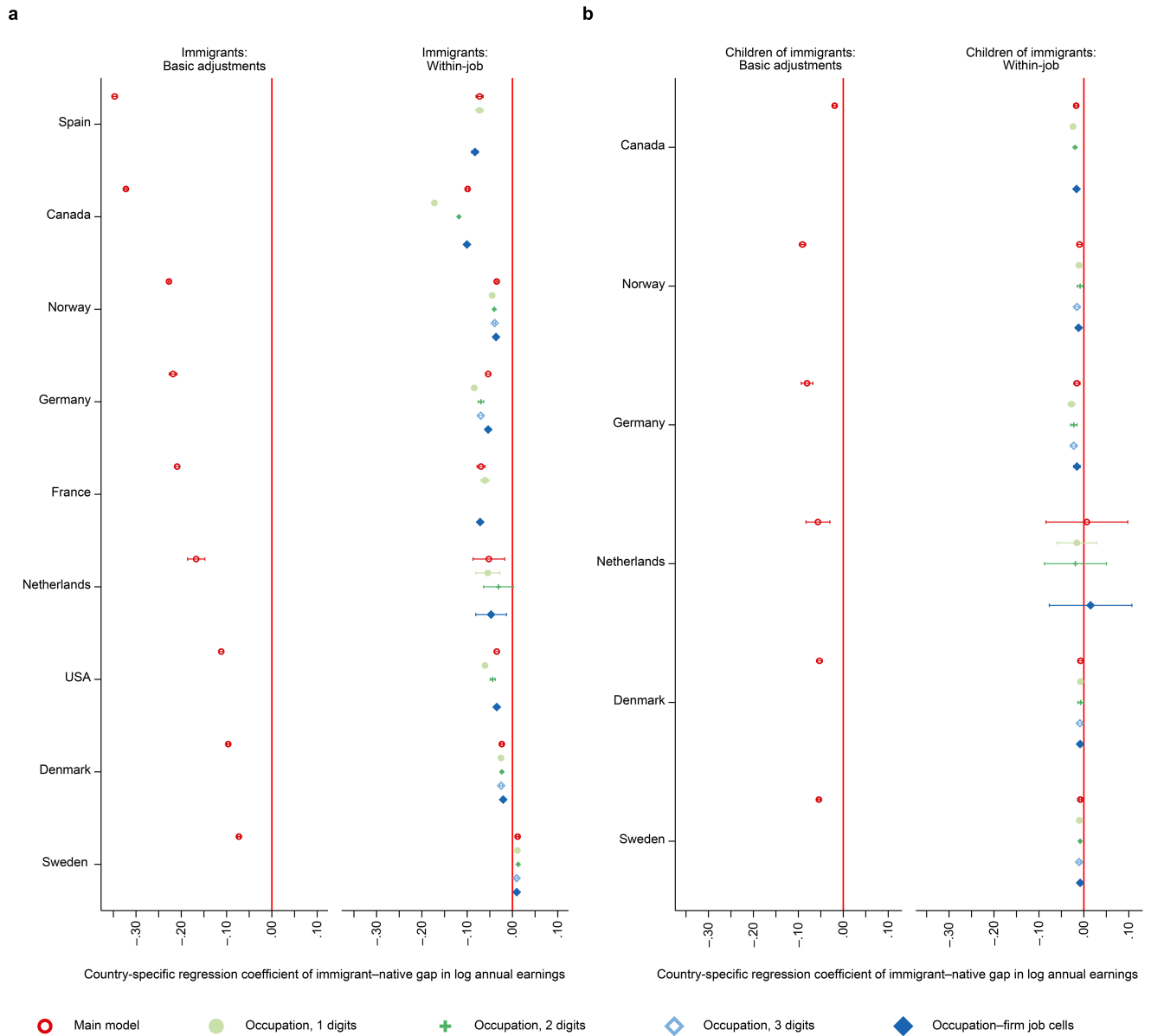
Extended Data Fig. 5 | Immigrant-native differences in annual earnings for immigrants and children of immigrants with upper secondary education or less after basic adjustments and within industry, occupation, establishment, and job. a. Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin, averaged across countries using a random-effects meta-analysis of the pooled country-specific estimates for each model (immigrants: $n = 9$; Canada, Denmark, France, Germany, Netherlands, Norway, Spain, Sweden, and the United States; children of immigrants: $n = 6$; Canada, Denmark, Germany, Netherlands, Norway, and Sweden). **b.** Differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants separately by world region of origin, averaged across countries using a random-effects meta-analysis of the pooled

country-origin-specific estimates for each model (immigrants $n = 45$; children of immigrants $n = 30$; five origin-estimates for each destination country). In panels **a** and **b**, dots show the country-specific data points for the immigrant-native earnings differences; the error bars indicate the 95% confidence intervals of the pooled average immigrant-native earnings difference from the meta-analyses. **c.** Country-specific differences in log annual earnings relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin estimated from OLS regressions from administrative records on country-specific samples of workers, aged 25–60 years, with upper secondary education or less, and the error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In all panels, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 22–24 provides additional information.



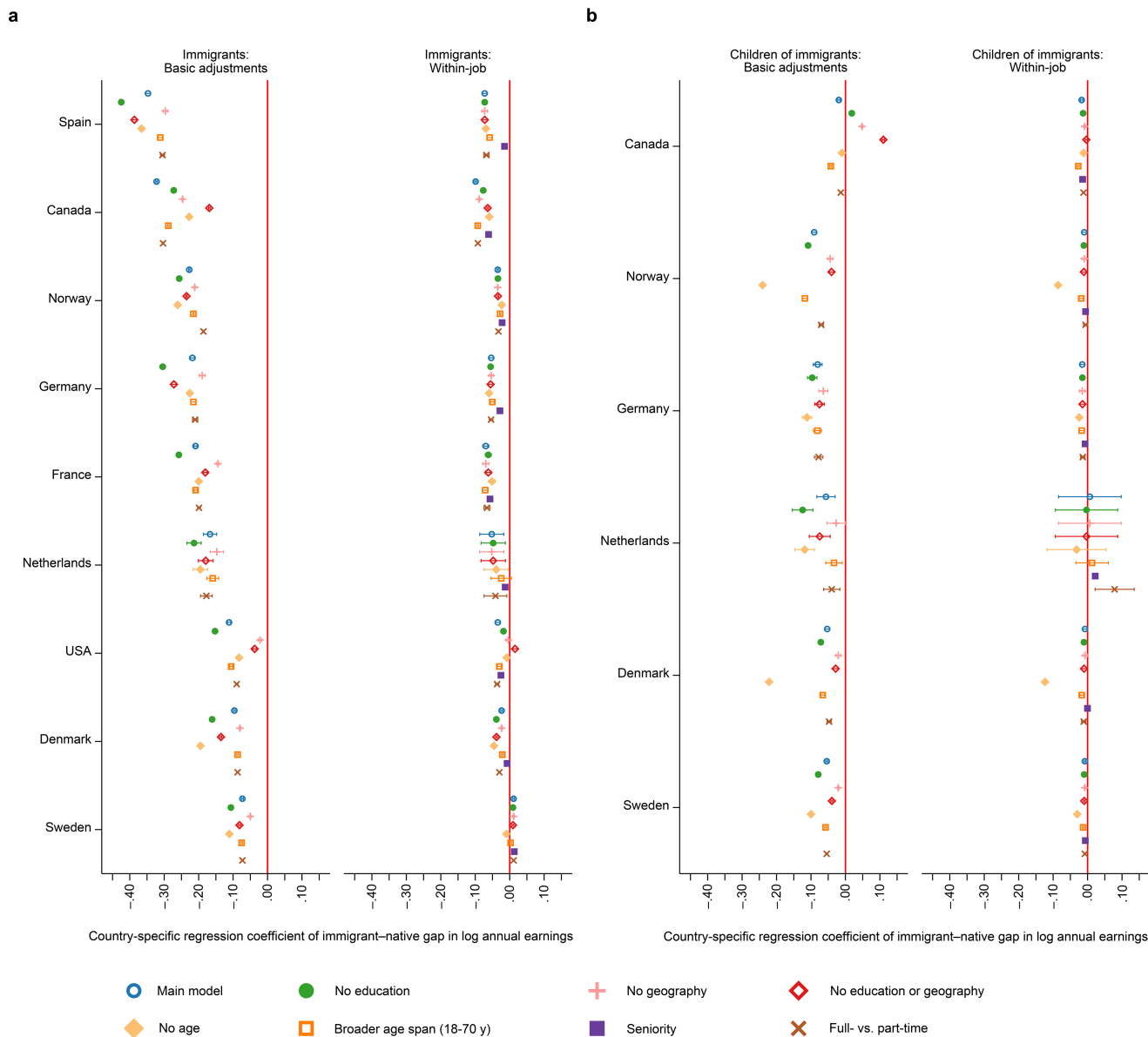
Extended Data Fig. 6 | Immigrant-native differences in hourly wages for immigrants and children of immigrants after basic adjustments and within industry, occupation, establishment, and job. **a**, Differences in log hourly wages relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin, averaged across countries using a random-effects meta-analysis of the pooled country-specific estimates for each model (immigrants: $n = 6$; Denmark, France, Netherlands, Norway, Spain, and the United States; children of immigrants: $n = 3$; Denmark, Netherlands, and Norway). **b**, Differences in log hourly wages relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants separately by world region of origin, averaged across countries using a random-effects meta-analysis of the

pooled country-origin-specific estimates for each model (immigrants $n = 30$; children of immigrants $n = 15$; five origin-estimates for each destination country). In panels **a** and **b**, dots show the country-specific data points for the immigrant-native earnings differences; the error bars indicate the 95% confidence intervals of the pooled average immigrant-native earnings difference from the meta-analyses. **c**, Country-specific differences in log hourly wages relative to natives after basic adjustments and within industry, occupation, establishment, and job for immigrants and children of immigrants from all world regions of origin estimated from OLS regressions from administrative records on country-specific samples of workers aged 25–60 years, and the error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In all panels, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 25–27 provides additional information.



Extended Data Fig. 7 | Sensitivity analysis of immigrant-native differences in annual earnings using alternative job definitions. Each estimate represents the country-specific coefficient from OLS regressions from administrative records for the differences in log annual earnings relative to natives after basic adjustments and within job for immigrants (a) and children of immigrants (b), aged 25–60 years, from models with alternative job definitions. Error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. The basic adjustments model controls for age, age squared, education, sex, and geographic region and the within-job model also controls for fixed effects for occupation-establishment units (i.e., jobs).

‘Main model’ results report estimates from the main country-specific results reported in Fig. 1b. ‘Occupation, 1 digit’, ‘Occupation, 2 digits’, and ‘Occupation, 3 digits’ report estimates from models where jobs (occupation-establishment units) are defined using 1, 2, or 3-digit occupation codes, respectively. ‘Occupation-firm job cells’ report estimates from models where jobs are defined using information on firm identifiers instead of establishment identifiers. The error bars indicate the 95% confidence intervals of the country-specific immigrant-native earnings differences. In panels a and b, the red line at $x=0$ represents the reference category of native workers. Supplementary Tables 29–32 provides additional information.



Extended Data Fig. 8 | Sensitivity analysis of immigrant–native earnings differences after basic adjustments and within jobs using alternative covariate adjustments and age restriction of the sample. Each estimate represents the country-specific coefficient from OLS regressions from administrative records for the differences in log annual earnings relative to natives after basic adjustments and within job for immigrants (a) and children of immigrants (b), aged 25–60 years, from models with alternative covariate adjustments and age restrictions of the sample. Error bars indicate the 95% confidence intervals of the country-specific immigrant–native earnings differences. ‘Main model’ results report estimates from the main country-specific results reported in Fig. 1b, where the basic adjustments model controls for age, age squared, education, sex, and geographic region and the within-job model also controls for fixed effects for occupation–establishment units

(i.e., jobs). The ‘No education’, ‘No geography’, ‘No education or geography’, and ‘No age’ results report estimates from models without adjustment for education, geographic region of employment, education or geographic region of employment, and age, respectively. The ‘Broader age range’ results report estimates from a model where the samples include workers aged 18–70 years. The ‘Seniority’ and ‘Fulltime’ results report estimates from models with additional adjustments for seniority (number of years employed at current establishment) and full- versus part-time employment status. The error bars indicate the 95% confidence intervals of the country-specific immigrant–native earnings differences. In panels a and b, the red line at $x = 0$ represents the reference category of native workers. Supplementary Tables 33–39 provides additional information.

Article

Extended Data Table 1 | Key features of administrative records across countries

	Number of observations	Year	Source	Immigrant background	Geographic region measure	Industry measure	Occupation measure	Establishment measure	Education measure
	(1)	(3)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Canada	2,771,043	2016	Linked registry and census	Ego and parental country of birth	Census metropolitan areas and census agglomerations	3-digit NAICS	4-digit NOC	Firm	5 categories
Denmark	1,755,962	2019	Registry	Ego and parental country of birth	Municipality	4-digit NACE	4-digit ISCO	Establishment	5 categories and missing
France	764,703	2018	Linked registry and census	Ego region of birth	County	4-digit NACE	2-digit CSP	Establishment	4 categories and missing
Germany	1,089,303	2017	Sample from registry	Nationality in social security registry data and first names	Municipality	3-digit NACE	4-digit ISCO	Establishment	3 categories and missing
Netherlands	56,829	2019	Sample from registry	Ego and parental country of birth	Municipality	4-digit NACE	2-digit ISCO	Establishment	5 categories and missing
Norway	1,866,155	2019	Registry	Ego and parental country of birth	Municipality	4-digit NACE	4-digit ISCO	Establishment	5 categories and missing
Spain	476,108	2018	Sample from registry	Ego country of birth	Municipality	2-digit CNAE	Grupo de cotización	Establishment	4 categories and missing
Sweden	3,340,002	2018	Registry	Ego and parental country of birth	Municipality	3-digit NACE	4-digit ISCO	Establishment	5 categories and missing
United States	1,398,000	2017	Linked registry and census	Ego country of birth	County	3-digit NAICS	3-digit SOC	Firm	5 categories and missing

Number of observations contains the number of individual worker observations for Model 1 (Basic adjustments) reported in Fig. 1b and Supplementary Table 3.

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n/a | Confirmed

- The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement
- A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- The statistical test(s) used AND whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- A description of all covariates tested
- A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
Give P values as exact values whenever suitable.
- For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

- Data collection Researchers were not involved in data collection. The data used in the study are derived from restricted-access administrative records from national statistical agencies. The project focuses on drawing high-level insights about demographic groups of people, rather than individuals.
- Data analysis We used the statistical software Stata (v.18.0) for our data analyses. The code that supports the findings of this study is available on the Open Science Framework repository (<https://doi.org/10.17605/osf.io/tjeun>).

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

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The data used in this study are available on the Open Science Framework repository (<https://doi.org/10.17605/osf.io/tjeun>).

Research involving human participants, their data, or biological material

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Reporting on sex and gender	The main analyses present results for pooled samples of men and women. Additional analyses presented in the Extended Data and Supplementary Information report results separately for men and women.
Reporting on race, ethnicity, or other socially relevant groupings	In five countries (Canada, Denmark, Netherlands, Norway, and Sweden), we can identify the country of birth of individuals and their parents. Immigrants are defined as persons who were born abroad, while children of immigrants are defined as persons who were born in their current country of residence to two foreign-born parents; both groups are compared to natives, defined as individuals who were born in their country of residence and had at least one native-born parent. In three countries (France, Spain, and the United States), only an individual's country of birth is available (i.e., information on their parents' country of birth is not available), allowing us to compare immigrants (i.e., those born abroad) to natives (in this case, those born in their country of residence). For Germany, information on the country of birth is unavailable, and so we identify immigrants and children of immigrants using longitudinal data on citizenship status, nationality, and name-based information derived from social security records. See country-specific information in Supplementary Information for details. The results reported in the main analysis adjusts for sex, age, educational attainment, and geographic region of employment.
Population characteristics	See description of "Behavioural & social sciences study design" below.
Recruitment	No participants were recruited for this study.
Ethics oversight	This research was conducted following University of California, Irvine regulations for the ethical conduct of research (Protocol #5287). We followed the relevant guidance and country-specific regulations to ensure the confidentiality and privacy of the administrative records used to create the publicly available meta-analytic data. Access to country-specific administrative records was authorized by: Statistics Canada (Canada); Statistics Denmark (Denmark); the French Comité du Secret Statistique (France); the German Institute for Employment Research (Germany); the Central Bureau of Statistics of the Netherlands (Netherlands); Statistics Norway (Norway); the Ministry of Labor, Migration and Social Security of Spain (Spain); Statistics Sweden (Sweden); and the U.S. Census Bureau (United States of America). The U.S. Census Bureau has ensured appropriate access and use of confidential data and has reviewed these results for disclosure avoidance protection (Project 7526852: CBDRB-FY2022-CES010-014, CBDRB-FY23-CES014-017, CBDRB-FY25-CES005-004).

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

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Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	This is a quantitative study which analyses the overall and within-industry, within-occupation, within-establishment, and within-job immigrant--native pay differences in nine countries.
Research sample	Workers aged 25--60 years in Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden, and the United States.
Sampling strategy	We created and analyzed a public-use dataset containing information about the overall and within-industry, within-occupation, within-establishment, and within-job immigrant--native pay differences in Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden, and the United States.
Data collection	Researchers were not involved in collecting data from individual workers. Researchers created a public-use dataset from restricted-access administrative records from Canada, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden, and the United States.
Timing	We created our public use meta-analytic dataset from the most recent annual administrative records from each country at the start of the study. These data cover the years 2016 (Canada), 2017 (Germany, United States of America), 2018 (France, Spain, Sweden), and 2019 (Denmark, Netherlands, Norway).
Data exclusions	No valid data were excluded; see Methods section and country-specific descriptions in the Supplementary Information for details.
Non-participation	Because our data are derived from administrative records, non-participation is not an issue.
Randomization	This is not a randomized controlled trial and participants were not randomized into experimental groups. This is a observational study comparing differences in pay between immigrants, children of immigrants, and natives who work in the same occupation for the

same employer (i.e., occupy the same job), where randomization was not feasible. Key findings are robust to the use of different subsamples; alternative job definitions, covariate adjustments, and sample restrictions; and an alternative longitudinal modeling strategy; see the Methods, Extended Data, and Supplementary Information for details.

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Methods

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Seed stocks

Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.

Novel plant genotypes

Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.

Authentication

Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosaicism, off-target gene editing) were examined.