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Women, Education, and Occupational Segregation in Serbia: Evidence from LFS Data



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A B S T R A C T

Rising female employment and educational attainment do not necessarily reduce occupational gender segregation because changes in the gender composition of occupations may be reinforced or offset by shifts in occupational structure. We examine the evolution and sources of occupational gender segregation in Serbia using annually weighted Labour Force Survey repeated cross-sections for 2010–2024. We estimate Duncan dissimilarity indices across broad and detailed occupational levels, decompose their changes into within-occupation gender composition, occupational structure, and women's aggregate employment share, and quantify uncertainty using a bootstrap adapted to the available clustering identifiers. The results show that broad occupational segregation remained relatively stable after 2014, but that this stability concealed substantial opposing movements during 2014–2020. A more balanced gender

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composition within major occupational groups reduced segregation, while the redistribution of employment across those groups produced an almost equal increase. Over the same period, segregation increased across three-digit occupations, showing that stability at the broad level can coexist with increasing separation at a finer occupational resolution. We also identify divergent patterns across education groups. Secondary-educated workers consistently displayed the highest segregation, while tertiary-educated workers had lower levels but no statistically distinguishable decline. Among low-educated workers, detailed segregation increased in both post-2014 windows, and both increases were statistically larger than the corresponding changes among secondary- and tertiary-educated workers. Overall, occupational integration in Serbia was partial, scale-dependent, and educationally uneven, demonstrating that aggregate stability cannot be interpreted without examining its underlying components and occupational resolution.

KEYWORDS: *occupational gender segregation, occupational restructuring, educational attainment, Duncan dissimilarity index, Shapley decomposition*

Introduction

Occupational gender segregation, the unequal distribution of women and men across occupations, is one of the most durable features of modern labour markets and an important mechanism through which inequalities in pay, authority, and career progression are sustained (Charles & Grusky, 2004; Duncan & Duncan, 1955). Its aggregate stability, however, can be misleading. Segregation can change because the gender composition of occupations changes, because occupations with different gender compositions expand or contract, or because women's aggregate share of employment changes. It is also sensitive to occupational resolution: movement towards a more similar distribution across major occupational groups can coexist with continued or increasing separation across the narrower occupations nested within them. Distinguishing these processes is therefore necessary before stability or change in a segregation index can be interpreted as labour market integration.

Serbia provides an informative setting for examining these processes. Between 2010 and 2024, the labour market recovered from the post-2008 downturn while employment shifted away from agriculture and traditional industry, women's employment increased, the educational composition of the workforce improved, and demographic contraction continued to reshape the size and regional distribution of the working-age population (Paunović

Radulović & Vladisavljević, 2024). These changes need not have operated in the same direction. The growth or decline of already gender-typed occupations may alter segregation without changing their internal gender composition, while educational upgrading may broaden access to employment without dissolving gendered fields of study and occupation-specific pathways. Serbia therefore allows us to examine how structural and compositional change interacted in a post-transition and European Union (EU) accession economy undergoing employment recovery and educational transformation.

Research on Serbia has documented women's position in the post-transition labour market, persistent gender differences in employment and earnings, and horizontal segregation in education (Anić & Krstić, 2019; Babović & Petrović, 2021; Reva, 2012). However, there are no credible studies that systematically examine occupational gender segregation in Serbia. Therefore, it is still unknown how segregation evolved over an extended period, whether trends at the broad occupational level also hold across detailed occupations, which structural and compositional processes accounted for changes in segregation, and whether levels and trajectories differed across education groups. These questions are important because international evidence shows that rising female employment and educational attainment do not necessarily reduce occupational segregation, and that change can be slow and uneven across education groups (Blau, Brummund, & Liu, 2013; Borrowman & Klasen, 2020; Eurofound & European Commission Joint Research Centre, 2021). Comparable transition and EU-accession economies are under-represented in research that jointly examines occupational resolution, mechanisms of change, and educational heterogeneity.

In this study, we address that gap using harmonised, annually weighted Serbian Labour Force Survey (LFS) repeated cross-sections for 2010–2024. We estimate Duncan dissimilarity indices for the ten International Standard Classification of Occupations (ISCO) major groups over the full period and for three-digit occupations within survey- and classification-consistent analytical windows. We then apply a Shapley decomposition of changes in segregation (Deutsch, Flückiger, & Silber, 2009; Salardi, 2016) and use a bootstrap adapted to the available clustering identifiers to quantify sampling uncertainty. Finally, we estimate education-specific indices and directly test differences in their changes. Our contribution is empirical and interpretative: applying established methods to Serbia, we show how offsetting

components, occupational resolution, and educational heterogeneity jointly qualify aggregate stability. This extends the international discussion of uneven occupational integration to a post-transition economy experiencing employment recovery and educational upgrading.

Research Background

Structural and Educational Transformation in Serbia

Serbia entered the analysed period with weak post-crisis employment and a sizeable gender employment gap. Published LFS indicators show that the employment rate among people aged 15–64 was 40.1% for women and 54.4% for men in 2010, compared with 60.8% and 71.7%, respectively, in 2024 (Statistical Office of the Republic of Serbia [SORS], 2011, 2025). Because these endpoints span changes in survey methodology, they are contextual indicators rather than a fully comparable series, but they nevertheless indicate that women's employment expanded and that the reported gap narrowed from 14.3 to 10.9 percentage points. At the same time, the decline of agricultural employment and changes in industry and services altered the occupational mix. During the recovery between 2014 and 2017, employers' expectations also pointed to growing demand for service, sales, craft, and related trade occupations (Ognjenović, 2018). This matters for segregation because the redistribution of employment towards growing occupations can either reinforce or offset changes in the representation of women and men within occupations.

The workforce also became more highly educated, with women accounting for approximately 57% of students and 59% of graduates in Serbia (Official Gazette of the Republic of Serbia, 2021). Higher attainment, however, has coexisted with persistent gender differentiation by field of study. Women are more strongly represented in education, health, social sciences, and the humanities, while men are more strongly represented in engineering and technical fields. In information and communication technology (ICT), for example, women accounted for 28.6% of graduates and 21.6% of professionals in the available Serbian indicators (Babović & Petrović, 2021). A similar differentiation is visible within scientific research, where highly educated women and men are unevenly distributed across disciplines. Analysing Serbian data for 2012–2022, Lazarević-Moravčević et al. (2023) found that women formed a majority of researchers

in the humanities and medical and health sciences, whereas men predominated in engineering and technology. Educational expansion may therefore change the relative size of education groups without producing equivalent integration in the fields and occupational pathways through which qualifications are converted into employment.

Education and Occupational Segregation

Education may be related to the level and the dynamics of occupational segregation through mechanisms operating at different stages. Educational attainment defines the groups compared in this paper; the pathways from education into employment help explain the occupational distributions observed within those groups. Gendered expectations can shape field-of-study choices, while vocational and technical programmes link those choices closely to particular occupations (Heiniger & Imdorf, 2018; Gutfleisch & Nennstiel, 2025). Among tertiary-educated workers, fields of study explain part of occupational segregation, alongside sorting after education (Zheng & Weeden, 2023). The transition into employment adds another distinction: participation shapes which women and men at each educational level are represented among workers, while occupational sorting shapes the jobs of those who enter. Hiring is one part of this sorting process: experimental evidence shows that discrimination varies with an occupation's gender composition (Adamovic & Leibbrandt, 2023). Crowding into a limited set of occupations and the devaluation of female-dominated work may further reproduce existing boundaries, while family-related constraints can shape later transitions even after initial entry (Borrowman & Klasen, 2020; Charles & Grusky, 2004).

These mechanisms imply neither a monotonic education gradient nor uniform change over time. Secondary-educated workers may be highly segregated where vocational, technical, administrative, and service pathways lead directly to gender-typed occupations. A shrinking low-education group may become more segregated if its remaining employment becomes concentrated in a narrower set of male-dominated manual and female-dominated service jobs. Tertiary-educated workers may be less segregated without becoming progressively more integrated, while movement into the same major occupational groups may coexist with continued separation across detailed occupations within them. Finally, structural transformation may reinforce or offset within-occupation integration by changing the relative employment weight of differently

gendered occupations. The empirical analysis therefore treats education not simply as a hierarchy of attainment, but as a set of pathways whose occupational consequences may differ in both level and direction over time.

Methodology

Data

The analysis is based on Serbian LFS microdata for 2010–2024 collected and provided by SORS, organised as annual repeated cross-sections. The LFS is Serbia's standard instrument for labour market measurement and produces internationally comparable estimates based on harmonised definitions (SORS, 2016). The survey covers residents of private households in Serbia excluding Kosovo and Metohija, using a two-stage stratified sample of enumeration areas and households drawn from population-census frames (SORS, 2016, 2025). Data are collected through face-to-face and telephone interviews (SORS, n.d.). All estimates use LFS weights and represent employed individuals aged 15–64 with a valid occupation code. Annual unweighted samples range from roughly 13,000 in the earlier years to nearly 49,000 in the most recent, corresponding to weighted employed populations of about 2.1–2.7 million. Year-specific observation counts, including women and men separately, and weighted employment totals are reported in Supplementary Material, Table S1, Panel A. Women's share of employment rises from 42.8% in 2010 to 45.9% in 2024.

Comparisons account for survey breaks and occupational reclassification. Occupations were coded to ISCO-88 in 2010–2012 and to ISCO-08 from 2013 onward. Because three-digit codes are not comparable across this transition, 2013 is retained in the broad 2010–2013 window but excluded from the detailed 2010–2012 window. We treat the ten ISCO major groups as sufficiently comparable for reporting the broad annual index over 2010–2024, but restrict detailed comparisons to survey- and classification-consistent windows: 2010–2012, 2014–2020, and 2021–2024. All decompositions and inferential contrasts use endpoints within one of these windows. The first boundary reflects the move from twice-yearly to quarterly collection in 2014 and to continuous weekly collection in 2015, together with sample redesign, sample expansion, and changes in estimation. The 2014 data were subsequently revised using the estimation

system introduced in 2015. The second boundary reflects the redesigned LFS introduced in 2021 under Regulation (EU) 2019/1700, which revised concepts, definitions, and questionnaire content. Because the pre-2021 series was revised only for selected basic indicators, comparability could not be restored for the detailed occupational analyses used here (SORS, 2016, 2022). Detailed harmonisation rules, analytical-sample validation, and numerical quality-control checks are reported in Supplementary Material, Table S8.

Occupational Detail and Education Groups

Occupations are analysed at the broad level of ten ISCO major groups (one-digit) and the detailed level of three-digit minor groups, of which approximately 112–129 are observed annually; two-digit point estimates provide an intermediate resolution. Education is grouped as low (primary education or less), secondary, and tertiary. Segregation measures are estimated for the full workforce and separately within each education group.

Measuring Occupational Segregation

We measure segregation using the Duncan and Duncan (1955) index of dissimilarity, the most widely used measure of occupational gender segregation. For a year with J occupations, the index is

$$D = \frac{1}{2} \sum_{j=1}^{J} \left| \frac{w_j}{W} - \frac{m_j}{M} \right| \qquad (1)$$

where w_j and m_j are the weighted numbers of women and men in occupation j, and W and M are their weighted totals across all occupations. The index ranges from 0, when the occupational distributions of women and men coincide, to 1, when no occupation contains both. It can also be interpreted as the share of women, or men, who would have to change occupations for the two distributions to coincide. Because the index tends to increase as occupations are divided more finely, we report it at broad and detailed levels and compare changes only within a fixed classification. Each occupation's contribution is one-half of the absolute difference between its share of employed women and its share of employed men; these contributions identify the occupations driving aggregate movements.

Decomposing Changes in Segregation

Changes in the index are decomposed by Shapley decomposition, following Deutsch, Flückiger, and Silber (2009) and Salardi (2016). Three components describe changes in the joint distribution of sex and occupation: within-occupation gender composition, occupational structure (the distribution of total employment across occupations), and women's aggregate employment share. For each comparison, counterfactual two-by-J tables are generated by iterative proportional fitting, moving one component from its start-year to its end-year value while holding the others fixed. The Shapley value averages each component's marginal contribution across all possible switching orders. The three contributions therefore sum exactly to the observed change, without a residual. An integrating within-occupation contribution indicates reduced gender sorting after standardising occupational size and women's overall employment share; integration refers to more similar occupational distributions, not necessarily a 50:50 gender balance. A positive structural contribution can arise when strongly gender-typed occupations expand relative to more balanced occupations, or when the latter contract.

We use endpoint and chained decompositions. The endpoint decomposition compares the first and last year of a window. The chained decomposition sums the components from successive one-year transitions; comparing gross annual movement with the net endpoint change shows how much movement is self-cancelling. We examine six endpoint contrasts: 2010–2013, 2014–2020, and 2021–2024 at the broad level, and 2010–2012, 2014–2020, and 2021–2024 at the detailed level. These are complemented by the 23 one-year transitions within the corresponding windows.

Statistical Inference

Uncertainty is quantified using 5,000 bootstrap replications adapted to the clustering identifiers available in each period. Within each year, households are resampled with replacement for 2014–2024; because household identifiers are unavailable in the earlier files, records are resampled for 2010–2013. Households provide the broadest clustering unit identified in these files, making household resampling the closest feasible approximation to the dependence structure for 2014–2024. Every index, decomposition, and contrast is recomputed in each replicate, propagating sampling variability through all analytical stages. Two-sided 95%

confidence intervals are the 2.5th and 97.5th percentiles of the replicate distribution. Changes over time and differences between groups are calculated within each replicate before the percentiles are taken, thereby accounting for dependence between estimates based on shared within-year resampled units. A change or difference is considered statistically distinguishable from zero when its interval excludes zero. A fixed random-number seed ensures reproducibility.

Segregation by Education

Indices and endpoint changes are estimated separately for the three education groups using the same occupational levels, analytical windows, and bootstrap design. Within a year, common resampled units are used across education groups and occupational resolutions. We also calculate three direct contrasts between education-specific endpoint changes: secondary minus low, tertiary minus low, and tertiary minus secondary. These contrasts are differenced within each replicate, allowing differences in change to be tested directly rather than inferred from separate group-specific significance tests.

Data Analysis

All analyses were performed in R version 4.5.2 (R Core Team, 2025). Data import, harmonisation, and computation used the *haven*, *dplyr*, *tidyr*, *purrr*, *tibble*, *stringr*, *readr*, and *Matrix* packages, while figures were produced using *ggplot2*, *scales*, *patchwork*, and *ragg*. The Duncan indices, Shapley decompositions, and bootstrap procedures adapted to the available clustering identifiers were implemented in R functions created for this purpose.

Results

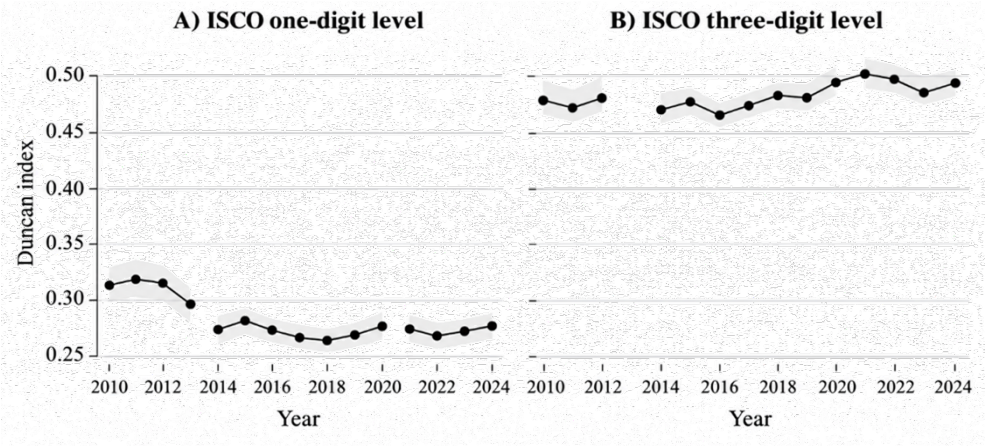
Overall Trends Across Occupational Resolutions

Figure 1 displays annual Duncan dissimilarity indices at two levels of occupational resolution. Panel A shows segregation across the ten ISCO major groups, whereas Panel B traces segregation across three-digit occupations within the three survey- and classification-consistent analytical

windows. Lines are interrupted at the survey and classification boundaries to avoid implying continuity across non-comparable observations.

At the one-digit level, segregation declined descriptively between 2010 and 2013, from 0.312 to 0.295, but the endpoint change was not statistically distinguishable from zero. After 2014, the index remained within a narrow range of 0.264 to 0.281, with no statistically distinguishable endpoint change in either post-2014 window. The broad occupational distribution of women and men therefore shows relative stability rather than a sustained process of integration.

Figure 1: Overall trends in occupational gender segregation



Source: Authors' calculations based on weighted Serbian LFS microdata

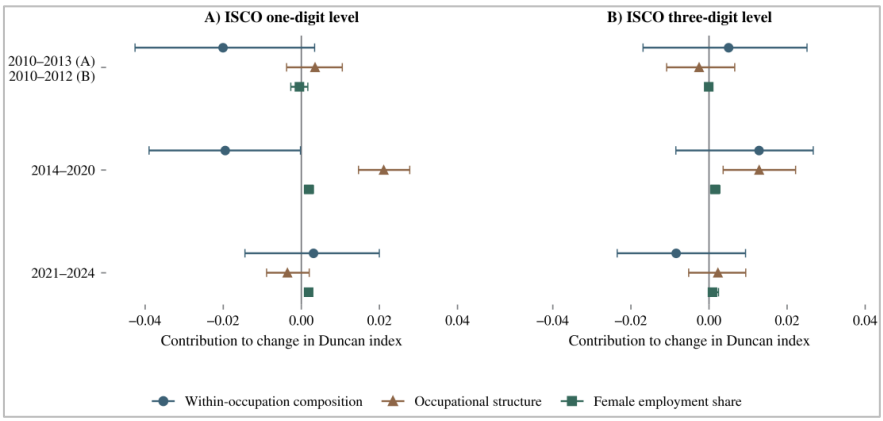
A different pattern emerges at the three-digit level. Detailed segregation was essentially unchanged during 2010–2012 but increased from 0.470 to 0.497 during 2014–2020. The resulting change of 0.027 was statistically distinguishable from zero (95% confidence interval (CI) [0.004, 0.042]) and was the only overall endpoint change supported by the bootstrap intervals. During 2021–2024, the index fluctuated without producing a statistically distinguishable endpoint change. Because Duncan indices mechanically increase with occupational detail, their levels should not be compared across resolutions. The relevant result is the divergence in within-resolution trajectories: during 2014–2020, stability across major occupational groups coincided with increasing segregation across the narrower occupations within them. Complete annual estimates at one-, two-, and three-digit levels and endpoint changes are reported in Supplementary Material, Table S2.

Sources of Change in Segregation

Figure 2 decomposes each endpoint change into three components: changes in gender composition within occupations, changes in occupational structure, and changes in women's aggregate employment share. Negative contributions indicate integration, whereas positive contributions increase segregation. By construction, the three components sum to the observed change in the Duncan index.

The central result is the decomposition of the one-digit index during 2014–2020. Its small net increase of 0.004 was not the product of underlying stability, but of two sizeable movements in opposite directions. Changes in gender composition within major occupational groups reduced segregation by 0.020, while changes in the relative size of those groups increased it by 0.021. The corresponding intervals placed the structural contribution clearly above zero and the integrating contribution narrowly below zero. The increase in women's aggregate employment share added a statistically distinguishable but substantively small contribution of 0.002. This small contribution reflects the distinction between women's overall representation and their occupational distribution: the index compares distributions within each sex, so increased female employment need not translate into occupational integration. Thus, integration within major occupational groups was almost exactly neutralised by employment growth and contraction across groups with different gender compositions.

Figure 2: Sources of change in occupational segregation: Endpoint Shapley decomposition



Source: Authors' calculations based on weighted Serbian LFS microdata

The decomposition at the three-digit level reveals a different configuration during the same period. Both the within-occupation and occupational-structure point estimates increased segregation, each contributing approximately 0.013, while the female-share component again remained small. The structural contribution was statistically distinguishable from zero (95% CI [0.004, 0.022]), whereas the interval for the within-occupation component included zero. The contrast across resolutions is therefore substantive rather than merely numerical. Gender composition became more balanced within major occupational groups, but this integrating movement did not extend to the narrower occupations contained within them. Meanwhile, changes in occupational structure operated in a segregation-increasing direction at both resolutions.

No comparably clear decomposition pattern emerged in the other analytical windows. The descriptive reduction in the one-digit index during 2010–2013 was associated mainly with an integrating within-occupation contribution, but all component intervals included zero. The detailed change during 2010–2012 was negligible, while the small one- and three-digit endpoint changes during 2021–2024 reflected opposing and imprecisely estimated within-occupation and structural contributions. Women's aggregate employment share made small positive contributions in the post-2014 windows, but it never accounted for a substantial share of the total movement.

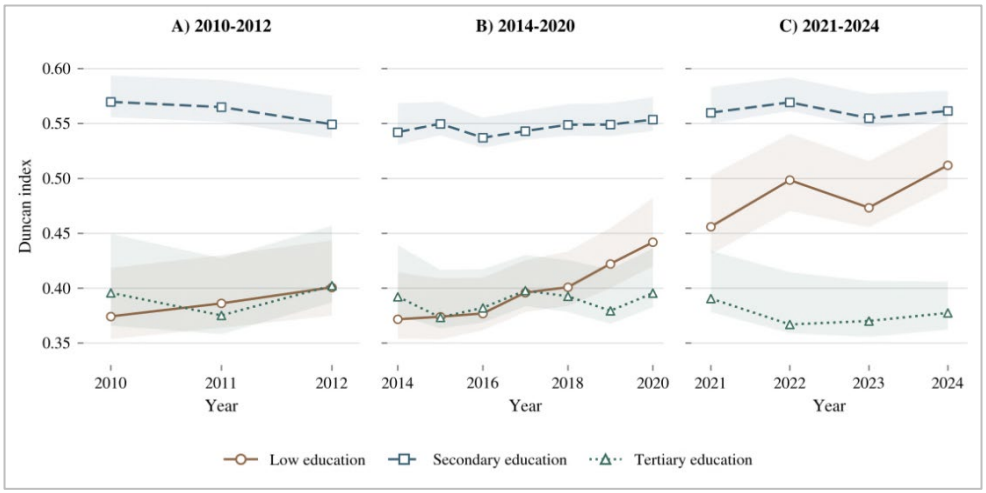
Figure 2 therefore shows that changes in segregation were governed primarily by gender re-composition within occupations and by the redistribution of employment across occupations, rather than by the changing aggregate representation of women in employment. These two processes could either reinforce one another or operate in opposite directions. Their near-complete cancellation at the one-digit level during 2014–2020 explains why aggregate stability concealed substantial underlying change. The chained decompositions yielded the same substantive interpretation (for details, see Supplementary Material, Table S3).

Education-specific Patterns

Figure 3 presents three-digit Duncan indices separately for workers with low, secondary, and tertiary education. The education-specific pattern differs depending on whether the comparison concerns the level or the trajectory of segregation. Secondary-educated workers consistently

displayed the highest level, whereas the clearest post-2014 increase occurred among low-educated workers.

Figure 3: Occupational segregation by education



Source: Authors' calculations based on weighted Serbian LFS microdata

The relative position of the three groups was already visible during 2010–2012. Segregation among secondary-educated workers remained substantially higher than among the low- and tertiary-educated, despite a descriptive decline over the window. The other two groups displayed lower and broadly similar levels, and none of the education-specific endpoint changes was statistically distinguishable from zero.

After 2014, the trajectories became more clearly differentiated. Segregation among secondary-educated workers remained persistently high but showed little net movement within either analytical window. Tertiary-educated workers continued to display lower segregation, but their annual indices reveal fluctuation rather than a sustained process of integration. Low-educated workers followed a different trajectory: their three-digit index increased from 0.372 to 0.442 during 2014–2020 and from 0.456 to 0.512 during 2021–2024. By the end of the period, their segregation had moved considerably closer to the consistently high level observed among secondary-educated workers.

The education-specific results therefore identify three distinct patterns rather than a simple gradient by attainment: (1) high and persistent

segregation among secondary-educated workers, (2) lower but non-declining segregation among tertiary-educated workers, and (3) increasing segregation among low-educated workers. In particular, the narrowing difference between the low- and secondary-education groups resulted from increasing segregation among the former, not from integration among the latter.

This divergence is specific to detailed occupations. At the one-digit level, secondary-educated workers remained the most segregated, but none of the education-specific endpoint changes was statistically distinguishable from zero, and low-educated workers did not show the same sustained post-2014 increase. Their divergence therefore occurred primarily across narrower occupations within major occupational groups rather than through redistribution across the major groups themselves. Figure 3 thus extends the scale-dependent pattern observed for the workforce as a whole: educational differences in the evolution of segregation become substantially more visible at a finer occupational resolution. The complete one-digit results are reported in Supplementary Material, Figure S1 and Table S4.

Direct Comparisons of Education-specific Changes

Table 1 formalises the divergence visible in Figure 3 by comparing education-specific endpoint changes during the two post-2014 analytical windows. In both periods, the three-digit index increased among low-educated workers, while the corresponding changes among secondary- and tertiary-educated workers were small and not statistically distinguishable from zero.

More importantly, the direct contrasts show that the increase among low-educated workers was statistically larger than the changes in each of the other two education groups. This result was reproduced in both 2014–2020 and 2021–2024. The post-2014 divergence of the low-education group therefore does not rest on comparing a statistically distinguishable change in one group with statistically indistinguishable changes in others. The between-group differences in change were themselves supported by the bootstrap intervals. Table 1 thus strengthens the descriptive pattern in Figure 3 in two respects. First, it identifies increasing segregation among low-educated workers as the only education-specific change consistently supported across both post-2014 windows. Second, it shows that this trajectory differed from both the persistent high segregation of secondary-educated workers and the lower, comparatively stable segregation of

tertiary-educated workers. The results therefore indicate a repeated and education-specific divergence concentrated among workers with the lowest educational attainment.

Table 1: Education-Specific Changes in Occupational Segregation at the ISCO Three-Digit Level

Education group	Starting Duncan index	Ending Duncan index	Change (95% CI)	Change minus low-education change (95% CI)
2014-2020				
Low (primary or less)	.372	.442	.070 [.024, .109]	Reference
Secondary	.542	.554	.011 [−.015, .033]	−.059 [−.107, −.010]
Tertiary	.392	.395	.003 [−.039, .044]	−.067 [−.124, −.005]
2021-2024				
Low (primary or less)	.456	.512	.056 [.009, .103]	Reference
Secondary	.560	.561	.001 [−.022, .021]	−.054 [−.107, −.006]
Tertiary	.390	.377	−.013 [−.057, .013]	−.069 [−.135, −.021]

Note: Values are survey-weighted Duncan dissimilarity indices calculated at the ISCO three-digit level. Changes equal the ending index minus the starting index. Direct contrasts equal the change for the listed group minus the change for the low-education group. Percentile 95% confidence intervals are based on 5,000 bootstrap replications. CI = confidence interval; ISCO = International Standard Classification of Occupations.

Source: Authors' calculations based on weighted Serbian LFS microdata

Robustness and Occupational Contributions

The complete set of pairwise contrasts showed that statistically distinguishable differences in change were confined to comparisons involving low-educated workers at the three-digit level in the two post-2014 windows. No corresponding difference was identified at the one-digit level, during 2010–2012 at the detailed level, or between secondary- and tertiary-

educated workers in any analytical window (Supplementary Material, Table S5).

The increase among low-educated workers was robust across all 12 sensitivity estimates for sparse and non-overlapping occupations. Every estimate was positive and every confidence interval excluded zero. The result persisted when the analysis was restricted to common occupational support, occupations satisfying progressively higher sample-size thresholds, and occupations containing both women and men at both endpoints. The employment shares represented by one-sex and small-sample occupations also declined across both post-2014 windows, providing no evidence that the increase was an artefact of sparse or changing occupational support (Supplementary Material, Table S6).

The occupational composition of the increase differed between periods. During 2014–2020, the largest segregation-reinforcing contributions came from subsistence crop farmers, mining and construction labourers, and building trades, while creative and performing artists made the largest integrating contribution. During 2021–2024, cleaners and helpers and shop salespersons made the largest segregation-reinforcing contributions, whereas building trades made the largest integrating contribution. The five largest absolute movements accounted for 36.6% and 42.1% of gross occupational movement, respectively. The repeated increase among low-educated workers thus reflected different period-specific configurations of occupation-level change rather than a stable ranking and direction of occupational contributors (Supplementary Material, Table S7).

Discussion

Serbia's labour market recovery and educational upgrading did not generate a uniform process of occupational gender integration. Across the separate analytical series, broad segregation was descriptively lower in the later series than in the earliest series, a pattern consistent with a longer-run downward tendency but not with a single comparable 2010–2024 change. Three findings qualify this pattern: post-2014 broad stability reflected the cancellation of opposing processes; broad stability coexisted with increasing detailed segregation during 2014–2020; and educational trajectories diverged, with secondary-educated workers remaining the most segregated and low-educated workers recording the clearest increases.

The 2014–2020 broad decomposition provides the clearest evidence of cancellation. A more balanced gender composition within major groups reduced segregation, but employment redistribution across those groups produced an almost equal increase. The larger gross movements in the chained decomposition confirm that the small endpoint change resulted from competing processes rather than structural persistence (Deutsch, Flückiger, & Silber, 2009).

Occupational resolution changes this interpretation. During 2014–2020, the three-digit index increased significantly while the one-digit index remained nearly unchanged. This divergence concerns within-resolution changes, not the mechanically higher level of indices based on more detailed classifications, and it was not driven by increasing numbers of sparse or single-sex occupations. Broad stability can therefore coexist with growing separation across narrower occupations. This interpretation is consistent with complementary evidence for Serbia showing that three-digit occupational reallocation substantially exceeds reallocation across major groups, so that broad classifications can obscure sizeable offsetting movements within categories (Blau et al., 2013; Charles & Grusky, 2004; Ognjenović et al., 2026; Strawiński et al., 2018).

The educational pattern was also non-linear. Secondary-educated workers remained the most segregated, tertiary-educated workers had lower but non-declining segregation, and low-educated workers recorded statistically distinguishable increases in both post-2014 windows that exceeded the changes in the other groups. This does not support a simple gradient in which more education uniformly produces integration. Vocational routes may sustain segregation among secondary-educated workers, while gendered fields of study may constrain integration among tertiary-educated workers. Serbian evidence on researchers also shows that women's strong overall representation can coexist with pronounced gender differentiation across scientific disciplines (Lazarević-Moravčević et al., 2023). For the shrinking low-education group, changes in participation may alter who is employed, alongside changes in sorting into gender-typed manual, elementary, and service jobs. These mechanisms offer a possible interpretation of the contrasting educational trajectories.

The Duncan index measures differences between the occupational distributions of women and men, not occupational hierarchy, earnings, authority, or job quality. This distinction is important in the Serbian context, where evidence from the public sector identifies gender differences in

perceived barriers to career progression, mentorship, work-family reconciliation, stereotypes, and discrimination (Stanišić & Ječmenica, 2025). A larger contribution from a professional occupation may reflect increasing female concentration and therefore raise measured segregation, even when women's entry into that occupation represents an improvement in status or pay. Changes in occupational dissimilarity should consequently not be interpreted automatically as improvements or deteriorations in women's labour market position.

The small contribution of women's aggregate employment share also shows that increased female employment and greater similarity in occupational distributions are distinct dimensions of gender equality. Ognjenović (2018) reported nearly equal employment rates for tertiary-educated women and men in Serbia in 2017. Considered alongside our findings, this illustrates how near parity in employment rates can coexist with persistent occupational segregation within the same educational group. European evidence similarly shows that women's employment can rise without a corresponding expansion of gender-balanced jobs (Bettio & Verashchagina, 2009; Eurofound & European Commission Joint Research Centre, 2021). Occupational segregation may contribute to gender pay differentials, but it remains analytically distinct from the wage gap and its unexplained component (Anić & Krstić, 2019; Blau & Kahn, 2017; Ognjenović, 2021, 2025).

Employment and educational gains were therefore insufficient for uniform occupational integration. Monitoring only employment rates or broad sectors can conceal sorting across detailed occupations and education groups. Gender-equality policy should monitor finer occupational distributions and gendered education-to-occupation pathways, particularly in vocational, technical, engineering, and ICT fields (Babović & Petrović, 2021).

Several limitations qualify the conclusions. Repeated cross-sections cannot trace individual careers, occupational transitions, or cohort replacement. The overall Duncan index is not a weighted average of the education-specific indices, so the declining size and increasing segregation of the low-education group are concurrent processes, not a formally decomposed mediation mechanism. Comparisons are restricted to survey- and classification-consistent windows. Because primary sample units (PSU) and stratum identifiers were unavailable, the bootstrap was adapted to the available clustering identifiers and does not reproduce the full complex

survey design. The resulting confidence intervals are approximate: unobserved clustering may increase sampling variance, whereas stratification and calibration can reduce it, so the net effect on interval width is uncertain. Results close to the zero-exclusion threshold should therefore be interpreted in light of this design approximation. Finally, the Duncan index is sensitive to occupational resolution and does not measure earnings or job quality. The proposed occupational and educational mechanisms therefore remain interpretations requiring longitudinal data and complementary measures of vertical inequality.

Conclusion

Using Serbian LFS data for 2010–2024, we find that occupational integration was partial, uneven, and dependent on occupational resolution and education. Across the separate analytical series, broad segregation was descriptively lower in the later series than in the earliest series, a pattern consistent with a longer-run downward tendency but not with a single comparable 2010–2024 change. Within the 2014–2020 analytical window, broad stability concealed an integrating change in gender composition within major groups that was offset by segregation-increasing employment redistribution. Detailed segregation showed a statistically distinguishable increase during 2014–2020, while education-specific trajectories diverged: secondary-educated workers remained the most segregated, tertiary-educated workers showed lower but non-declining segregation, and segregation among low-educated workers increased in both post-2014 windows.

The main contribution is empirical and interpretative: the Serbian evidence shows that aggregate stability must be interpreted through its components, occupational resolution, and educational heterogeneity. Weighted indices establish the trajectories, endpoint and chained Shapley decompositions reveal offsetting movements, and education-specific estimates with direct contrasts identify divergent group trajectories. Together, these stages support an account of integration shaped by occupational and educational pathways alongside changes in women's employment and qualifications. Policies should therefore monitor detailed occupational distributions and address gendered education-to-occupation pathways. In practice, reporting trends separately by educational attainment would make the repeated increase among low-educated workers visible

alongside aggregate indicators. Longitudinal research should distinguish individual mobility from cohort and compositional change, connect segregation to earnings and job quality, and test the mechanisms underlying the divergent educational trajectories. Comparative research could examine whether the same combination of offsetting change and educational divergence occurs in other post-transition economies.

Open Science and Data Availability

The anonymised Serbian LFS microdata used in this study cannot be shared by the authors because they were obtained under restricted-access conditions. Eligible research organisations and institutions may independently request access to the relevant 2010–2024 microdata from the SORS, subject to its approval and the applicable access agreement. Reproducibility materials are available on the Open Science Framework at https://osf.io/ujgx7.

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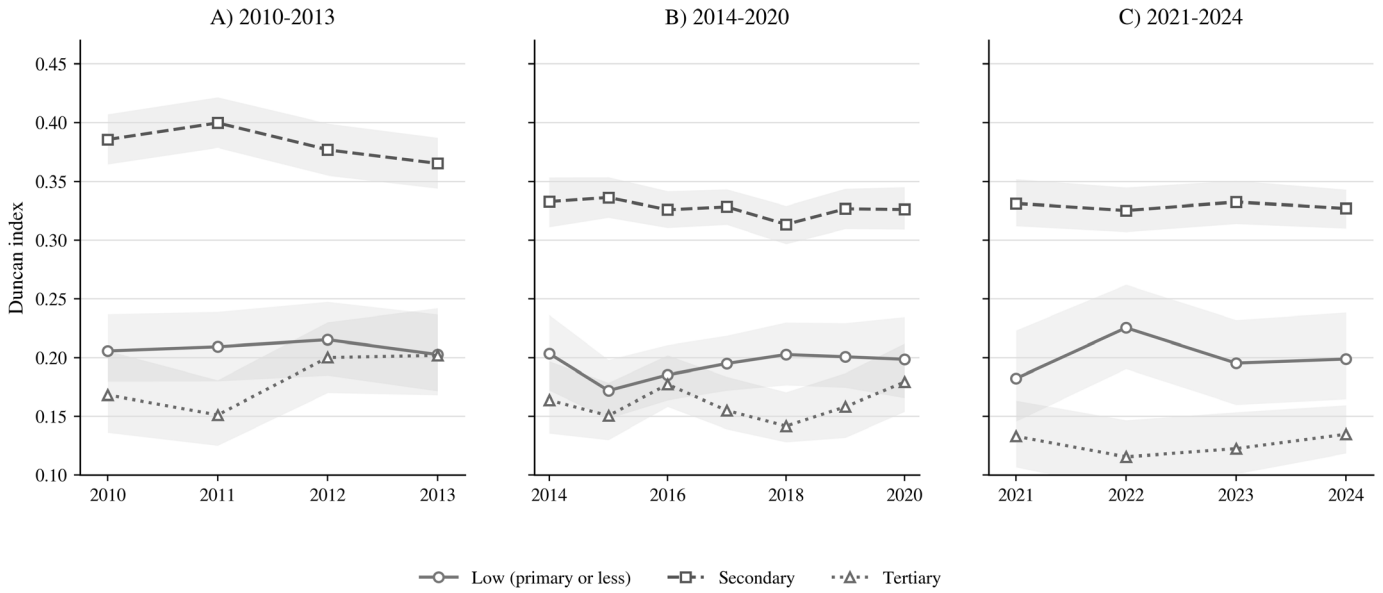
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Supplementary Material

Women, Education, and Occupational Segregation in Serbia: Evidence from LFS Data

Figure S1. Broad Occupational Segregation by Education



Note. Lines show survey-weighted Duncan dissimilarity indices at the ISCO one-digit level; shaded bands are pointwise percentile 95% confidence intervals based on 5,000 bootstrap replications adapted to the available clustering identifiers. Lines connect estimates only within survey-consistent periods. ISCO = International Standard Classification of Occupations.

Table S1. Analytical Samples and Coverage

Panel A. Analytical sample by year

Year	Survey period	Unweighted N	Women	Men	Weighted employment (000s)	Female share (%)	Broad groups	Detailed occupations	Bootstrap units
2010	2010-2013	13,546	5,719	7,827	2,268.6	42.8	10	112	13,546
2011	2010-2013	13,571	5,677	7,894	2,156.9	42.2	10	112	13,571
2012	2010-2013	13,371	5,570	7,801	2,138.6	42.0	10	114	13,371
2013	2010-2013	15,057	6,276	8,781	2,196.3	42.5	10	128	15,057
2014	2014-2020	31,182	13,312	17,870	2,439.3	43.3	10	127	10,476
2015	2014-2020	37,508	16,139	21,369	2,465.7	43.4	10	127	14,330
2016	2014-2020	46,236	20,183	26,053	2,577.5	44.0	10	128	16,983
2017	2014-2020	45,966	20,255	25,711	2,647.6	44.4	10	127	17,146
2018	2014-2020	46,625	20,535	26,090	2,685.1	44.3	10	127	17,339
2019	2014-2020	43,866	19,446	24,420	2,733.5	44.7	10	129	16,982
2020	2014-2020	38,796	17,257	21,539	2,724.2	44.7	10	126	15,434
2021	2021-2024	37,351	16,344	21,007	2,643.3	44.5	10	123	14,726
2022	2021-2024	37,197	16,516	20,681	2,706.6	45.0	10	123	14,259
2023	2021-2024	41,134	18,638	22,496	2,710.9	45.6	10	123	15,796
2024	2021-2024	48,770	22,276	26,494	2,747.9	45.9	10	124	18,246

Panel B. Sample and weighted employment by education

Year	Low N	Low employment (000s)	Secondary N	Secondary employment (000s)	Tertiary N	Tertiary employment (000s)
2010	2,844	445.0	8,093	1,338.8	2,609	484.8
2011	2,660	411.9	8,079	1,266.0	2,832	479.0
2012	2,484	387.7	7,994	1,253.9	2,893	496.9
2013	2,968	396.9	8,973	1,287.7	3,116	511.7
2014	5,878	389.3	18,614	1,452.0	6,690	597.9
2015	6,536	379.6	22,402	1,455.9	8,570	630.2
2016	8,342	406.1	27,498	1,513.5	10,396	657.9
2017	8,244	406.8	27,172	1,550.0	10,550	690.7
2018	7,896	387.0	27,721	1,574.5	11,008	723.6
2019	7,371	389.0	26,130	1,602.9	10,365	741.6
2020	6,031	358.9	23,473	1,626.5	9,292	738.8
2021	5,213	326.3	22,817	1,548.9	9,321	768.0
2022	4,905	314.4	22,935	1,585.5	9,357	806.6
2023	5,179	298.7	25,125	1,585.7	10,830	826.5
2024	5,828	289.1	29,231	1,590.1	13,711	868.7

Panel C. Occupational coverage and support

Year	ISCO standard	Detailed level retained	Broad groups	ISCO-2 occupations	ISCO-3 occupations	One-sex ISCO-3 occupations	Employment in one-sex occupations (%)	Employment in ISCO-3 cells with n < 30 (%)
2010	ISCO-88	Yes	10	28	112	12	2.9	3.6
2011	ISCO-88	Yes	10	28	112	19	4.2	4.2
2012	ISCO-88	Yes	10	28	114	18	2.0	4.4
2013	ISCO-08 transition year; detailed level not used	No	10	—	—	—	—	—
2014	ISCO-08	Yes	10	43	127	8	4.0	0.5
2015	ISCO-08	Yes	10	43	127	5	0.6	0.5
2016	ISCO-08	Yes	10	43	128	3	0.1	0.2
2017	ISCO-08	Yes	10	43	127	5	0.1	0.2
2018	ISCO-08	Yes	10	43	127	6	0.8	0.2
2019	ISCO-08	Yes	10	43	129	6	0.2	0.2
2020	ISCO-08	Yes	10	43	126	5	0.2	0.2
2021	ISCO-08	Yes	10	42	123	2	0.1	0.4
2022	ISCO-08	Yes	10	42	123	2	0.0	0.3
2023	ISCO-08	Yes	10	42	123	7	0.6	0.3
2024	ISCO-08	Yes	10	42	124	5	0.1	0.2

Note. Weighted employment is shown in thousands. Detailed occupational estimates are not retained for the 2013 transition year. For 2010-2013, bootstrap units are records because household identifiers are unavailable; for 2014-2024, household-within-year clusters are used.

Table S2. Overall Duncan Indices and Endpoint Changes

Panel A. Annual estimates by occupational resolution

Year	ISCO one-digit: D (SE) [95% CI]	ISCO two-digit: D	ISCO three-digit: D (SE) [95% CI]
2010	.312 (.009) [.295, .329]	.386	.479 (.008) [.470, .502]
2011	.317 (.009) [.299, .334]	.392	.473 (.008) [.465, .495]
2012	.313 (.009) [.295, .331]	.380	.482 (.008) [.472, .504]
2013	.295 (.009) [.278, .312]	—	—
2014	.273 (.008) [.258, .289]	.412	.470 (.008) [.462, .492]
2015	.280 (.006) [.268, .293]	.420	.476 (.006) [.469, .493]
2016	.273 (.006) [.261, .284]	.405	.465 (.006) [.459, .480]
2017	.268 (.006) [.257, .279]	.408	.475 (.006) [.467, .489]
2018	.264 (.006) [.252, .276]	.416	.484 (.006) [.476, .499]
2019	.269 (.006) [.256, .281]	.413	.483 (.006) [.475, .498]
2020	.277 (.007) [.263, .290]	.423	.497 (.006) [.487, .513]
2021	.275 (.007) [.262, .290]	.425	.501 (.007) [.491, .518]
2022	.269 (.007) [.255, .283]	.423	.497 (.007) [.489, .516]
2023	.272 (.007) [.259, .285]	.419	.487 (.007) [.480, .505]
2024	.277 (.006) [.265, .289]	.432	.496 (.006) [.489, .511]

Panel B. Survey-consistent endpoint changes

Resolution	Period	Start year	End year	Start D	End D	Change	SE	95% CI	CI excludes zero
ISCO one-digit	2010-2013 broad	2010	2013	.312	.295	−.017	.012	[−.041, .007]	No
ISCO one-digit	2014-2020 broad	2014	2020	.273	.277	.004	.010	[−.017, .024]	No
ISCO one-digit	2021-2024 broad	2021	2024	.275	.277	.001	.009	[−.017, .019]	No
ISCO three-digit	2010-2012 ISCO-3	2010	2012	.479	.482	.002	.012	[−.020, .025]	No
ISCO three-digit	2014-2020 ISCO-3	2014	2020	.470	.497	.027	.010	[.004, .042]	Yes
ISCO three-digit	2021-2024 ISCO-3	2021	2024	.501	.496	−.005	.009	[−.021, .014]	No

Note. D = Duncan dissimilarity index; SE = bootstrap standard error; CI = confidence interval. ISCO two-digit estimates are included as diagnostic point estimates and were not used for the main inferential comparisons. Percentile intervals are based on 5,000 bootstrap replications.

Table S3. Full Shapley Decomposition Results

Panel A. Endpoint Shapley decompositions

Resolution	Period	Component	Contribution	SE	95% CI	CI excludes zero	Endpoint change
ISCO one-digit	2010-2013 broad	Within-occupation composition	−.020	.012	[−.043, .003]	No	−.017
ISCO one-digit	2010-2013 broad	Occupational structure	.004	.004	[−.004, .011]	No	−.017
ISCO one-digit	2010-2013 broad	Overall female share	−.000	.001	[−.003, .002]	No	−.017
ISCO one-digit	2014-2020 broad	Within-occupation composition	−.020	.010	[−.039, −.000]	Yes	.004
ISCO one-digit	2014-2020 broad	Occupational structure	.021	.003	[.015, .028]	Yes	.004
ISCO one-digit	2014-2020 broad	Overall female share	.002	.001	[.001, .003]	Yes	.004
ISCO one-digit	2021-2024 broad	Within-occupation composition	.003	.009	[−.014, .020]	No	.001
ISCO one-digit	2021-2024 broad	Occupational structure	−.004	.003	[−.009, .002]	No	.001
ISCO one-digit	2021-2024 broad	Overall female share	.002	.001	[.001, .003]	Yes	.001
ISCO three-digit	2010-2012 ISCO-3	Within-occupation composition	.005	.011	[−.017, .025]	No	.002
ISCO three-digit	2010-2012 ISCO-3	Occupational structure	−.003	.004	[−.011, .007]	No	.002

Resolution	Period	Component	Contribution	SE	95% CI	CI excludes zero	Endpoint change
ISCO three-digit	2010-2012 ISCO-3	Overall female share	−.000	.000	[−.001, .001]	No	.002
ISCO three-digit	2014-2020 ISCO-3	Within-occupation composition	.013	.009	[−.008, .027]	No	.027
ISCO three-digit	2014-2020 ISCO-3	Occupational structure	.013	.005	[.004, .022]	Yes	.027
ISCO three-digit	2014-2020 ISCO-3	Overall female share	.002	.001	[.000, .003]	Yes	.027
ISCO three-digit	2021-2024 ISCO-3	Within-occupation composition	−.008	.008	[−.023, .009]	No	−.005
ISCO three-digit	2021-2024 ISCO-3	Occupational structure	.002	.004	[−.005, .009]	No	−.005
ISCO three-digit	2021-2024 ISCO-3	Overall female share	.001	.001	[.000, .002]	Yes	−.005

Panel B. Chained Shapley components summarized by period

Resolution	Period	Component	Chained contribution	SE	95% CI	Endpoint contribution	Chained minus endpoint
ISCO one-digit	2010-2013 broad	Within-occupation composition	−.020	.012	[−.042, .004]	−.020	.000
ISCO one-digit	2010-2013 broad	Occupational structure	.003	.004	[−.004, .010]	.004	−.000
ISCO one-digit	2010-2013 broad	Overall female share	−.001	.001	[−.003, .002]	−.000	−.000
ISCO one-digit	2014-2020 broad	Within-occupation composition	−.019	.010	[−.039, .000]	−.020	.001
ISCO one-digit	2014-2020 broad	Occupational structure	.021	.003	[.014, .027]	.021	−.000
ISCO one-digit	2014-2020 broad	Overall female share	.002	.001	[.001, .003]	.002	−.000
ISCO one-digit	2021-2024 broad	Within-occupation composition	.003	.009	[−.014, .020]	.003	.000
ISCO one-digit	2021-2024 broad	Occupational structure	−.004	.003	[−.009, .002]	−.004	−.000
ISCO one-digit	2021-2024 broad	Overall female share	.002	.001	[.001, .003]	.002	.000
ISCO three-digit	2010-2012 ISCO-3	Within-occupation composition	.004	.011	[−.017, .025]	.005	−.001
ISCO three-digit	2010-2012 ISCO-3	Occupational structure	−.002	.005	[−.010, .008]	−.003	.001
ISCO three-digit	2010-2012 ISCO-3	Overall female share	−.000	.000	[−.001, .001]	−.000	−.000

Resolution	Period	Component	Chained contribution	SE	95% CI	Endpoint contribution	Chained minus endpoint
ISCO three-digit	2014-2020 ISCO-3	Within-occupation composition	.012	.009	[−.010, .025]	.013	−.001
ISCO three-digit	2014-2020 ISCO-3	Occupational structure	.015	.005	[.005, .024]	.013	.002
ISCO three-digit	2014-2020 ISCO-3	Overall female share	.001	.001	[−.000, .002]	.002	−.001
ISCO three-digit	2021-2024 ISCO-3	Within-occupation composition	−.007	.008	[−.022, .011]	−.008	.002
ISCO three-digit	2021-2024 ISCO-3	Occupational structure	−.000	.004	[−.008, .008]	.002	−.002
ISCO three-digit	2021-2024 ISCO-3	Overall female share	.002	.001	[.001, .003]	.001	.001

Panel C. Annual chained components

Resolution	Transition	Observed change	Within-occupation contribution [95% CI]	Structure contribution [95% CI]	Female-share contribution [95% CI]
ISCO one-digit	2010-2011	.005	.001 [−.022, .024]	.005 [−.002, .012]	−.001 [−.003, .001]
ISCO one-digit	2011-2012	−.004	−.002 [−.026, .022]	−.001 [−.008, .005]	−.000 [−.002, .002]
ISCO one-digit	2012-2013	−.018	−.018 [−.042, .005]	−.001 [−.008, .006]	.001 [−.001, .003]
ISCO one-digit	2014-2015	.007	.008 [−.011, .026]	−.001 [−.006, .005]	.000 [−.001, .001]
ISCO one-digit	2015-2016	−.008	−.012 [−.028, .005]	.003 [−.002, .008]	.001 [−.000, .002]
ISCO one-digit	2016-2017	−.005	−.007 [−.022, .008]	.002 [−.003, .007]	.000 [−.000, .001]
ISCO one-digit	2017-2018	−.004	−.010 [−.025, .005]	.006 [.001, .011]	−.000 [−.001, .001]
ISCO one-digit	2018-2019	.005	.000 [−.016, .016]	.004 [−.001, .009]	.001 [−.000, .001]
ISCO one-digit	2019-2020	.008	.002 [−.015, .019]	.006 [.001, .012]	.000 [−.001, .001]
ISCO one-digit	2021-2022	−.007	−.008 [−.028, .011]	.001 [−.005, .007]	.001 [−.000, .002]
ISCO one-digit	2022-2023	.003	.007 [−.013, .025]	−.004 [−.010, .002]	.001 [−.000, .002]
ISCO one-digit	2023-2024	.005	.005 [−.012, .022]	−.001 [−.006, .005]	.000 [−.001, .002]
ISCO three-digit	2010-2011	−.007	−.012 [−.031, .009]	.005 [−.003, .014]	−.000 [−.001, .001]
ISCO three-digit	2011-2012	.009	.016 [−.006, .035]	−.007 [−.015, .002]	.000 [−.001, .001]
ISCO three-digit	2014-2015	.007	.004 [−.015, .020]	.003 [−.006, .011]	.000 [−.001, .001]
ISCO three-digit	2015-2016	−.011	−.009 [−.024, .005]	−.003 [−.010, .005]	.000 [−.000, .001]
ISCO three-digit	2016-2017	.009	.006 [−.008, .019]	.003 [−.003, .010]	.000 [−.000, .001]
ISCO three-digit	2017-2018	.010	.007 [−.008, .020]	.003 [−.004, .010]	−.000 [−.001, .000]
ISCO three-digit	2018-2019	−.001	−.005 [−.019, .010]	.004 [−.003, .010]	.000 [−.000, .001]
ISCO three-digit	2019-2020	.013	.009 [−.007, .025]	.005 [−.002, .012]	.000 [−.001, .001]

Resolution	Transition	Observed change	Within-occupation contribution [95% CI]	Structure contribution [95% CI]	Female-share contribution [95% CI]
ISCO three-digit	2021-2022	−.004	−.003 [−.017, .017]	−.002 [−.010, .006]	.001 [−.000, .002]
ISCO three-digit	2022-2023	−.010	−.015 [−.033, .001]	.004 [−.004, .012]	.001 [−.000, .002]
ISCO three-digit	2023-2024	.009	.011 [−.006, .025]	−.002 [−.009, .005]	.000 [−.000, .001]

Note. Shapley contributions sum to the corresponding Duncan-index change, subject only to numerical rounding. Endpoint decompositions compare the first and last year of each valid survey-consistent window. Chained results sum adjacent-year decompositions within each window. CI = confidence interval. Values displayed as .000 or −.000 may represent nonzero estimates that round to three decimal places.

Table S4. Complete Education-Specific Duncan Results

Panel A. Annual ISCO one-digit estimates by education

Year	Low: D (SE) [95% CI]	Secondary: D (SE) [95% CI]	Tertiary: D (SE) [95% CI]
2010	.206 (.015) [.180, .237]	.386 (.011) [.364, .407]	.168 (.018) [.136, .206]
2011	.209 (.015) [.180, .239]	.400 (.011) [.379, .422]	.151 (.014) [.125, .181]
2012	.215 (.016) [.185, .248]	.377 (.011) [.355, .399]	.200 (.015) [.170, .230]
2013	.203 (.017) [.171, .237]	.365 (.011) [.344, .387]	.202 (.019) [.168, .242]
2014	.203 (.016) [.172, .236]	.333 (.011) [.311, .353]	.164 (.016) [.136, .197]
2015	.172 (.013) [.148, .198]	.336 (.009) [.319, .354]	.151 (.013) [.130, .179]
2016	.185 (.012) [.164, .211]	.326 (.008) [.310, .342]	.177 (.011) [.158, .202]
2017	.195 (.012) [.172, .219]	.328 (.008) [.313, .343]	.155 (.011) [.139, .184]
2018	.203 (.014) [.176, .230]	.313 (.008) [.297, .329]	.142 (.011) [.128, .170]
2019	.201 (.014) [.174, .229]	.327 (.009) [.309, .344]	.158 (.014) [.132, .187]
2020	.199 (.017) [.165, .235]	.326 (.009) [.309, .345]	.179 (.015) [.154, .212]
2021	.182 (.020) [.146, .223]	.331 (.010) [.312, .352]	.133 (.015) [.107, .163]
2022	.225 (.019) [.190, .262]	.325 (.010) [.307, .345]	.115 (.015) [.087, .147]
2023	.195 (.018) [.160, .232]	.332 (.009) [.314, .351]	.122 (.014) [.101, .154]
2024	.199 (.019) [.165, .238]	.327 (.008) [.310, .343]	.135 (.011) [.118, .160]

Panel B. Annual ISCO three-digit estimates by education

Year	Low: D (SE) [95% CI]	Secondary: D (SE) [95% CI]	Tertiary: D (SE) [95% CI]
2010	.374 (.017) [.354, .418]	.570 (.010) [.556, .594]	.396 (.021) [.366, .449]
2011	.386 (.017) [.364, .430]	.565 (.010) [.552, .590]	.375 (.018) [.358, .427]
2012	.401 (.018) [.375, .444]	.549 (.010) [.537, .575]	.402 (.018) [.387, .457]
2014	.372 (.015) [.354, .414]	.542 (.010) [.531, .568]	.392 (.016) [.376, .439]
2015	.374 (.014) [.353, .409]	.550 (.008) [.539, .570]	.373 (.013) [.364, .417]
2016	.377 (.012) [.362, .410]	.537 (.007) [.528, .555]	.382 (.012) [.369, .417]
2017	.396 (.012) [.378, .426]	.543 (.007) [.535, .562]	.398 (.012) [.384, .430]
2018	.401 (.013) [.384, .433]	.549 (.007) [.539, .568]	.393 (.012) [.378, .426]
2019	.422 (.014) [.400, .455]	.549 (.008) [.539, .568]	.379 (.013) [.368, .417]
2020	.442 (.016) [.420, .482]	.554 (.008) [.543, .574]	.395 (.014) [.383, .436]
2021	.456 (.018) [.431, .503]	.560 (.008) [.550, .583]	.390 (.014) [.378, .434]
2022	.498 (.018) [.470, .541]	.569 (.008) [.561, .592]	.367 (.014) [.359, .414]
2023	.473 (.015) [.455, .516]	.555 (.008) [.547, .577]	.370 (.013) [.356, .407]
2024	.512 (.015) [.491, .552]	.561 (.007) [.552, .580]	.377 (.011) [.362, .406]

Panel C. Endpoint changes for all available periods and resolutions

Resolution	Period	Education group	Start D	End D	Change	SE	95% CI	CI excludes zero
ISCO one-digit	2010-2013 broad	Low (primary or less)	.206	.203	−.003	.022	[−.047, .040]	No
ISCO one-digit	2010-2013 broad	Secondary	.386	.365	−.020	.015	[−.050, .011]	No
ISCO one-digit	2010-2013 broad	Tertiary	.168	.202	.034	.025	[−.016, .084]	No
ISCO one-digit	2014-2020 broad	Low (primary or less)	.203	.199	−.005	.024	[−.051, .043]	No
ISCO one-digit	2014-2020 broad	Secondary	.333	.326	−.007	.014	[−.033, .023]	No
ISCO one-digit	2014-2020 broad	Tertiary	.164	.179	.015	.021	[−.026, .058]	No
ISCO one-digit	2021-2024 broad	Low (primary or less)	.182	.199	.017	.027	[−.036, .071]	No
ISCO one-digit	2021-2024 broad	Secondary	.331	.327	−.004	.013	[−.032, .021]	No
ISCO one-digit	2021-2024 broad	Tertiary	.133	.135	.002	.018	[−.032, .039]	No
ISCO three-digit	2010-2012 ISCO-3	Low (primary or less)	.374	.401	.026	.024	[−.022, .071]	No
ISCO three-digit	2010-2012 ISCO-3	Secondary	.570	.549	−.020	.014	[−.047, .008]	No

Resolution	Period	Education group	Start D	End D	Change	SE	95% CI	CI excludes zero
ISCO three-digit	2010-2012 ISCO-3	Tertiary	.396	.402	.007	.028	[−.041, .071]	No
ISCO three-digit	2014-2020 ISCO-3	Low (primary or less)	.372	.442	.070	.022	[.024, .109]	Yes
ISCO three-digit	2014-2020 ISCO-3	Secondary	.542	.554	.011	.013	[−.015, .033]	No
ISCO three-digit	2014-2020 ISCO-3	Tertiary	.392	.395	.003	.021	[−.039, .044]	No
ISCO three-digit	2021-2024 ISCO-3	Low (primary or less)	.456	.512	.056	.024	[.009, .103]	Yes
ISCO three-digit	2021-2024 ISCO-3	Secondary	.560	.561	.001	.011	[−.022, .021]	No
ISCO three-digit	2021-2024 ISCO-3	Tertiary	.390	.377	−.013	.018	[−.057, .013]	No

Note. Values are survey-weighted Duncan indices. Annual intervals are pointwise percentile 95% confidence intervals. Endpoint changes equal the ending index minus the starting index. Detailed estimates exclude the 2013 transition year.

Table S5. Complete Direct Contrasts Between Education Groups

Resolution	Period	Direct contrast	Difference in change	SE	95% CI	CI excludes zero
ISCO one-digit	2010-2013 broad	Secondary change minus low change	−.017	.027	[−.069, .037]	No
ISCO one-digit	2010-2013 broad	Tertiary change minus low change	.037	.034	[−.029, .103]	No
ISCO one-digit	2010-2013 broad	Tertiary change minus secondary change	.054	.030	[−.004, .112]	No
ISCO one-digit	2014-2020 broad	Secondary change minus low change	−.002	.028	[−.056, .053]	No
ISCO one-digit	2014-2020 broad	Tertiary change minus low change	.020	.032	[−.041, .084]	No
ISCO one-digit	2014-2020 broad	Tertiary change minus secondary change	.022	.026	[−.029, .072]	No
ISCO one-digit	2021-2024 broad	Secondary change minus low change	−.021	.030	[−.080, .038]	No
ISCO one-digit	2021-2024 broad	Tertiary change minus low change	−.015	.032	[−.077, .049]	No
ISCO one-digit	2021-2024 broad	Tertiary change minus secondary change	.006	.022	[−.036, .052]	No
ISCO three-digit	2010-2012 ISCO-3	Secondary change minus low change	−.047	.028	[−.098, .011]	No
ISCO three-digit	2010-2012 ISCO-3	Tertiary change minus low change	−.020	.037	[−.081, .063]	No

Resolution	Period	Direct contrast	Difference in change	SE	95% CI	CI excludes zero
ISCO three-digit	2010-2012 ISCO-3	Tertiary change minus secondary change	.027	.031	[−.029, .096]	No
ISCO three-digit	2014-2020 ISCO-3	Secondary change minus low change	−.059	.025	[−.107, −.010]	Yes
ISCO three-digit	2014-2020 ISCO-3	Tertiary change minus low change	−.067	.030	[−.124, −.005]	Yes
ISCO three-digit	2014-2020 ISCO-3	Tertiary change minus secondary change	−.008	.025	[−.055, .040]	No
ISCO three-digit	2021-2024 ISCO-3	Secondary change minus low change	−.054	.026	[−.107, −.006]	Yes
ISCO three-digit	2021-2024 ISCO-3	Tertiary change minus low change	−.069	.030	[−.135, −.021]	Yes
ISCO three-digit	2021-2024 ISCO-3	Tertiary change minus secondary change	−.015	.021	[−.062, .020]	No

Note. Each contrast is the endpoint change for the first listed education group minus the endpoint change for the second listed group. Tests are based on the joint bootstrap distribution of the two changes and do not infer a group difference by comparing separate significance decisions.

Table S6. Low-Education Sensitivity and Support Analyses

Panel A. Predefined sensitivity scenarios

Period	Scenario	Occupations retained	N start / end	D start / end	Change	SE	95% CI	Positive bootstrap changes (%)	Difference from full-sample change
2014-2020 ISCO-3	All observed occupations	87	5,878 / 6,031	.372 / .442	.070	.022	[.024, .109]	99.8	.000
2014-2020 ISCO-3	Occupations observed at both endpoints	72	5,862 / 6,015	.370 / .439	.069	.022	[.022, .109]	99.9	−.001
2014-2020 ISCO-3	Common occupations with n >= 10 at both endpoints	49	5,704 / 5,888	.354 / .439	.084	.022	[.034, .122]	100.0	.014
2014-2020 ISCO-3	Common occupations with n >= 20 at both endpoints	37	5,529 / 5,632	.342 / .432	.090	.023	[.039, .128]	100.0	.020
2014-2020 ISCO-3	Common occupations with n >= 30 at both endpoints	28	5,302 / 5,253	.320 / .429	.109	.024	[.056, .148]	100.0	.039
2014-2020 ISCO-3	Common occupations containing both sexes at both endpoints	39	5,100 / 5,035	.268 / .348	.080	.025	[.033, .129]	100.0	.010
2021-2024 ISCO-3	All observed occupations	91	5,213 / 5,828	.456 / .512	.056	.024	[.009, .103]	98.9	.000
2021-2024 ISCO-3	Occupations observed at both endpoints	74	5,200 / 5,807	.455 / .512	.057	.024	[.007, .102]	99.0	.001

Period	Scenario	Occupations retained	N start / end	D start / end	Change	SE	95% CI	Positive bootstrap changes (%)	Difference from full-sample change
2021-2024 ISCO-3	Common occupations with n >= 10 at both endpoints	48	5,078 / 5,655	.449 / .506	.057	.024	[.008, .104]	98.9	.001
2021-2024 ISCO-3	Common occupations with n >= 20 at both endpoints	41	4,981 / 5,533	.446 / .505	.059	.025	[.008, .106]	99.0	.003
2021-2024 ISCO-3	Common occupations with n >= 30 at both endpoints	34	4,811 / 5,292	.436 / .505	.070	.025	[.014, .114]	99.5	.014
2021-2024 ISCO-3	Common occupations containing both sexes at both endpoints	45	4,417 / 4,927	.334 / .410	.076	.025	[.025, .123]	99.8	.020

Panel B. Endpoint support and sparse-occupation diagnostics

Period	Year	N	Occupations	Both sexes	One sex only	Employment in one-sex occupations (%)	n < 10: occupations (employment %)	n < 20: occupations (employment %)	n < 30: occupations (employment %)	Minimum sex n < 5: occupations (employment %)
2014-2020 ISCO-3	2014	5,878	79	46	33	12.9	28 (2.4%)	41 (6.1%)	48 (8.8%)	58 (22.7%)
2014-2020 ISCO-3	2020	6,031	80	51	29	11.9	27 (1.9%)	35 (3.9%)	45 (8.2%)	49 (21.3%)
2021-2024 ISCO-3	2021	5,213	82	54	28	9.9	32 (2.2%)	41 (4.7%)	48 (8.0%)	55 (27.9%)
2021-2024 ISCO-3	2024	5,828	83	54	29	8.6	30 (1.7%)	39 (4.3%)	44 (6.5%)	54 (22.9%)

Note. All 12 predefined sensitivity estimates use the same low-education population and endpoint windows as the primary analysis. Positive bootstrap changes (%) is the share of valid bootstrap replications with a positive endpoint change. Parentheses in Panel B show the weighted employment share represented by the corresponding sparse-occupation category.

Table S7. Occupational Contributions

Panel A. ISCO three-digit occupation drivers among low-educated workers, 2014-2020

Net change = .070; top five absolute movements = 36.6% of gross absolute movement.

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
1	631	Subsistence Crop Farmers	.022	[.012, .033]	1.000	Reinforcing	4.0 / 5.6	52.1 / 69.7	Yes
2	931	Mining and Construction Labourers	.013	[.006, .021]	1.000	Reinforcing	1.7 / 3.2	0.0 / 0.0	Yes
3	711	Building Frame and Related Trades Workers	.012	[.004, .020]	.999	Reinforcing	1.4 / 2.7	0.0 / 0.0	Yes
4	265	Creative and Performing Artists	−.006	[−.010, −.002]	.998	Integrating	0.7 / 0.2	1.3 / 27.6	Yes
5	753	Garment and Related Trades Workers	.006	[−.002, .014]	.933	Reinforcing	1.4 / 1.8	78.6 / 86.1	Yes
6	815	Textile, Fur and Leather Products Machine Operators	.005	[−.000, .011]	.972	Reinforcing	0.3 / 1.2	92.3 / 80.7	Yes
7	632	Subsistence Livestock Farmers	−.005	[−.011, .000]	.973	Integrating	1.7 / 0.5	63.6 / 61.7	Yes
8	613	Mixed Crop and Animal Producers	.005	[−.009, .015]	.681	Reinforcing	15.5 / 15.1	43.6 / 45.9	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
9	833	Heavy Truck and Bus Drivers	.005	[−.001, .012]	.944	Reinforcing	1.5 / 2.1	0.0 / 0.0	Yes
10	722	Blacksmiths, Toolmakers and Related Trades Workers	.004	[−.002, .010]	.899	Reinforcing	0.7 / 1.4	4.9 / 8.8	Yes
11	932	Manufacturing Labourers	.004	[−.003, .008]	.781	Reinforcing	1.3 / 2.3	44.6 / 51.9	Yes
12	522	Shop Salespersons	.003	[−.007, .014]	.721	Reinforcing	2.6 / 3.2	72.8 / 73.2	Yes
13	532	Personal Care Workers in Health Services	.003	[−.001, .007]	.915	Reinforcing	0.3 / 0.6	82.2 / 90.6	Yes
14	921	Agricultural, Forestry and Fishery Labourers	.003	[−.008, .012]	.638	Reinforcing	5.9 / 5.3	40.6 / 38.1	Yes
15	751	Food Processing and Related Trades Workers	.003	[−.006, .007]	.588	Reinforcing	1.9 / 1.7	43.6 / 33.9	Yes
16	541	Protective Services Workers	−.003	[−.008, .002]	.857	Integrating	1.3 / 1.0	0.0 / 1.4	Yes
17	713	Painters, Building Structure Cleaners and Related Trades Workers	−.003	[−.012, .005]	.744	Integrating	1.9 / 1.6	0.7 / 1.1	Yes
18	814	Rubber, Plastic and Paper Products Machine Operators	−.002	[−.005, .001]	.841	Integrating	0.4 / 0.4	12.9 / 44.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
19	612	Animal Producers	−.002	[−.016, .011]	.625	Integrating	8.0 / 8.9	50.9 / 49.5	Yes
20	524	Other Sales Workers	.002	[−.001, .005]	.863	Reinforcing	0.2 / 0.5	40.4 / 21.6	Yes
21	422	Client Information Workers	−.002	[−.005, .000]	.933	Integrating	0.4 / 0.1	6.1 / 100.0	Yes
22	831	Locomotive Engine Drivers and Related Workers	−.002	[−.005, .001]	.897	Integrating	0.4 / 0.2	0.0 / 0.0	Yes
23	512	Cooks	.002	[−.003, .007]	.755	Reinforcing	0.6 / 0.7	85.5 / 94.8	Yes
24	741	Electrical Equipment Installers and Repairers	.002	[−.001, .004]	.892	Reinforcing	0.2 / 0.3	30.3 / 5.5	Yes
25	817	Wood Processing and Papermaking Plant Operators	.002	[−.002, .003]	.734	Reinforcing	0.3 / 0.3	43.0 / 17.8	Yes
26	821	Assemblers	−.002	[−.004, .006]	.547	Integrating	0.3 / 2.0	92.1 / 46.3	Yes
27	723	Machinery Mechanics and Repairers	−.002	[−.006, .003]	.759	Integrating	0.7 / 0.5	0.0 / 0.0	Yes
28	611	Market Gardeners and Crop Growers	−.002	[−.015, .013]	.577	Integrating	12.0 / 8.4	46.9 / 38.6	Yes
29	933	Transport and Storage Labourers	.002	[−.002, .005]	.792	Reinforcing	0.6 / 0.8	4.4 / 2.4	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
30	941	Food Preparation Assistants	.002	[−.002, .006]	.772	Reinforcing	0.2 / 0.5	100.0 / 80.6	Yes
31	413	Keyboard Operators	−.001	[−.005, .002]	.785	Integrating	0.2 / 0.1	100.0 / 92.3	Yes
32	216	Architects, Planners, Surveyors and Designers	.001	[.000, .004]	.641	Reinforcing	0.0 / 0.2	— / 0.0	No
33	513	Waiters and Bartenders	.001	[−.005, .007]	.674	Reinforcing	0.9 / 1.0	75.5 / 78.6	Yes
34	523	Cashiers and Ticket Clerks	.001	[−.001, .004]	.862	Reinforcing	0.1 / 0.2	64.7 / 100.0	Yes
35	754	Other Craft and Related Workers	−.001	[−.004, .001]	.839	Integrating	0.2 / 0.1	100.0 / 69.9	Yes
36	952	Street Vendors (excluding Food)	−.001	[−.004, .000]	.868	Integrating	0.1 / 0.0	100.0 / —	No
37	911	Domestic, Hotel and Office Cleaners and Helpers	.001	[−.015, .018]	.551	Reinforcing	6.6 / 7.1	92.3 / 90.4	Yes
38	721	Sheet and Structural Metal Workers, Moulders and Welders, and Related Workers	.001	[−.003, .006]	.658	Reinforcing	0.6 / 0.9	1.6 / 10.7	Yes

Panel A. ISCO three-digit occupation drivers among low-educated workers, 2014-2020 (continued)

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
39	811	Mining and Mineral Processing Plant Operators	−.001	[−.004, .002]	.768	Integrating	0.4 / 0.3	0.0 / 7.5	Yes
40	516	Other Personal Services Workers	.001	[−.001, .003]	.739	Reinforcing	0.1 / 0.1	40.4 / 0.0	Yes
41	132	Manufacturing, Mining, Construction and Distribution Managers	.001	[.000, .002]	.982	Reinforcing	0.0 / 0.1	— / 0.0	No
42	515	Building and Housekeeping Supervisors	.001	[−.001, .003]	.798	Reinforcing	0.3 / 0.3	17.4 / 4.0	Yes
43	712	Building Finishers and Related Trades Workers	.001	[−.004, .006]	.645	Reinforcing	1.0 / 1.1	0.0 / 0.0	Yes
44	752	Wood Treaters, Cabinet-makers and Related Trades Workers	.001	[−.003, .005]	.690	Reinforcing	0.5 / 0.7	3.7 / 11.4	Yes
45	031	Armed Forces Occupations, Other Ranks	−.001	[−.002, .000]	.918	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
46	634	Subsistence Fishers, Hunters, Trappers and Gatherers	−.001	[−.002, .000]	.951	Integrating	0.2 / 0.0	23.7 / —	No

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
47	816	Food and Related Products Machine Operators	−.001	[−.003, .003]	.556	Integrating	0.3 / 0.5	17.4 / 49.8	Yes
48	961	Refuse Workers	−.001	[−.009, .008]	.572	Integrating	2.6 / 2.1	16.2 / 11.5	Yes
49	514	Hairdressers, Beauticians and Related Workers	−.001	[−.004, .003]	.579	Integrating	0.3 / 0.5	75.6 / 55.9	Yes
50	441	Other Clerical Support Workers	−.001	[−.002, .002]	.507	Integrating	0.1 / 0.3	0.0 / 40.1	Yes
51	235	Other Teaching Professionals	−.001	[−.002, .000]	.628	Integrating	0.1 / 0.0	0.0 / —	No
52	834	Mobile Plant Operators	−.001	[−.009, .007]	.571	Integrating	1.9 / 1.9	0.0 / 2.0	Yes
53	832	Car, Van and Motorcycle Drivers	.001	[−.003, .004]	.627	Reinforcing	0.6 / 0.7	0.0 / 0.0	Yes
54	421	Tellers, Money Collectors and Related Clerks	−.001	[−.002, .000]	.791	Integrating	0.2 / 0.0	62.0 / 0.0	Yes
55	143	Other Services Managers	.001	[−.001, .003]	.686	Reinforcing	0.0 / 0.1	100.0 / 81.9	Yes
56	835	Ships' Deck Crews and Related Workers	−.000	[−.001, .000]	.964	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
57	962	Other Elementary Workers	.000	[−.003, .004]	.602	Reinforcing	0.6 / 0.4	26.3 / 16.2	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
58	731	Handicraft Workers	.000	[−.001, .002]	.609	Reinforcing	0.1 / 0.1	29.0 / 74.7	Yes
59	141	Hotel and Restaurant Managers	−.000	[−.002, .001]	.645	Integrating	0.1 / 0.1	0.0 / 63.2	Yes
60	742	Electronics and Telecommunications Installers and Repairers	−.000	[−.002, .000]	.957	Integrating	0.1 / 0.0	27.9 / 100.0	Yes
61	912	Vehicle, Window, Laundry and Other Hand Cleaning Workers	−.000	[−.004, .002]	.630	Integrating	0.7 / 0.4	52.3 / 31.3	Yes
62	633	Subsistence Mixed Crop and Livestock Farmers	.000	[−.012, .012]	.529	Reinforcing	9.1 / 3.3	51.1 / 66.8	Yes
63	622	Fishery Workers, Hunters and Trappers	−.000	[−.001, .002]	.377	Integrating	0.1 / 0.1	23.9 / 45.8	Yes
64	251	Software and Applications Developers and Analysts	.000	[.000, .001]	.649	Reinforcing	0.0 / 0.0	— / 0.0	No
65	432	Material Recording and Transport Clerks	.000	[−.004, .005]	.553	Reinforcing	0.4 / 0.8	0.0 / 18.6	Yes
66	951	Street and Related Services Workers	−.000	[−.001, .001]	.693	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
67	131	Production Managers in Agriculture, Forestry and Fisheries	.000	[−.000, .001]	.603	Reinforcing	0.0 / 0.0	100.0 / 100.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
68	222	Nursing and Midwifery Professionals	−.000	[−.001, .000]	.631	Integrating	0.0 / 0.0	100.0 / —	No
69	311	Physical and Engineering Science Technicians	.000	[.000, .001]	.641	Reinforcing	0.0 / 0.0	— / 0.0	No
70	511	Travel Attendants, Conductors and Guides	.000	[.000, .001]	.643	Reinforcing	0.0 / 0.0	— / 0.0	No
71	812	Metal Processing and Finishing Plant Operators	.000	[−.003, .005]	.531	Reinforcing	0.3 / 0.4	12.8 / 68.3	Yes
72	112	Managing Directors and Chief Executives	.000	[.000, .001]	.630	Reinforcing	0.0 / 0.0	— / 0.0	No

Panel A. ISCO three-digit occupation drivers among low-educated workers, 2014-2020 (continued)

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
73	813	Chemical and Photographic Products Plant and Machine Operators	−.000	[−.002, .002]	.427	Integrating	0.1 / 0.3	22.6 / 50.6	Yes
74	732	Printing Trades Workers	−.000	[−.000, .002]	.189	Integrating	0.0 / 0.2	0.0 / 43.1	Yes
75	431	Numerical Clerks	−.000	[−.002, .001]	.578	Integrating	0.1 / 0.1	100.0 / 100.0	Yes
76	621	Forestry and Related Workers	−.000	[−.004, .003]	.528	Integrating	0.4 / 0.4	2.3 / 0.0	Yes
77	142	Retail and Wholesale Trade Managers	.000	[.000, .000]	.632	Reinforcing	0.0 / 0.0	— / 0.0	No
78	531	Child Care Workers and Teachers' Aides	−.000	[−.003, .002]	.550	Integrating	0.2 / 0.1	100.0 / 100.0	Yes
79	331	Financial and Mathematical Associate Professionals	.000	[.000, .000]	.650	Reinforcing	0.0 / 0.0	— / 0.0	No
80	818	Other Stationary Plant and Machine Operators	.000	[−.003, .004]	.565	Reinforcing	0.4 / 0.7	22.4 / 32.5	Yes
81	264	Authors, Journalists and Linguists	−.000	[−.000, .000]	.642	Integrating	0.0 / 0.0	100.0 / —	No

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
82	111	Legislators and Senior Officials	−.000	[−.000, .000]	.627	Integrating	0.0 / 0.0	0.0 / —	No
83	412	Secretaries (general)	−.000	[−.001, .001]	.516	Integrating	0.0 / 0.0	100.0 / 100.0	Yes
84	411	General Office Clerks	−.000	[−.001, .001]	.545	Integrating	0.0 / 0.0	100.0 / 86.6	Yes
85	021	Non-commissioned Armed Forces Officers	−.000	[−.000, .000]	.632	Integrating	0.0 / 0.0	0.0 / —	No
86	342	Sports and Fitness Workers	.000	[−.000, .001]	.513	Reinforcing	0.0 / 0.0	0.0 / 0.0	Yes
87	521	Street and Market Salespersons	.000	[−.005, .004]	.509	Reinforcing	1.0 / 0.7	30.9 / 26.0	Yes

Panel B. ISCO three-digit occupation drivers among low-educated workers, 2021-2024

Net change = .056; top five absolute movements = 42.1% of gross absolute movement.

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
1	911	Domestic, Hotel and Office Cleaners and Helpers	.034	[.016, .050]	1.000	Reinforcing	5.7 / 9.0	92.8 / 93.9	Yes
2	522	Shop Salespersons	.012	[.000, .025]	.977	Reinforcing	3.3 / 4.0	78.0 / 88.4	Yes
3	711	Building Frame and Related Trades Workers	−.010	[−.019, −.001]	.988	Integrating	3.5 / 2.0	3.0 / 0.0	Yes
4	921	Agricultural, Forestry and Fishery Labourers	.008	[−.005, .016]	.875	Reinforcing	6.0 / 5.6	42.5 / 32.8	Yes
5	753	Garment and Related Trades Workers	−.006	[−.014, .001]	.966	Integrating	1.6 / 1.0	81.0 / 74.3	Yes
6	521	Street and Market Salespersons	.005	[−.001, .010]	.938	Reinforcing	0.8 / 1.4	37.5 / 22.2	Yes
7	751	Food Processing and Related Trades Workers	.005	[−.005, .012]	.764	Reinforcing	1.9 / 2.6	41.7 / 52.0	Yes
8	931	Mining and Construction Labourers	.005	[−.007, .016]	.790	Reinforcing	4.8 / 5.3	0.7 / 1.6	Yes
9	932	Manufacturing Labourers	−.005	[−.014, .005]	.800	Integrating	2.9 / 2.2	54.2 / 33.9	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
10	833	Heavy Truck and Bus Drivers	.004	[−.004, .012]	.851	Reinforcing	2.5 / 3.0	0.0 / 0.7	Yes
11	941	Food Preparation Assistants	.004	[−.002, .010]	.897	Reinforcing	0.8 / 1.0	71.1 / 85.8	Yes
12	961	Refuse Workers	.003	[−.006, .014]	.755	Reinforcing	3.6 / 2.7	26.4 / 16.6	Yes
13	523	Cashiers and Ticket Clerks	.003	[.001, .007]	.999	Reinforcing	0.0 / 0.3	100.0 / 100.0	Yes
14	815	Textile, Fur and Leather Products Machine Operators	−.003	[−.014, .006]	.683	Integrating	1.5 / 1.5	91.7 / 84.6	Yes
15	821	Assemblers	.003	[−.008, .013]	.698	Reinforcing	1.8 / 2.9	71.5 / 65.6	Yes
16	531	Child Care Workers and Teachers' Aides	−.003	[−.009, .004]	.778	Integrating	0.6 / 0.4	100.0 / 98.2	Yes
17	722	Blacksmiths, Toolmakers and Related Trades Workers	.003	[−.004, .007]	.727	Reinforcing	1.5 / 1.0	30.8 / 14.4	Yes
18	933	Transport and Storage Labourers	−.002	[−.009, .004]	.785	Integrating	1.5 / 1.0	5.4 / 0.6	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
19	721	Sheet and Structural Metal Workers, Moulders and Welders, and Related Workers	.002	[−.003, .007]	.802	Reinforcing	1.0 / 1.0	10.4 / 1.4	Yes
20	516	Other Personal Services Workers	−.002	[−.004, .000]	.951	Integrating	0.2 / 0.1	0.0 / 38.8	Yes
21	752	Wood Treaters, Cabinet-makers and Related Trades Workers	−.002	[−.007, .004]	.717	Integrating	1.2 / 1.0	16.6 / 21.5	Yes
22	514	Hairdressers, Beauticians and Related Workers	−.002	[−.004, .001]	.849	Integrating	0.4 / 0.3	66.1 / 41.3	Yes
23	513	Waiters and Bartenders	−.002	[−.008, .004]	.697	Integrating	0.9 / 1.1	77.3 / 65.1	Yes
24	811	Mining and Mineral Processing Plant Operators	.002	[−.001, .004]	.894	Reinforcing	0.3 / 0.5	6.2 / 5.5	Yes
25	814	Rubber, Plastic and Paper Products Machine Operators	.002	[−.004, .007]	.707	Reinforcing	0.8 / 1.1	23.0 / 21.1	Yes
26	143	Other Services Managers	.002	[−.000, .004]	.932	Reinforcing	0.0 / 0.3	18.0 / 10.9	Yes
27	613	Mixed Crop and Animal Producers	−.001	[−.019, .016]	.562	Integrating	15.6 / 12.5	46.3 / 48.6	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
28	912	Vehicle, Window, Laundry and Other Hand Cleaning Workers	.001	[−.002, .006]	.724	Reinforcing	0.5 / 0.9	34.9 / 30.3	Yes
29	741	Electrical Equipment Installers and Repairers	.001	[−.001, .004]	.880	Reinforcing	0.2 / 0.3	0.0 / 0.0	Yes
30	612	Animal Producers	−.001	[−.015, .012]	.580	Integrating	7.8 / 6.2	47.1 / 49.3	Yes
31	411	General Office Clerks	.001	[−.001, .004]	.868	Reinforcing	0.1 / 0.3	59.5 / 75.3	Yes
32	817	Wood Processing and Papermaking Plant Operators	−.001	[−.004, .003]	.591	Integrating	0.4 / 0.6	11.5 / 33.9	Yes
33	713	Painters, Building Structure Cleaners and Related Trades Workers	−.001	[−.009, .006]	.635	Integrating	2.1 / 1.9	0.0 / 0.5	Yes
34	712	Building Finishers and Related Trades Workers	−.001	[−.009, .006]	.606	Integrating	1.6 / 1.5	0.0 / 0.0	Yes
35	342	Sports and Fitness Workers	.001	[−.001, .004]	.793	Reinforcing	0.1 / 0.3	0.0 / 16.3	Yes
36	818	Other Stationary Plant and Machine Operators	.001	[−.003, .005]	.642	Reinforcing	0.6 / 1.1	50.0 / 52.2	Yes
37	951	Street and Related Services Workers	.001	[−.000, .003]	.907	Reinforcing	0.0 / 0.1	0.0 / 0.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
38	413	Keyboard Operators	−.001	[−.003, .000]	.900	Integrating	0.2 / 0.0	73.4 / 100.0	Yes
39	334	Administrative and Specialized Secretaries	.001	[.000, .003]	.636	Reinforcing	0.0 / 0.1	— / 100.0	No
40	512	Cooks	.001	[−.006, .007]	.627	Reinforcing	0.8 / 0.9	93.3 / 89.3	Yes
41	431	Numerical Clerks	−.001	[−.002, .000]	.862	Integrating	0.1 / 0.0	100.0 / —	No
42	816	Food and Related Products Machine Operators	−.001	[−.004, .006]	.467	Integrating	0.6 / 1.1	53.9 / 37.9	Yes
43	732	Printing Trades Workers	−.001	[−.003, .001]	.770	Integrating	0.1 / 0.1	89.1 / 66.1	Yes
44	524	Other Sales Workers	−.001	[−.004, .003]	.550	Integrating	0.6 / 0.7	32.1 / 43.6	Yes
45	441	Other Clerical Support Workers	−.001	[−.003, .001]	.789	Integrating	0.2 / 0.1	68.8 / 0.0	Yes
46	313	Process Control Technicians	−.001	[−.002, .000]	.867	Integrating	0.1 / 0.0	100.0 / —	No
47	832	Car, Van and Motorcycle Drivers	.001	[−.004, .006]	.606	Reinforcing	0.9 / 1.0	0.0 / 0.0	Yes
48	432	Material Recording and Transport Clerks	−.001	[−.005, .005]	.565	Integrating	0.7 / 1.1	17.0 / 29.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
49	332	Sales and Purchasing Agents and Brokers	.001	[−.000, .002]	.855	Reinforcing	0.0 / 0.1	100.0 / 100.0	Yes
50	511	Travel Attendants, Conductors and Guides	−.001	[−.002, .000]	.630	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
51	731	Handicraft Workers	−.001	[−.002, .001]	.583	Integrating	0.2 / 0.2	58.6 / 45.5	Yes
52	831	Locomotive Engine Drivers and Related Workers	−.001	[−.003, .001]	.751	Integrating	0.2 / 0.1	3.7 / 0.0	Yes
53	834	Mobile Plant Operators	.001	[−.008, .009]	.545	Reinforcing	2.2 / 1.9	6.7 / 0.0	Yes
54	742	Electronics and Telecommunications Installers and Repairers	.001	[−.001, .002]	.737	Reinforcing	0.1 / 0.1	18.3 / 0.0	Yes
55	611	Market Gardeners and Crop Growers	−.001	[−.015, .012]	.545	Integrating	9.5 / 8.7	45.0 / 46.6	Yes
56	351	Information and Communications Technology Operations and User Support Technicians	−.001	[−.002, .000]	.628	Integrating	0.0 / 0.0	100.0 / —	No
57	322	Nursing and Midwifery Associate Professionals	.001	[.000, .001]	.953	Reinforcing	0.0 / 0.0	— / 100.0	No
58	422	Client Information Workers	−.000	[−.002, .001]	.712	Integrating	0.1 / 0.0	82.1 / 80.9	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
59	314	Life Science Technicians and Related Associate Professionals	.000	[.000, .001]	.872	Reinforcing	0.0 / 0.1	— / 0.0	No
60	265	Creative and Performing Artists	.000	[−.003, .004]	.591	Reinforcing	0.4 / 0.4	9.4 / 8.1	Yes
61	421	Tellers, Money Collectors and Related Clerks	−.000	[−.001, .000]	.801	Integrating	0.0 / 0.0	0.0 / 42.8	Yes
62	251	Software and Applications Developers and Analysts	.000	[.000, .001]	.619	Reinforcing	0.0 / 0.0	— / 100.0	No
63	754	Other Craft and Related Workers	−.000	[−.002, .001]	.633	Integrating	0.2 / 0.2	54.7 / 49.1	Yes
64	723	Machinery Mechanics and Repairers	.000	[−.003, .004]	.581	Reinforcing	0.6 / 0.6	1.6 / 0.0	Yes
65	131	Production Managers in Agriculture, Forestry and Fisheries	−.000	[−.001, .000]	.640	Integrating	0.0 / 0.0	100.0 / —	No
66	532	Personal Care Workers in Health Services	−.000	[−.004, .004]	.568	Integrating	0.5 / 0.5	97.6 / 97.1	Yes
67	962	Other Elementary Workers	−.000	[−.004, .004]	.553	Integrating	0.6 / 0.9	4.9 / 18.7	Yes
68	812	Metal Processing and Finishing Plant Operators	.000	[−.002, .003]	.589	Reinforcing	0.2 / 0.4	50.2 / 34.2	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
69	112	Managing Directors and Chief Executives	−.000	[−.001, .000]	.859	Integrating	0.0 / 0.0	0.0 / —	No
70	312	Mining, Manufacturing and Construction Supervisors	.000	[−.000, .001]	.852	Reinforcing	0.0 / 0.1	0.0 / 25.3	Yes
71	216	Architects, Planners, Surveyors and Designers	.000	[.000, .001]	.857	Reinforcing	0.0 / 0.0	— / 0.0	No
72	212	Mathematicians, Actuaries and Statisticians	−.000	[−.001, .000]	.637	Integrating	0.0 / 0.0	0.0 / —	No
73	142	Retail and Wholesale Trade Managers	.000	[−.001, .001]	.619	Reinforcing	0.0 / 0.1	0.0 / 100.0	Yes
74	325	Other Health Associate Professionals	−.000	[−.002, .001]	.589	Integrating	0.1 / 0.0	100.0 / 100.0	Yes
75	311	Physical and Engineering Science Technicians	.000	[−.000, .001]	.729	Reinforcing	0.0 / 0.1	21.7 / 25.3	Yes
76	952	Street Vendors (excluding Food)	.000	[.000, .000]	.650	Reinforcing	0.0 / 0.0	— / 0.0	No
77	132	Manufacturing, Mining, Construction and Distribution Managers	−.000	[−.002, .002]	.511	Integrating	0.1 / 0.3	0.7 / 25.9	Yes
78	321	Medical and Pharmaceutical Technicians	−.000	[−.000, .000]	.623	Integrating	0.0 / 0.0	100.0 / —	No

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
79	835	Ships' Deck Crews and Related Workers	−.000	[−.000, .000]	.631	Integrating	0.0 / 0.0	0.0 / —	No
80	031	Armed Forces Occupations, Other Ranks	.000	[−.001, .001]	.608	Reinforcing	0.0 / 0.1	0.0 / 0.0	Yes
81	622	Fishery Workers, Hunters and Trappers	.000	[−.002, .001]	.284	Reinforcing	0.1 / 0.0	46.8 / 0.0	Yes
82	813	Chemical and Photographic Products Plant and Machine Operators	−.000	[−.003, .001]	.633	Integrating	0.1 / 0.0	61.1 / 100.0	Yes
83	141	Hotel and Restaurant Managers	−.000	[−.001, .000]	.810	Integrating	0.1 / 0.0	45.6 / 46.1	Yes
84	515	Building and Housekeeping Supervisors	−.000	[−.003, .003]	.502	Integrating	0.3 / 0.4	8.0 / 16.9	Yes
85	121	Business Services and Administration Managers	.000	[.000, .000]	.635	Reinforcing	0.0 / 0.0	— / 0.0	No
86	343	Artistic, Cultural and Culinary Associate Professionals	.000	[.000, .002]	.982	Reinforcing	0.0 / 0.2	— / 41.0	No
87	235	Other Teaching Professionals	.000	[−.001, .001]	.514	Reinforcing	0.0 / 0.0	0.0 / 0.0	Yes
88	335	Government Regulatory Associate Professionals	−.000	[−.000, .000]	.521	Integrating	0.0 / 0.0	0.0 / 0.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
89	315	Ship and Aircraft Controllers and Technicians	.000	[.000, .000]	.637	Reinforcing	0.0 / 0.0	— / 0.0	No
90	541	Protective Services Workers	−.000	[−.005, .005]	.506	Integrating	0.9 / 0.9	0.0 / 1.8	Yes
91	621	Forestry and Related Workers	.000	[−.003, .003]	.511	Reinforcing	0.4 / 0.5	2.5 / 5.6	Yes

Panel C. Descriptive ISCO one-digit contribution analysis, 2010-2024

ISCO major group	Occupation	2010 contribution	2024 contribution	Change	Women's distribution share 2010 (%)	Women's distribution share 2024 (%)	Men's distribution share 2010 (%)	Men's distribution share 2024 (%)
0	Armed Forces Occupations	.004	.004	.000	0.0	0.1	0.8	1.0
1	Managers	.010	.011	.000	4.3	2.9	6.3	5.1
2	Professionals	.040	.045	.005	16.5	23.1	8.6	14.1
3	Technicians and Associate Professionals	.044	.027	−.017	20.4	15.8	11.6	10.3
4	Clerical Support Workers	.018	.022	.004	8.7	11.4	5.0	7.0
5	Service and Sales Workers	.037	.037	.000	18.8	19.4	11.4	11.9
6	Skilled Agricultural, Forestry and Fishery Workers	.011	.007	−.004	14.5	7.4	16.7	8.9
7	Craft and Related Trades Workers	.076	.068	−.009	4.6	4.3	19.9	17.9
8	Plant and Machine Operators and Assemblers	.054	.048	−.006	1.9	6.6	12.7	16.3
9	Elementary Occupations	.017	.007	−.010	10.3	8.9	7.0	7.5

Note. Panels A and B decompose the low-education endpoint change additively across ISCO three-digit occupations. Occupation-specific intervals are exploratory percentile intervals and are not adjusted for multiple comparisons; P(point direction) is the bootstrap probability of the point-estimate direction. Panel C is descriptive and crosses survey and classification periods; it is not an inferential endpoint comparison.

Table S8. Harmonisation and Quality-Control Summary

Panel A. Harmonisation rules and survey/classification breaks

Years	Occupational classification and use	Employment variable	Age variable	Weight	Education harmonisation	Bootstrap unit
2010-2012	ISCO-88; detailed results retained	PSTATUS1	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-6 secondary; 7-10 tertiary	Record
2013	ISCO-08 transition year; broad results only	PSTATUS1	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-6 secondary; 7-10 tertiary	Record
2014-2018	ISCO-08; first post-break detailed window; 2014 weights revised under the 2015 estimation system	PSTATUS1	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-9 secondary; 10-13 tertiary	Household within year
2019-2020	ISCO-08; first post-break survey window	PSTATUS	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-9 secondary; 10-13 tertiary	Household within year
2021-2024	ISCO-08; redesigned survey window	EMPSTAT	AGE	COEFFY	HATLEVEL 1-4 low; 5-9 secondary; 10-13 tertiary	Household within year

Panel B. Selection and analytical-sample validity by survey period

Survey period	Raw records	Employed aged 15-64	Missing/999/invalid ISCO excluded	Analytical records	Invalid analytical fields	Duplicate year-source rows	Expected years present
2010-2013	179,927	55,690	145	55,545	0	0	Yes
2014-2020	838,969	290,387	208	290,179	0	0	Yes
2021-2024	455,011	164,452	0	164,452	0	0	Yes

Panel C. Key numerical and reproducibility checks

Quality-control check	Result	Status
Broad/detailed Duncan cell contributions reconcile to total indices	Maximum absolute difference = 0.00e+00	Pass
Shapley contributions satisfy the efficiency identity	Maximum absolute residual = 1.73e-17	Pass
Education-specific point estimates reconcile with overall calculation inputs	Maximum absolute difference = 0.00e+00	Pass
Low-education sensitivity point estimates reconcile with primary education-specific results	1.6653e-16	Pass
Valid low-education endpoint bootstrap replicates	5000	Pass
Occupation-level contribution changes sum to the low-education endpoint change	4.4409e-16	Pass
Annual occupation-level contributions sum to the annual low-education Duncan index	1.249e-16	Pass
Occupation-level bootstrap changes reconcile with the low-education endpoint changes	0e+00	Pass
Occupation-level endpoint contributions sum to the reported endpoint change	1.249e-16	Pass

Quality-control check	Result	Status
Official ISCO-08 minor-group title count	130	Pass
Verified key ISCO-08 titles	6/6	Pass
ISCO-08 titles missing for used codes	0	Pass

Note. The table reports publication-readable harmonisation and QC summaries. Complete mapping tables, intermediate objects, bootstrap replicate files, and execution logs remain part of the reproducibility package rather than the Supplementary Material. Bootstrap resampling is adapted to the available clustering identifiers and does not reproduce the full complex survey design because PSU and stratum identifiers are unavailable.