Gender, education expansion and intergenerational educational mobility around the world

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Abstract: The extent to which people's social status is associated with their parents' status has far-reaching implications for the openness of and stratification in society. Whereas most research focused on the father-child association in advanced economies, less is known about the role mothers play in intergenerational mobility, particularly in a global context. We assembled a dataset of 1.79 million individuals born in 1956–1990 across 106 societies to examine the global patterns of intergenerational educational mobility and how they vary with education expansion and changes in parents' educational pairing. With education expansion, father-child associations in educational status become weaker and mother-child associations become stronger. With the prevalence of hypogamous parents (mother more educated), mother-child associations are stronger but father-child associations are weaker. With the prevalence of hypergamous parents (father more educated), mother-daughter associations are weaker. Our global evidence calls for a gender-sensitive understanding of how education expansion matters for intergenerational mobility.

Intergenerational or social mobility refers to the extent to which individuals can achieve their social status independent of their parents' status. As higher social mobility represents greater equality of opportunity[1,2], understanding and facilitating social mobility is of great interest to the scientific community, policymakers, and the public. Education is widely considered a fundamental source of social stratification[3–5]. It is a strong predictor of individuals' economic outcomes such as earnings and occupations, as well as non-pecuniary outcomes such as health, fertility, mortality, and social behaviours[4,6–11]. Therefore, intergenerational persistence of educational status not only reflects inequality of educational opportunity but also hinders progress toward equality in a wide range of domains[11–13].

In recognizing the importance of educational mobility, international organizations such as the United Nations (UN) and World Bank, as well as national and local governments, have invested heavily in education expansion[14,15]. Over the past decades, the expansion of primary and secondary education has been a key engine fuelling the modernization of low- and middle-income countries; and the expansion of tertiary education has been a prominent trend in advanced economies[16,17]. The global expansion of education is legitimized and buttressed by several institutional and cultural changes, including trends toward scientization, the rise of development planning, democratization, and increasing commitment to human rights[17,18]. With these changes, education expansion is widely expected to equalize educational opportunity and promote intergenerational mobility[11,15,19,20].

Competing perspectives, however, exist in terms of whether education expansion can fulfil this expectation. Classic modernization theories predicted a linear decline in intergenerational educational persistence with the expansion of education[21]. Problematizing this linear assumption, the Kuznets curve predicted an inverted U-shaped trajectory: intergenerational educational persistence would first increase but eventually decrease with education expansion[22,23]. By contrast, the notion of effectively maintained inequality posited that education expansion may do little to reduce intergenerational persistence of educational status, as better-educated parents would seek and manage to secure continuing educational advantage for their children[24]. To date, there has yet to be comprehensive evidence that helps clarify the relationship between education expansion and intergenerational educational mobility on a global scale—a gap we aim to fill in this study.

Since the 1960s, world expansion of education has evolved alongside a remarkable "gender revolution" in education[25–27]. The educational gender gap once favouring men is closing in many low- and middle-income countries[25] and has reversed to women's advantage in many advanced economies[27]. Nevertheless, research on intergenerational mobility has not kept pace with these trends. Most research has either focused on patrilineal father-child associations[12,13,28–31] or adopted a gender-blind approach to measuring the origin of mobility using parents' highest or average education[15,32,33]. Although the rise of women in education has rendered it untenable to neglect gender dynamics in educational mobility, only a handful of recent studies have examined mothers' contribution to social mobility, but only in a single country or a limited range of countries[5,19,34–38].

With education expansion, the mother's education may play an increasingly crucial role in intergenerational mobility, over and above the father's education. Although education expansion increases educational opportunities, it may also fuel demand for new distinctions and competition for more exclusive educational status[20,24,39]. Whether children can get ahead in education may increasingly depend on navigating heterogeneous school systems and concerted cultivation, including homework supervision, arranging extracurricular activities, and investing in supplementary private education[24,35,40,41]. As mothers continue to assume the primary responsibility for childrearing[26,42], they undertake most of these day-to-day efforts that are essential to securing children's advantageous educational status. With education expansion, better-educated mothers have become more likely than their less-educated counterparts to practise intensive mothering[41,43,44]. In so doing, educated mothers bolster their children's educational status by passing on not only their cognitive ability and pecuniary resources but also aspirations, values, and educational know-how[11,45]. Against this backdrop, our key objective is to provide gender-sensitive evidence on the relationship between education expansion and the importance of mothers' (vs. fathers') educational status in intergenerational mobility.

Education expansion has also paved the way for macro-compositional changes in parents' educational pairing patterns[46]. In the past decades, traditional hypergamous heterosexual unions in which women are paired with a better-educated man have declined in many countries, whereas homogamy and hypogamy in which women are paired with a similarly- or less-educated man have increased[27,46,47,48]. Nevertheless, the extent to which education expansion translates into changing educational pairing patterns also hinges on gendered educational opportunity, normative recognition of women's education, and broader gender empowerment in a given context[49,50]. Such contextual constellations embodied in the macro patterns of parents' educational pairing not only shape the influence of the mother vs. the father over their children, but also affect the children's tendency to view and follow the mother vs. the father as potential role models[38]. Thus, consideration of parents' changing educational pairing patterns constitutes an essential part of our gender-sensitive approach to examining intergenerational mobility.

Building on the above discussion, this study provides gender-sensitive global evidence on the associations between education expansion, changing macro patterns of parents' educational pairing, and educational mobility. To do so, we assembled a large-scale dataset by harmonizing 545 multinational and national surveys. This dataset contains 1,785,683 men and women born between 1956 and 1990, covering 106 societies that hosted 89% of the world's population as of 2022[51]. In what follows, we first describe patterns of education expansion and parents' educational pairing across birth cohorts, societies, and world regions. We then illustrate the importance of considering the mother's education in intergenerational mobility. Finally, we examine how the importance of mothers' vs. fathers' educational status in intergenerational mobility varies with education expansion and parents' educational pairing patterns. We conclude by discussing how attention to gender, particularly to the mother's education, and our global evidence advance understanding of intergenerational educational mobility.

Results

Global patterns of education expansion

Figure 1 shows that the trajectory and pace of education expansion across cohorts varied considerably by society (grey lines) and world region (colour lines). In this and the next section, all cohort change statistics (Δ) reported in the text are calculated based on the percentage-point difference between the first and last cohorts, all tests are two-tailed, and all reported change statistics are statistically significant below the 0.001 level unless otherwise specified.

In Africa, Asia and the Pacific, Latin America, and the Middle East, the proportion of individuals with either no schooling or only primary education (International Standard Classification of Education [ISCED] 0–1) decreased substantially across the 1956–1990 birth cohorts. Such decrease was steeper for women than for men in Asia and the Pacific (men: Δ–18.1, 95% confidence interval (CI), (–24.3, –12.0); women: Δ–31.2 (–40.6, –21.9); here and below, we use 'P_g' to denote the P statistic for gender difference between men and women: $P_g = 0.022$). It was sizable but similar between men and women in Africa (Δ–21.0 (–28.6, –13.4); Δ–22.4 (–29.3, –15.4); $P_g = 0.786$), Latin America (Δ–38.2 (–43.8, –32.6); Δ–41.2 (–45.1, –37.3); $P_g = 0.394$), and the Middle East (Δ–30.0 (–39.3, –20.6); Δ–37.5 (–47.8, –27.2); $P_g = 0.289$). By contrast, the prevalence of having no schooling or only primary education remained consistently low in Europe and North America, where the proliferation of primary education predated our focal cohorts[52]. As for lower secondary (ISCED 2) and post-secondary (ISCED 4) education, their proportions fluctuated across cohorts without a clear pattern of increase or decrease across the regions.

[Insert Fig. 1 Here]

Compositional changes in upper secondary education (ISCED 3) followed divergent trajectories in different regions. The proportion of people with upper secondary education increased across cohorts, for men and women alike, in Africa (Δ11.1 (8.3, 13.8); Δ9.5 (6.6, 12.5); $P_g = 0.465$), Latin America (Δ21.6 (18.1, 25.1); Δ24.2 (19.8, 28.6); $P_g = 0.335$), and the Middle East (Δ11.9 (3.3, 20.6), $P = 0.007$; Δ13.5 (5.7, 21.4); $P_g = 0.787$). But it decreased sharply in North America (Δ–12.9 (–17.4, –8.5); Δ–19.1 (–23.8, –14.3); $P_g = 0.063$) and less sharply in Europe (Δ–5.8 (–10.2, –1.3), $P = 0.011$; Δ–5.5 (–10.1, –0.1), $P = 0.020$; $P_g = 0.928$), while staying relatively stable in Asia and the Pacific.

Lower tertiary education (ISCED 5–6) expanded considerably across cohorts in Asia and the Pacific (Δ17.5 (11.2, 23.7); Δ21.5 (14.7, 28.3); $P_g = 0.395$), Europe (Δ8.9 (4.6, 13.2); Δ6.6 (1.6, 11.7); $P_g = 0.511$), Latin America (Δ13.6 (11.2, 16.0); Δ13.4 (10.3, 16.4); $P_g = 0.907$), the Middle East (Δ13.9 (8.7, 19.2); Δ20.2 (16.2, 24.1); $P_g = 0.063$), and North America (Δ15.9 (14.7, 17.0); Δ11.6 (9.9, 13.3); $P_g < 0.001$), but to a far lesser extent in Africa (Δ3.3 (1.7, 4.9); Δ2.3 (1.5, 3.1); $P_g = 0.263$). In Europe, the proportion of individuals with postgraduate education (ISCED 7–8) nearly doubled from 10.9% (9.3, 12.5) to 20.3% (17.6, 23.1) among men, and it increased even further from 10.3% (9.1, 11.4) to 24.4% (21.5, 27.4) among women ($P_g = 0.037$). The cohort expansion of postgraduate education in North America is also greater among women (Δ6.8 (6.1, 7.4)) than men (Δ1.9 (1.0, 2.8)) ($P_g < 0.001$). In the other regions, the proportion of people with postgraduate education remained consistently low across cohorts.

The above results show that the progress of education expansion from lower to higher levels in Africa lagged behind Europe and North America, with Asia and the Pacific, Latin America, and the Middle East caught in between.

Changing patterns of parents' educational pairing

Figure 2 presents cohort changes in parents' educational pairing patterns across societies (grey lines) and world regions (colour lines). At first glance, the results seem to run counter to Esteve et al.'s observation of a recent global decline in educational hypergamy but an increase in homogamy and hypogamy[46]. However, as Fig. 2 delineates trends in educational pairing among the parents of individuals born between 1956 and 1990, the patterns reflect couples' educational pairing at a time when women did not yet have an educational advantage over men in most societies.

[Insert Fig. 2 Here]

As Fig. 2 shows, there was a slight cohort decrease in parents' educational homogamy among European men and women (Δ–5.8 (–8.7, –2.9); Δ–4.4 (–7.8, –0.1), $P = 0.013$; $P_g = 0.537$) and among North American men (Δ–2.8 (–4.2, –1.4)) but not women (Δ–0.5 (–1.4, 0.4), $P = 0.304$; $P_g = 0.006$). In comparison, the decrease was far more pronounced in Africa (Δ–14.6 (–17.1, –12.0); Δ–12.9 (–15.2, –10.6); $P_g = 0.345$), Asia and the Pacific (Δ–16.4 (–20.4, –12.3); Δ–16.4 (–20.2, –12.6); $P_g = 0.997$), Latin America (Δ–20.1 (–21.9, –18.3); Δ–15.3 (–17.3, –13.3); $P_g < 0.001$), and the Middle East (Δ–17.2 (–20.9, –13.4); Δ–14.4 (–18.5, –10.3); $P_g = 0.326$). As Fig. 2 depicts an early stage of education expansion experienced by the parents of the 1956–1990 birth cohorts, particularly in the latter four regions, cohort decreases in educationally homogamous parents were primarily driven by a decline in both parents having no schooling or only primary education.

The proportion of hypergamous parents increased across cohorts of men and women in Africa (Δ10.5 (8.9, 12.1); Δ9.5 (7.9, 11.0); $P_g = 0.355$), Asia and the Pacific (Δ9.3 (6.5, 12.1); Δ9.7 (7.1, 12.2); $P_g = 0.847$), Latin America (Δ10.8 (8.9, 12.8); Δ7.4 (5.5, 9.2); $P_g = 0.011$), and the Middle East (Δ10.5 (7.3, 13.8); Δ7.8 (3.8, 11.8); $P_g = 0.296$). This is likely because educational opportunities were prioritized for men during an early stage of education expansion[33]. By contrast, the proportion of hypergamous parents fluctuated across cohorts of men and women in North America, but it decreased slightly in Europe (Δ–3.5 (–6.1, –1.0), $P = 0.011$; Δ–4.2 (–7.0, –1.4), $P = 0.004$; $P_g = 0.705$).

A cohort increase in hypogamous parents is mainly found in Asia and the Pacific (Δ7.1 (5.0, 9.1); Δ6.7 (4.8, 8.6); $P_g = 0.787$), Europe (Δ9.2 (6.6, 11.8); Δ8.6 (5.9, 11.3); $P_g = 0.730$), Latin America (Δ9.3 (7.9, 10.6); Δ7.9 (6.5, 9.3); $P_g = 0.178$), and the Middle East (Δ6.6 (4.7, 8.5); Δ6.6 (4.5, 8.7); $P_g = 0.988$), for men and women alike. The proportion of hypogamous parents increased to a lesser extent in Africa (Δ4.1 (2.6, 5.5); Δ3.5 (2.1, 4.8); $P_g = 0.533$) and North America (Δ0.7 (–0.4, 1.8), $P = 0.202$; Δ3.5 (2.7, 4.3); $P_g < 0.001$).

Intergenerational mobility: mothers' vs. fathers' education

In Fig. 3, we compare the importance of mothers' vs. fathers' educational status in intergenerational mobility across societies and regions. To do so, we use the coefficients for fathers' and mothers' educational positions from models predicting individuals' educational positions[11,13,15,28,32]. The models included both parents' educational positions. Notably, unlike the absolute education measures used in Figs. 1 and 2, we use rank-based measures of relative educational positions here and in the next section. Thus, the coefficients capture the extent to which one's relative educational position among birth cohort peers from the same society varies with every one percentile point increase in the mother's and father's relative educational positions among the mothers and fathers of one's peers[1]. Compared with absolute education measures, the relative educational position measures (i.e., ranked within society and cohort) are more comparable across birth cohorts and societies, as they are unaffected by drastic cohort changes and societal differences in educational distribution[30,37]. The rank-based measures reflect individuals' and their parents' relative standing among peers and are increasingly popular in social mobility research because they speak directly to its core interest in social status constructed through relative comparison[1,30,37].

[Insert Fig. 3 Here]

In Fig. 3, grey dots above the diagonal line represent societies where, according to the point estimates, individuals' educational positions are more closely associated with mothers' than with fathers' educational positions. We conducted additional *F* tests to ascertain whether the estimated coefficients for mothers' and fathers' educational positions are statistically different at the 0.05 level or below. Among men, the coefficient for mothers' educational positions is not statistically different from, and thus comparable in size with, that for fathers' positions in 57 out of the 106 societies, while the coefficient for fathers' positions is larger than that for mothers' positions in the remaining 49 societies ($P < 0.05$; see Supplementary Table 7 for a detailed list of societies and specific *P* values). Among women, the coefficient for mothers' educational positions is larger than, comparable with, and smaller than that for fathers' positions in 21, 65, and 20 societies, respectively. Thus, compared with fathers' educational positions, mothers' positions play an equally or even more important role in intergenerational mobility in a broader range of societies for women than men.

[Insert Fig. 4 Here]

Figure 4 delineates cohort trends in the coefficients for parents' educational positions. Among men (Panels A1–A6), fathers' coefficients decreased in Africa (Δ–0.063 (–0.098, –0.028), $P < 0.001$) and Asia and the Pacific (Δ–0.065 (–0.094, –0.037), $P < 0.001$). The cohort increase in mothers' coefficients in Asia and the Pacific (Δ0.045 (0.008, 0.081), $P = 0.015$) further reduces the differential importance of mothers' and fathers' educational positions in intergenerational mobility. In Europe, with a cohort increase in mothers' coefficients (Δ0.121 (0.097, 0.146), $P < 0.001$) and a decrease in fathers' coefficients (Δ–0.070 (–0.094, –0.046), $P < 0.001$), the importance of mothers' educational positions overtook that of fathers' positions in predicting the educational positions of men born between 1981and 1990. In the Middle East, the mother-father coefficient gap substantially narrowed across cohorts, as mothers' coefficients remained stable but fathers' coefficients nearly halved in size from 0.570 (0.525, 0.615) to 0.291 (0.264, 0.318) ($P < 0.001$). By contrast, both parents' coefficients remained relatively stable in Latin America. While fathers' coefficients fluctuated across cohorts of North American men, mothers' coefficients remained relatively stable across the 1956–1985 cohorts and then decreased in the 1986–1990 cohort.

Among women (Panels B1–B6 of Fig. 4), mothers' coefficients increased sharply across the 1956–1975 cohorts in Africa (Δ0.191 (0.153, 0.229), $P < 0.001$) and then stabilized among those born in 1976–1990. This trend was mirrored in the reverse direction by a downward trajectory across the 1956–1975 cohorts (Δ–0.127 (–0.156, –0.097), $P < 0.001$) and then stabilization of fathers' coefficients. Mothers' coefficients increased steadily in Asia and the Pacific (Δ0.039 (0.007, 0.071), $P = 0.018$) and Europe (Δ0.086 (0.063, 0.109), $P < 0.001$), but they remained more or less stable in Latin America and North America. Father's coefficients fluctuated in North America but decreased steadily across cohorts of women in Asia and the Pacific (Δ–0.074 (–0.101, –0.048), $P < 0.001$), Europe (Δ–0.034 (–0.056, –0.011), $P = 0.004$), and Latin America (Δ–0.114 (–0.131, –0.096), $P < 0.001$). Across cohorts of Middle Eastern women, fathers' coefficients decreased considerably (Δ–0.049 (–0.095, –0.003), $P = 0.039$), and mothers' coefficients decreased even further (Δ–0.238 (–0.303, –0.174), $P < 0.001$). Comparing mothers' and fathers' coefficients, the importance of mothers' educational positions has caught up with that of fathers' positions in women's intergenerational mobility in Africa and Asia and the Pacific, and surpassed that of fathers' positions in Europe and Latin America. In the Middle East, however, as the decrease is sharper for mothers' than fathers' coefficients, the gap between mothers' and fathers' educational positions in predicting women's educational positions has widened.

The above results call into question intergenerational mobility research that typically captured individuals' educational origin using only fathers' educational positions[13,28,29]. Figs. 3 and 4 clearly show that without considering mothers' educational positions, research would have underestimated parent-child associations in educational status, thus overestimating intergenerational mobility. Given the cohort increase in the importance of mothers' educational positions in Africa, Asia and the Pacific, and Europe observed in Fig. 4, without considering mothers' educational positions, research in these regions would have increasingly overestimated intergenerational mobility across the 1956–1990 cohorts.

Education expansion and parents' educational pairing pattern

We fitted a series of two-step multilevel models to understand how the roles of mothers' and fathers' educational positions in intergenerational mobility varied with society-cohort level education expansion and parents' educational pairing patterns. Our step-1 individual-level models estimated the coefficients for mothers' and fathers' educational positions in predicting men's and women's positions within each society-cohort unit, using 7-birth-year rolling samples to enhance estimation reliability. Our step-2 society-cohort level two-way fixed effects models then estimated how education expansion and changes in parents' educational pairing patterns were associated with the coefficients for mothers' and fathers' positions. To help interpret the results, we graph the average marginal effects of education expansion and parents' educational pairing patterns from the step-2 models in Fig. 5[53]. In Fig. 6, we further graph the predicted coefficients for fathers' and mothers' educational positions over the distributions of education expansion and parents' educational pairing patterns.

[Insert Figs. 5 and 6 Here]

In Model 1 (orange bars, round points in Fig. 5), we included society-cohort education composition measures at the secondary (both lower and upper), post-secondary, and tertiary levels. In Model 2 (blue bars, triangle points in Fig. 5), we included the proportions of hypergamous and hypogamous parents for each society-cohort unit. In Model 3 (black bars, square points in Fig. 5), both sets of predictors were included. When we compare the results from Models 1 and 2 with those from Model 3, both the orange and blue bars largely overlap with the black bars, indicating that education expansion and parents' educational pairing patterns do not mediate each other in predicting intergenerational mobility. This is not entirely surprising as education expansion does not necessarily translate into a rise in homogamy or hypogamy; rather, whether it does depends on gender norms and empowerment in a given context and the extent to which the expanded opportunities are equally accessible to both genders[49]. Below, we focus on the results from Model 3.

The results indicate that the role of fathers' educational status in intergenerational mobility weakens with education expansion. In Panel A1 of Fig. 5, the father-son association in educational positions is weaker in society-cohorts where larger proportions of people have completed secondary (B = –0.631 (–0.743, –0.520), P < 0.001), post-secondary (B = –0.332 (–0.539, –0.125), P = 0.002), and tertiary (B = –0.592 (–0.739, –0.445), P < 0.001) education. The orange lines in Panels A1–A3 of Fig. 6 further show that as we move from society-cohorts with the lowest to the highest level of education expansion, the predicted coefficients for fathers' educational positions decrease with the expansion of secondary education (0.572

(0.525, 0.618) to 0.010 (–0.046, 0.065)), post-secondary education (0.347 (0.326, 0.369) to 0.194 (0.117, 0.273)), and tertiary education (0.471 (0.432, 0.511) to –0.079 (–0.178, 0.020)). Similarly, in Panel B1 of Fig. 5, the father-daughter association in educational positions decreases with education expansion at the secondary (*B* = –0.412 (–0.541, –0.283), *P* < 0.001) and tertiary levels (*B* = –0.356 (–0.517, –0.196), *P* < 0.001). In Panels B1 and B3 of Fig. 6, the predicted coefficients for fathers' educational positions decrease from 0.450 (0.397, 0.504) to 0.084 (0.019, 0.148) with the expansion of secondary education and from 0.377 (0.334, 0.421) to 0.046 (–0.062, 0.154) with the expansion of tertiary education.

Conversely, the mother-child association in educational positions increases with education expansion. In Panel A2 of Fig. 5, the mother-son association in educational positions is stronger in society-cohorts where larger proportions of people have completed secondary (*B* = 0.173 (0.023, 0.323), *P* = 0.024) and tertiary (*B* = 0.217 (0.024, 0.410), *P* = 0.028) education. The blue lines in Panels A1 and A3 of Fig. 6 show that as we move from society-cohorts with the lowest to the highest level of education expansion, the predicted coefficients for mothers' educational positions increase from 0.132 (0.069, 0.194) to 0.285 (0.211, 0.360) with the expansion of secondary education and from 0.145 (0.093, 0.197) to 0.346 (0.216, 0.477) with the expansion of tertiary education. In Panel B2 of Fig. 5, similar results are observed for the mother-daughter association, which becomes stronger with education expansion at the secondary (*B* = 0.363 (0.191, 0.535), *P* < 0.001) and tertiary (*B* = 0.352 (0.130, 0.574), *P* = 0.002) levels. In Panels B1 and B3 of Fig. 6, the predicted coefficients for mothers' educational positions increase from 0.114 (0.044, 0.185) to 0.437 (0.351, 0.523) with the expansion of secondary education and from 0.169 (0.109, 0.228) to 0.496 (0.346, 0.646) with the expansion of tertiary education.

The results also reveal that father-child and mother-child associations in educational positions vary in opposite ways with changes in parents' educational pairing patterns. As shown in Panels A1 and A2 of Fig. 5, the father-son association is weaker (*B* = –0.487 (–0.712, –0.261), *P* < 0.001) and the mother-son association is stronger (*B* = 0.513 (0.217, 0.810), *P* < 0.001) in society-cohorts with a larger proportion of hypogamous parents where the mother is more educated than the father. This is further illustrated in Panel A5 of Fig. 6: as we move from society-cohorts with the lowest to the highest proportion of hypogamous parents, the father-son association decreases from 0.364 (0.340, 0.389) to 0.174 (0.107, 0.242) and the mother-son association increases from 0.152 (0.121, 0.184) to 0.352 (0.263, 0.441).

Among women, Panel B2 of Fig. 5 shows that the mother-daughter association in educational positions decreases with the prevalence of hypergamous parents where the father is more educated than the mother (*B* = –0.448 (–0.701, –0.196), *P* < 0.001). In Panel B4 of Fig. 6, the predicted coefficient for mothers' educational positions in society-cohorts with the lowest proportion of hypergamous parents is 0.343 (0.293, 0.393), three times the size of the corresponding coefficient in society-cohorts with the highest proportion of hypergamous parents (0.115 (0.031, 0.198)). Overall, the prevalence of more traditional hypergamous unions among parents is associated with weaker mother-daughter persistence of educational status. Meanwhile, with the prevalence of less traditional hypogamous unions among parents, mothers' educational status plays a more important role, and fathers' status plays a less important role, in predicting men's educational status.

Discussion

Understanding and facilitating intergenerational educational mobility are crucial to promoting equal opportunities that enable individuals to achieve educational success irrespective of their social origin[11]. In this study, we assembled a dataset of 1.79 million individuals born between 1956 and 1990 from 106 societies and provided global evidence on the roles of mothers' vs. fathers' educational status in intergenerational educational mobility. Our study offers comprehensive and gender-sensitive insights into educational mobility on a global scale.

Going beyond mainstream patrilineal or gender-blind approaches in social mobility research, our findings emphasize the importance of considering the role of the mother in educational mobility. In most world regions, due to a cohort increase in mother-child associations in educational status and a cohort decrease in father-child associations, mothers' educational status has come to play a comparable or more important role than fathers' status in educational mobility (Fig. 4). In Asia and the Pacific, Europe, Africa, and to a lesser extent Latin America, neglecting the role of mothers' education would lead to an underestimation of intergenerational educational persistence and thus an overestimation of educational mobility. The overestimation would have become more severe across the successive cohorts examined, given a cohort increase in the importance of mothers' education. Consequently, overlooking the role of the mother would provide a distorted and overly optimistic picture of (progress toward) equality of educational opportunity.

Our global evidence provides insights into contending perspectives on the relationship between education expansion and intergenerational educational mobility—namely, modernization, the Kuznets curve, and effectively maintained inequality[21,22,24]. Concurring with existing research[12,19,29], our findings show that education expansion is associated with weaker father-child persistence of educational status (Figs. 5, 6), which seems to support modernization theories[21]. However, our attention to the role of the mother reveals that mother-child associations in educational status have become stronger with education expansion (Figs. 5, 6). On balance, there is little empirical support for modernization theories in that intergenerational educational persistence has not necessarily declined with education expansion.

The Kuznets curve[22,23], which predicted an initial increase but an eventual decrease in intergenerational educational persistence with education expansion, may help shed some light on the diverging changes in mother-child and father-child associations as education expands. Given long-standing patrilineal traditions across many societies and the relatively recent rise of women in education[26], the importance of the mother's education in educational mobility only started to catch up with that of the father's education in more recent cohorts (Fig. 4). This suggests that the trajectory of changing mother-child associations in educational status may lag behind that of changing father-child associations. Therefore, it is possible that the relationship between education expansion and mother-child associations represents the first half of the Kuznets curve, whereas the relationship between education expansion and father-child associations represents the second half. However, it is worth noting that we did not find a curvilinear relationship between education expansion and mother/father-child associations in our supplementary analysis. To more fully ascertain whether Kuznets' prediction holds, future research needs to examine whether mother-child educational persistence eventually declines as educational opportunities continue to expand.

Our findings lend some support to the notion of effectively maintained inequality[24]. Although education expansion is associated with a waning role of fathers' educational status in predicting their children's status, the increase in the predictive power of mothers' educational status has offset, if not outweighed, the reduction in that of fathers' status, particularly when women's educational mobility is concerned (Figs. 5, 6). As a result, intergenerational persistence of educational status is effectively maintained. While our study focuses on individuals' vertical educational status relative to their peers, future research could examine the extent to which educated parents also seek to maintain horizontal educational advantages by securing high-quality elite education for their children.

Our findings show that the uneven degree and pace of mothers' rise in education around the world have additional implications for understanding global trends of educational mobility. Alongside education expansion in recent decades, educational hypergamy has declined whereas hypogamy has grown in many societies[27,46,47]. Nevertheless, such macro-compositional changes in educational pairing patterns result from not just education expansion but also changes in institutional and cultural contexts such as opportunities and norms regarding women's education and broader gender empowerment[49,50]. Against this backdrop, we find that mother-child and father-child associations in educational status vary with parents' educational pairing patterns, over and above education expansion. Specifically, mother-daughter associations in educational status are weaker with the prevalence of hypergamous parents, whereas mother-child, particularly mother-son, associations are stronger with the prevalence of hypogamous parents. By contrast, father-son associations are weaker with the prevalence of hypogamous parents. Our findings highlight that in addition to examining mothers' education at an individual level, it is imperative for social mobility research to recognize and consider the gendered context in which education expansion takes place.

The limitations of our analysis suggest a few important directions for future research. First, we did not control for socioeconomic indicators such as gross domestic product (*per capita*) because they were strongly correlated with the education composition measures. This is not surprising as education expansion is closely intertwined with socioeconomic development[54]. Second, we listwise deleted missing cases, without imputing the missing values. For example, those who do not know their parents' education are unlikely to be influenced by the parents' education, and imputation would result in a misrepresentation of parental influence that may well not exist in reality. Future research could systematically explore the reasons for missing reports of basic demographic information such as parental education. Third, our findings capture correlational, not causal, relationships between education expansion, parents' educational pairing patterns, and intergenerational educational mobility. Fourth, our discussion of micro-social mechanisms is necessarily limited given our focus on changes in educational composition at a macro level. Future efforts are needed to thoroughly investigate the nuanced gender dynamics underpinning how mothers and fathers shape their children's educational status, which will help clarify the causal mechanisms behind the associations reported in this study. Fifth, we have not been able to distinguish between divorced, separated, widowed, unmarried cohabiting, and married parents. But a decline in married households and a higher prevalence of single motherhood than single fatherhood in many societies further reinforce our call for attention to the mother's role in intergenerational mobility[55]. Finally, we focused on intergenerational persistence in educational status, but not other socioeconomic indicators, for substantive and practical reasons. If suitable high-quality data become available, future research could draw on our gender-sensitive and global approach to examine social mobility in other dimensions (e.g., income, occupation) around the world.

In sum, this study provides a comprehensive global picture of how the roles of mothers' vs. fathers' educational status in intergenerational mobility vary with education expansion and parents' educational pairing patterns. Social mobility research has a predominant Western focus, and only until recently have scholars attempted to chart the global pattern of educational mobility[15,33]. Nevertheless, overlooking the role of the mother and following a gender-blind approach, existing research has not kept pace with the rise of women in education. When we assembled our global dataset, a large number of surveys were excluded as they only asked about fathers' or parents' (highest) education without distinguishing between the mother and the father. Our study thus demonstrates the value of adopting a gender-sensitive approach that requires curating and analyzing data on both parents' education on a global scale. Only in so doing can academics, governments, and international organizations accurately capture, audit, and monitor intergenerational mobility and better understand the implications of the world expansion of education.

Methods

Data and sample

We combined and analyzed two sets of data. The first dataset provides information on individuals' own and both their mothers' and fathers' education, along with the individuals' demographic information such as sex and year of birth (or age). In assembling this dataset, we pooled and harmonized 545 surveys across 106 societies. See Supplementary Information Section 1.1 for a detailed list of the datasets used and information on how to access them.

To qualify for inclusion in our analysis, surveys must meet the following four criteria: (1) they are representative of their national populations; (2) they contain information on all variables used in the analysis, particularly the education of both parents, as many surveys only contain fathers' but not mothers' education; (3) the education measures provide sufficient detail to distinguish the 6 levels specified in the analysis; and (4) they have covered our focal birth cohorts (1956–1990).

To construct our analytical sample, we first excluded individuals under 25 years of age, as they may not have completed their education yet. We then excluded adults aged 65 and over to minimize mortality bias. Finally, after listwise deleting cases with missing information on the variables used, our analytical sample contains 1,785,683 individuals (960,773 women and 824,910 men) aged 25–64 born between 1956 and 1990. While the sample sizes are uneven across the 106 societies, our findings are robust to excluding societies with a relatively small sample ($N < 700$; Supplementary Figs. 5–6).

Despite variation across surveys, the overall level of missing data is low: only less than 0.01% of the original sample had missing information for age, less than 0.01% for survey year, 0.31% for individuals' own education, 9.58% for mothers' education, and 13.47% for fathers' education. Missingness for parents' education tends to be more prevalent in societies with higher levels of marital dissolution, nonmarital cohabitation, and childbirth out of wedlock. Our sensitivity analysis excluding surveys with more than 10% missing values for any of our variables yielded results that were substantively consistent with the main findings reported above (Supplementary Figs. 7–8).

The second dataset, compiled from the records of the World Population Prospects (WPP)[56], contains information on population sizes across birth years and societies (see Supplementary Information Section 1.1 for greater detail). This dataset was used to supply information for calculating the weights used in our individual-level analysis. We merged this WPP dataset into the first dataset based on individuals' year of birth, society of residence, and sex. As in the case of other large-scale cross-national analyses of intergenerational mobility[15], our sample captures all residents in a given society. We were unable to distinguish between foreign-born and native-born populations or between citizens and non-citizens because such data were not consistently collected across the surveys used.

Measures

Relative educational positions. We measured the educational status of individuals and their mothers and fathers in terms of their relative educational positions. Because the relative measures are not confounded by the uneven expansion of education at different levels across cohorts and societies, they are preferred over absolute measures of education levels or schooling years[30,37]. To generate the relative educational position measures, we first harmonized the absolute education measures across the 545 surveys based on the International Standard Classification of Education (ISCED) and the mappings provided by the Institute of Statistics, United Nations Educational, Scientific and Cultural Organization (http://uis.unesco.org/en/isced-mappings). We combined the ISCED levels into six categories: ISCED 0–1 (no formal schooling, primary), ISCED 2 (lower secondary), ISCED 3 (upper secondary), ISCED 4 (post-secondary, non-tertiary), ISCED 5–6 (short-cycle tertiary, bachelor's or equivalent), and ISCED 7–8 (master's, doctoral), as some societies had very small sample sizes at the two ends of the educational spectrum (ISCED 0 and 8).

Next, we calculated education percentile ranks (0–100) within society and birth year for individuals, their mothers, and their fathers, respectively. While parents' years of birth can vary for individuals born in the same year, we ranked mothers' and fathers' education based on the individuals' birth year. This means that the ranks meaningfully capture where individuals' parents stand educationally relative to their birth cohort peers' parents from the same society. For cases with the same level of education, we used the mid-point to adjust for percentile ranks[37]. To ensure a sufficient sample size for each cohort in each society, we calculated the ranks using 7-birth-year rolling samples. Given that peers born in the same year form the most relevant comparative referents and the relevance decreases as one moves further away from the focal birth year, we assigned a full weight of 1 to the focal birth year t and decreasing radius weights of 0.75 to t +/– 1, 0.5 to t +/– 2, and 0.25 to t +/– 3. The radius weights were used in combination with the society-cohort-sex population size weights (see the description of population weights below). Therefore, the final weight was the radius weight multiplied by the population weight. The data were left and right truncated for the first and last two birth years. See Supplementary Information Section 1.2 for further details of the relative educational position measures and our reason for focusing on intergenerational educational mobility. Here and below, all our results are robust to using alternative 5-birth-year rolling calculations with decreasing radius weighting that assigned a weight of 1 to t, 0.67 to t +/– 1, and 0.34 to t +/– 2 (see Supplementary Figs. 9–14).

Education expansion. To capture varying degrees of education expansion across cohorts and societies, we first combined the six ISCED categories into four for parsimony: ISCED 0–1 (no schooling, primary), ISCED 2–3 (secondary), ISCED 4 (post-secondary), and ISCED 5–8 (tertiary). Next, for each birth-year cohort in each society, we calculated 7-birth-year rolling averages of the proportion of individuals in each of the four regrouped ISCED categories. We applied decreasing radius weighting as in the calculation of relative educational positions. While our education expansion measures are consistent with measures of the proportion of a population having distinct levels of education used by the UN and World Bank and in previous research[16,25,57], our results are robust to measuring education expansion in terms of cohort-society mean levels of education (Supplementary Table 10).

Patterns of parents' educational pairing. To measure macro-compositional changes in parents' educational pairing patterns, we first compared the mother's and the father's absolute education levels (i.e., six ISCED categories) and classified their educational pairing into three types: (1) homogamy (mother = father), (2) hypergamy (mother < father), and (3) hypogamy (mother > father). Next, because we conceptualized shifting patterns of parents' educational pairing as a contextual-level change, we calculated the proportions of parents with each of the three educational pairing types within cohort and society, using the same 7-birth-year rolling average and decreasing radius weighting method as in the calculation of relative educational positions.

Population weights. As our analysis drew on sample surveys, we used weights to ensure the representativeness of our findings. We did not use the original weights provided by the surveys because they were intended to make the data representative of the national populations in the survey years. Instead, we weighted all analyses (except those for Figs. 5–6) based on the WPP records such that in each society, the weighted sample size for each sex of each birth year was the same as the corresponding population size of the same birth year and sex at age 5 (i.e., school entry age). We did not use population sizes at birth given considerable societal and cohort variations in infant and early childhood mortality rates[58]. See Supplementary Information Section 1.3 for further information about weighting.

World regions. In Figs. 1–4, we used the United Nations Statistics Division's classification of world regions[59]: Africa, Asia and the Pacific, Europe, Latin America, the Middle East, and North America. See Supplementary Fig. 15 for a map of societies and regions covered and Supplementary Figs. 16–17 for maps describing geographical differences in absolute education levels and parents' educational pairing.

Analysis

First, we conducted descriptive analyses to chart how the trends in individuals' absolute education and the pattern of parents' educational pairing varied across birth cohorts and societies/regions, separately for men and women (Figs. 1–2). Notably, we described how parents' educational pairing patterns varied across their children's birth cohorts. For this step of the analysis, individuals' birth years, ranging from 1956 to 1990, were aggregated into 5-birth-year intervals to yield more stable cohort trends. Population size weights were used in calculating the means within each 5-birth-year interval, society/region, and sex.

Second, we compared the importance of fathers' vs. mothers' relative educational positions in predicting the relative educational positions of men and women (Figs. 3–4). To do so, we fitted a series of ordinary least squares (OLS) regression models that included both parents' educational positions as the key independent variables to predict individuals' educational positions. We compared the coefficients for mothers' ($Medu_{isg/irg}$) and fathers' ($Fedu_{isg/irg}$) educational positions estimated based on Equation (1). The regression coefficients based on educational percentile ranks are akin to rank-rank correlation measures that are widely used in social mobility research[30,37], but are conditional on the control variables included in the models. To obtain the coefficients, we fitted the models within each society and then region, separately for women and men. We controlled for individuals' age, its quadratic term, and individuals' birth year dummies. As the data for some societies and regions included multiple surveys and multiple rounds of a given survey, we also controlled for survey and survey year dummies where relevant. Population weights were used. Equation (1) summarizes the models:

$$Edu_{isg} = \beta_f Fedu_{isg/irg} + \beta_m Medu_{isg/irg} + \beta_3 Controls + \varepsilon_{isg/irg};$$

with i (individual) = 1, ..., N_S; s (society) = 1, …, 106 / r (region) = 1, …, 6; g (gender) = 0, 1 (1)

To capture cohort trends in the coefficients within each world region (Fig. 4), we then fitted a series of OLS models across distinct region-cohort units. To enable sufficiently large samples for reliable estimation and presentation purposes, we collapsed birth years into 5-year cohort intervals and estimated the models within each cohort interval, region, and sex, adjusting for society-cohort-sex population sizes. The control variables included individuals' age, its quadratic term, society dummies, and survey and survey year dummies.

Finally, we fitted two-step multilevel regression models[60] to estimate the relationship between education expansion, parents' educational pairing patterns, and the strength of intergenerational educational persistence (Figs. 5–6). In the first step, we estimated a series of OLS regression models within each society and birth year, separately for men and women[60]. To ensure reliable estimation, we used 7-birth-year rolling samples with decreasing radius and population weights. As specified in Equation (2), we included fathers' and mothers' educational positions as the key predictors and controlled for individuals' age when surveyed and its quadratic term. In societies where multiple surveys and/or multiple rounds of a survey were used, we also controlled for survey and/or survey year dummies. We did not include other control variables, such as gross domestic product, because such socioeconomic indicators were strongly correlated with the education expansion measures. Their inclusion would have led to the problem of multicollinearity[61].

$$Edu_{iscg} = \beta_f Fedu_{iscg} + \beta_m Medu_{iscg} + \beta_3 Controls + \varepsilon_{iscg};$$

with i (individual) = 1, ..., N_{SC}; s (society) = 1, …, 106; c (cohort) = 1956, ..., 1990; g (gender) = 0, 1 (2)

We then used the coefficients for fathers' (β_f) and mothers' (β_m) educational positions obtained from Equation (2) as the dependent variables for the second step of the multilevel models. To minimize the influence of outliers, we bottom- and top-coded the coefficients at the 1st and 99th percentile, respectively. The histograms of the coefficients are presented in

Supplementary Fig. 18, and the scatterplots depicting the bivariate correlation between the coefficients for mothers and fathers are presented in Supplementary Fig. 19.

From the step-1 models, we thus assembled a society-cohort dataset (N = 3,693 society-cohort units for men and 3,688 for women). Using this society-cohort level dataset, we fitted two-way fixed effects models to estimate the relationship between the coefficients for parents' educational positions, education expansion, and patterns of parents' educational pairing[62], as specified in Equation (3):

$$\beta_{f} \text{ (or } \beta_{m}) = \alpha + \gamma_1 \text{Expansion}_{scg} + \gamma_2 \text{Pedu\_pairing}_{scg} + D_s + D_c + \eta_{scg};$$

with s (society) = 1, …, 106; c (cohort) = 1956, ..., 1990; g (gender) = 0, 1 (3)

where γ_1 is the estimated association between education expansion and intergenerational educational persistence, γ_2 captures the association between parents' educational pairing patterns and intergenerational persistence, and η_{scg} is a residual error term. Our models in the main article included only linear terms of education expansion and parents' educational pairing patterns, but our results were substantively similar if both linear and quadratic terms were included (see Supplementary Fig. 20). D_s and D_c are society and cohort dummies (i.e., the two-way fixed effects), and their inclusion helps account for unobserved heterogeneities across societies and cohorts. As our tests showed that η_{scg} was heteroscedastic, we estimated Equation (3) using generalized least squares (GLS) regression models, which also accounted for within-society autocorrelation (see Supplementary Information Section 1.4)[63]. We did not weight the step-2 models such that each society-cohort was counted equally. Therefore, the results were not driven by more populous societies or cohorts.

We sequentially fitted three sets of step-2 models, separately for men and women: (1) including only education expansion measures (γ_1), i.e., proportions of individuals with secondary, post-secondary, and tertiary education within each society and birth year, as the key predictors; (2) including only parents' educational pairing patterns (γ_2), i.e., the proportions of hypergamous and hypogamous parents within each society and birth year, as the key predictors; and (3) including both education expansion and parents' educational pairing patterns. This modelling strategy allowed us to examine the extent to which changes in parents' educational pairing patterns constituted a mechanism that mediated the relationship between education expansion and intergenerational educational persistence (see Supplementary Table 9 for full step-2 regression results). When estimating the coefficients for education expansion in step-2 models, we did not include the composition measures for parents' education, as they were strongly collinear with those for individuals' education (see Supplementary Information Section 1.4).

To test the possibility that changes in parents' absolute educational pairing patterns may have influenced intergenerational mobility through changes in parents' relative educational rank, we fitted models further including parents' relative educational rank (i.e., mothers' rank – fathers' rank) at society-cohort level (Supplementary Figs. 21–22). The results from these models differed little from those reported in the main article, indicating that the link between parents' absolute educational pairing patterns and intergenerational mobility exists independent of changes in parents' relative pairing patterns. Finally, all tests conducted in this study are two-tailed.

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

Data availability

Secondary data from multinational and national surveys and United Nations archival records were analyzed in this study. As the datasets are proprietary and require access permission from the original data collectors/holders, we are unable to make the data publicly available. The datasets and links for applying for and downloading the data are as follows, with further information provided in Supplementary Information Section 1.1: Encuesta de Caracterización Socioeconómica Nacional (https://www.casen2022.gob.cl/); General Social Survey, Canada (https://www150.statcan.gc.ca/n1/en/catalogue/89F0115X); Chinese General Social Survey (http://cgss.ruc.edu.cn/English/Home.htm); Ecuador Living Conditions Survey (https://www.ecuadorencifras.gob.ec/documentos/web-inec/ECV/ECV_2015/); EDAM – Enquête Djiboutienne auprès des Ménages – Indicateurs Sociaux (https://microdata.worldbank.org/index.php/catalog/3463); EMOVI – ESRU Social Mobility Survey in Mexico (https://www.icpsr.umich.edu/web/DSDR/studies/35333); Encuesta Nacional de Calidad de Vida (https://www.datos.gov.co/Estad-sticas-Nacionales/Encuesta-Nacional-de-Calidad-de-Vida-ECV-/mz9y-3x9k); European Social Survey (https://www.europeansocialsurvey.org/); European Values Survey (https://europeanvaluesstudy.eu/); Generations and Gender Programme (https://www.ggp-i.org/); General Household Survey, Nigeria (https://microdata.worldbank.org/index.php/catalog/3557); General Social Survey, USA (https://gss.norc.org/); Household Income and Expenditure Survey, Liberia (https://microdata.worldbank.org/index.php/catalog/2986); India Human Development Survey (https://ihds.umd.edu/); The Indonesian Family Life Survey (https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html); Integrated Household Survey (Gambia: https://microdata.worldbank.org/index.php/catalog/3323/related-materials; Malawi: https://microdata.worldbank.org/index.php/catalog/1003, https://microdata.worldbank.org/index.php/catalog/2936, https://microdata.worldbank.org/index.php/catalog/3818); International Social Survey Programme (https://issp.org/); Japanese General Social Survey (https://csrda.iss.u-tokyo.ac.jp/english/socialresearch/joint/); Korean General Social Survey (https://kossda.snu.ac.kr/handle/20.500.12236/21830); Kagera Health and Development Survey, Tanzania (https://microdata.worldbank.org/index.php/catalog/359, https://microdata.worldbank.org/index.php/catalog/79, https://microdata.worldbank.org/index.php/catalog/2251); Living Conditions Survey (Benin: https://microdata.worldbank.org/index.php/catalog/4291; Burkina Faso: https://microdata.worldbank.org/index.php/catalog/4290; Cote D'Ivoire: https://microdata.worldbank.org/index.php/catalog/2847; Guinea-Bissau: https://microdata.worldbank.org/index.php/catalog/4293; Mali: https://microdata.worldbank.org/index.php/catalog/4295; Niger: https://microdata.worldbank.org/index.php/catalog/4296; Senegal:

https://microdata.worldbank.org/index.php/catalog/4297; Togo: https://microdata.worldbank.org/index.php/catalog/4298); Life in Transitions Survey (https://www.ebrd.com/what-we-do/economic-research-and-data/data/lits.html); Labour Market Panel Surveys (Egypt: http://www.erfdataportal.com/index.php/catalog/157; Jordan: http://www.erfdataportal.com/index.php/catalog/139; Tunisia: http://www.erfdataportal.com/index.php/catalog/105); Living Standard Measurement Survey (Albania: https://microdata.worldbank.org/index.php/catalog/64; Brazil: https://microdata.worldbank.org/index.php/catalog/277; Ghana: https://microdata.worldbank.org/index.php/catalog?sort_by=rank&sort_order=desc&sk=LSMS+ghana+; Nigeria: https://microdata.worldbank.org/index.php/catalog/1002); National Income Dynamics Study, South Africa (http://www.nids.uct.ac.za/); National Panel Survey, Uganda (https://microdata.worldbank.org/index.php/catalog/1001/; https://microdata.worldbank.org/index.php/catalog/2663); National Household Sample Survey, Brazil (https://www.ibge.gov.br/en/statistics/social/housing/20620-summary-of-indicators-pnad2.html?=&t=microdados); Socioeconomic Survey (Ethiopia: https://microdata.worldbank.org/index.php/catalog/3823; Ghana: https://microdata.worldbank.org/index.php/catalog/2534; Iraq: https://microdata.worldbank.org/index.php/catalog/2334); STEP Skills Measurement Household Survey (Armenia: https://microdata.worldbank.org/index.php/catalog/2010; Bolivia: https://microdata.worldbank.org/index.php/catalog/2011; Colombia: https://microdata.worldbank.org/index.php/catalog/2012; Georgia: https://microdata.worldbank.org/index.php/catalog/2013; Ghana: https://microdata.worldbank.org/index.php/catalog/2015; Kenya: https://microdata.worldbank.org/index.php/catalog/2226; Laos: https://microdata.worldbank.org/index.php/catalog/2016; Macedonia: https://microdata.worldbank.org/index.php/catalog/2568; the Philippines: https://microdata.worldbank.org/index.php/catalog/3182; Sri Lanka: https://microdata.worldbank.org/index.php/catalog/2017; Ukraine: https://microdata.worldbank.org/index.php/catalog/2572; Vietnam: https://microdata.worldbank.org/index.php/catalog/2018); Taiwan Social Change Survey (https://www2.ios.sinica.edu.tw/sc/en/home2.php); World Values Survey (https://www.worldvaluessurvey.org/wvs.jsp); and World Population Prospects (https://population.un.org/wpp/).

Code availability

The codes for data cleaning, harmonization, analysis, and producing all graphs and tables reported in the main article and Supplementary Information (Section 1.5) are publicly available through the Open Science Framework: https://osf.io/3q75x/.

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Author contributions

Y.H. and Y.Q. conceptualized and designed the study. Y.H. curated the datasets and conducted the data analysis. Y.Q. conducted analysis replication and validation. Y.H. and Y.Q. wrote, reviewed, revised, edited, and finalized the manuscript.

Competing interests

The authors have no competing interests to declare.

Additional information

Supplementary information The online version contains supplementary material available at XXX

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References

1. Torche, F. Analyses of intergenerational mobility: An interdisciplinary review. *Ann. Am. Acad. of Polit. Soc. Sci.* **657**, 37–62 (2015).
2. Morgan, A. C., Laberge, N., Larremore, D. B., Galesic, M., Brand, J. E. & Clauset, A. Socioeconomic roots of academic faculty. *Nat. Hum. Behav.* (2022) doi:10.1038/s41562-022-01425-4.
3. Breen, R. & Jonsson, J. O. Explaining change in social fluidity: Educational equalization and educational expansion in twentieth-century Sweden. *Am. J. Sociol.* **112**, 1775–1810 (2007).
4. Fischer, C. S. & Hout, M. *Century of Difference: How America Changed in the Last One Hundred Years* (Russell Sage Foundation, 2006).
5. Song, X. & Mare, R. D. Short-term and long-term educational mobility of families: A two-sex approach. *Demography* **54**, 145–173 (2017).
6. Case, A. & Deaton, A. The great divide: education, despair, and death. *Annu. Rev. Econ.* **14**, 1–21 (2022).
7. Dotti Sani, G. M. & Treas, J. Educational gradients in parents' child-care time across countries, 1965–2012. *J. Marriage Fam.* **78**, 1083–1096 (2016).
8. Oreopoulos, P. & Salvanes, K. G. Priceless: The nonpecuniary benefits of schooling. *J. Econ. Perspect.* **25**, 159–84 (2011).
9. Psacharopoulos, G. & Patrinos, H. A. Returns to investment in education: A decennial review of the global literature. *Educ. Econ.* **26**, 445–458 (2018).
10. Subramanian, S. V., Huijts, T. & Avendano, M. Self-reported health assessments in the 2002 World Health Survey: How do they correlate with education? *Bull. World Health Organ.* **88**, 131–138 (2010).
11. Torche, F. in *Social Mobility in Developing Countries* (eds Iversen, V., Krishna, A. & Sen, K.) 139–171 (Oxford Univ. Press, 2021).
12. Barone, C. & Ruggera, L. Educational equalization stalled? Trends in inequality of educational opportunity between 1930 and 1980 across 26 European nations. *Eur. Soc.* **20**, 1–25 (2018).
13. Shavit, Y. & Blossfeld, H.-P. *Persistent Inequality: Changing Educational Attainment in Thirteen Countries* (Westview Press, 1993).
14. Power, C. *The Power of Education: Education for All, Development, Globalisation and UNESCO* (Springer, 2014).
15. Narayan, A., Van der Weide, R., Cojocaru, A., Lakner, C., Redaelli, S., Mahler, D. G., Ramasubbaiah, R. G. N. & Thewissen, S. *Fair Progress?: Economic Mobility across Generations around the World* (World Bank, 2018).
16. Meyer, J. W., Ramirez, F. O. & Soysal, Y. N. World expansion of mass education, 1870–1980. *Sociol. Educ*. **65**, 128–149 (1992).
17. Schofer, E. & Meyer, J. W. The worldwide expansion of higher education in the twentieth century. *Am. Sociol. Rev*. **70**, 898–920 (2005).
18. Thornton, A., Dorius, S. F. & Swindle, J. Developmental idealism: The cultural foundations of world development programs. *Sociol. Dev.* **1**, 277–320 (2015).
19. Azomahou, T. T. & Yitbarek, E. A. *Intergenerational Education Mobility in Africa: Has Progress Been Inclusive?* (World Bank, 2016).

20. Blanden, J. & Macmillan, L. Educational inequality, educational expansion and intergenerational mobility. *J. Soc. Policy* **45**, 615–615 (2016).
21. Treiman, D. J. Industrialization and social stratification. *Sociol. Inq.* **40**, 207–234 (1970).
22. Kuznets, S. Economic growth and income inequality. *Am. Econ. Rev.* **45**, 1–28 (1955).
23. Meschi, E. & Scervini, F. Expansion of schooling and educational inequality in Europe: The educational Kuznets curve revisited. *Oxf. Econ. Pap.* **66**, 660–680 (2014).
24. Lucas, S. R. Effectively maintained inequality: Education transitions, track mobility, and social background effects. *Am. J. Sociol.* **106**, 1642–1690 (2001).
25. OECD. *Education at a Glance 2021: OECD Indicators*. (Organisation for Economic Co-operation and Development, 2021).
26. Goldscheider, F., Bernhardt, E. & Lappegård, T. The gender revolution: A framework for understanding changing family and demographic behavior. *Popul. Dev. Rev.* **41**, 207–239 (2015).
27. Van Bavel, J., Schwartz, C. R. & Esteve, A. The reversal of the gender gap in education and its consequences for family life. *Annu. Rev. Sociol.* **44**, 341–360 (2018).
28. Blanden, J. Cross-country rankings in intergenerational mobility: A comparison of approaches from economics and sociology. *J. Econ. Surv.* **27**, 38–73 (2013).
29. Breen, R., Luijkx, R., Müller, W. & Pollak, R. Nonpersistent inequality in educational attainment: Evidence from eight European countries. *Am. J. Sociol.* **114**, 1475–1521 (2009).
30. Song, X., Massey, C. G., Rolf, K. A., Ferrie, J. P., Rothbaum, J. L. & Xie, Y. Long-term decline in intergenerational mobility in the United States since the 1850s. *Proc. Natl. Acad. Sci.* **117**, 251–258 (2020).
31. Breen, R. Education and intergenerational social mobility in the US and four European countries. *Oxf. Rev. Econ. Policy* **35**, 445–466 (2019).
32. Hertz, T., Tamara, J., Piraino, P., Sibel, S. & Nicole, S. The inheritance of educational inequality: International comparisons and fifty-year trends. *B.E. J. Econ. Anal. Policy* **7**, 1–30 (2007).
33. van der Weide, R., Lakner, C., Mahler, D, G., Narayan, A. & Ramasubbaiah, R. *Intergenerational Mobility around the World* (World Bank, 2021).
34. Aydemir, A. B. & Yazici, H. Intergenerational education mobility and the level of development. *Eur. Econ. Rev.* **116**, 160–185 (2019).
35. Chow, A. & Guppy, N. Intergenerational educational mobility over the past century in Canada. *Can. Rev. Sociol.* **58**, 372–398 (2021).
36. Minello, A. & Blossfeld, H.-P. From mother to daughter: Changes in intergenerational educational and occupational mobility in Germany. *Int. Stud. Sociol. Educ.* **24**, 65–84 (2014).
37. Xie, Y., Dong, H., Zhou, X. & Song, X. Trends in social mobility in postrevolution China. *Proc. Natl. Acad. Sci.* **119**, e2117471119 (2022).
38. Beller, E. Bringing intergenerational social mobility research into the twenty-first century: Why mothers matter. *Am. Sociol. Rev.* **74**, 507–528 (2009).
39. Gerber, T. P. & Hout, M. Educational stratification in Russia during the Soviet period. *Am. J. Sociol.* **101**, 611–660 (1995).
40. Park, H., Buchmann, C., Choi, J. & Merry, J. J. Learning beyond the school walls: Trends and implications. *Annu. Rev. Sociol.* **42**, 231–252 (2016).

41. Lareau, A. *Unequal Childhoods: Class, Race, and Family Life* (Univ. of California Press, 2003).
42. Craig, L. & Mullan, K. How mothers and fathers share childcare: A cross-national time-use comparison. *Am. Sociol. Rev.* **76**, 834–861 (2011).
43. Guryan, J., Hurst, E. & Kearney, M. Parental education and parental time with children. *J. Econ. Perspect.* **22**, 23–46 (2008).
44. Hays, S. *The Cultural Contradictions of Motherhood* (Yale Univ. Press, 1996).
45. Jaeger, M. M. Educational mobility across three generations: The changing impact of parental social class, economic, cultural and social capital. *Eur. Soc.* **9**, 527–550 (2007).
46. Esteve, A., Schwartz, C. R., Van Bavel, J., Permanyer, I., Klesment, M. & García-Román, J. The end of hypergamy: Global trends and implications. *Popul. Dev. Rev*. **42**, 615–625 (2016).
47. Erát, D. Educational assortative mating and the decline of hypergamy in 27 European countries. *Demographic Res.* **44**, 157–188 (2021).
48. Eika, L., Mogstad, M. & Zafar, B., Educational assortative mating and household income inequality. *J. Polit. Econ.* **127,** 2795–2835 (2019).
49. Han, S. W. Is it only a numbers game? A macro-level study of educational hypogamy. *Demography* **59**, 1571–1593 (2022).
50. Raymo, J. M. & Iwasawa, M. Marriage market mismatches in Japan: An alternative view of the relationship between women's education and marriage. *Am. Sociol Rev.* **70**, 801–822 (2005).
51. World Population Dashboard, United Nations Population Fund, https://www.unfpa.org/data/world-population-dashboard (2022).
52. Benavot, A. & Riddle, P. The expansion of primary education, 1870–1940: Trends and issues. *Sociol. Educ.* **61**, 191–210 (1988).
53. Williams, R. Using the margins command to estimate and interpret adjusted predictions and marginal effects. *Stata J.* **12**, 308–331 (2012).
54. Hannum, E. & Buchmann, C. Global educational expansion and socio-economic development: An assessment of findings from the social sciences. *World Dev*. **33**, 333–354 (2005).
55. Duncan, S. & Edwards, R. *Single Mothers in International Context: Mothers or Workers?* (Routledge, 2013).
56. World Population Prospects, https://population.un.org/wpp/Download/Standard/Population/ (2019).
57. Barakat, B. & Shields, R. Just another level? Comparing quantitative patterns of global expansion of school and higher education attainment. *Demography* **56**, 917–934 (2019).
58. Bhatia, A., Krieger, N. & Subramanian, S. V. Learning from history about reducing infant mortality: Contrasting the centrality of structural interventions to early 20th-century successes in the United States to their neglect in current global initiatives. *Milbank Q.* **97**, 285–345 (2019).
59. Statistics Division, United Nations, *Standard Country or Area Code for Statistical Use*, https://unstats.un.org/unsd/methodology/m49/ (n.d).
60. Snijders, T. A. & Bosker, R. J. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling* (Sage, 2011).
61. Mason, C. H. & Perreault, W. D. Collinearity, power, and interpretation of multiple regression analysis. *J. Marketing Res*. **28**, 268–280 (1991).

62. Frees, E. W. & Frees. *Longitudinal and Panel Data: Analysis and Applications in the Social Sciences* (Cambridge Univ. Press, 2004).
63. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data* (MIT Press, 2010).

Figures

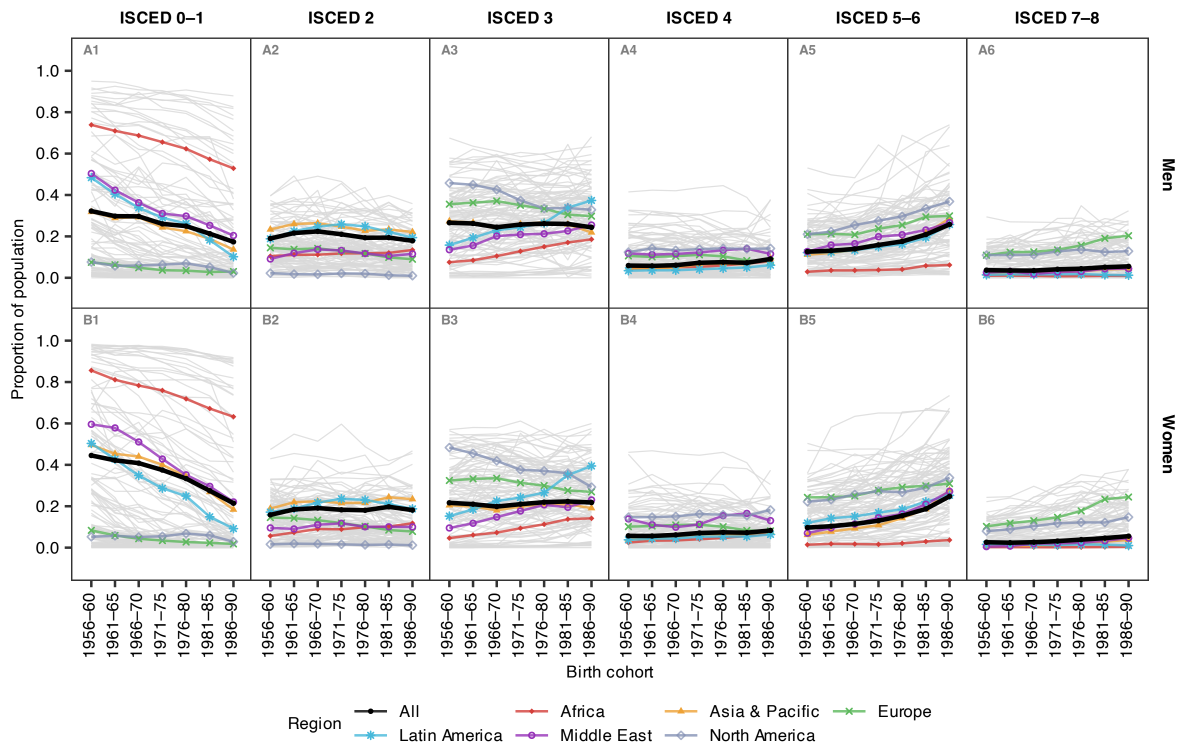


Fig. 1 | Cohort changes in education composition, by region and society. Grey lines depict mean cohort trajectories for each society, colour lines depict the mean trajectories for each region, and the bold black line depicts the mean trajectory for the world. ISCED = International Standard Classification of Education, where level 0 = no formal schooling, level 1 = primary education, level 2 = lower secondary education, level 3 = upper secondary education, level 4 = post-secondary education, level 5 = short-cycle tertiary education, level 6 = Bachelor's or equivalent, level 7 = Master's or equivalent, and level 8 = Doctorate or equivalent. *N* = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.

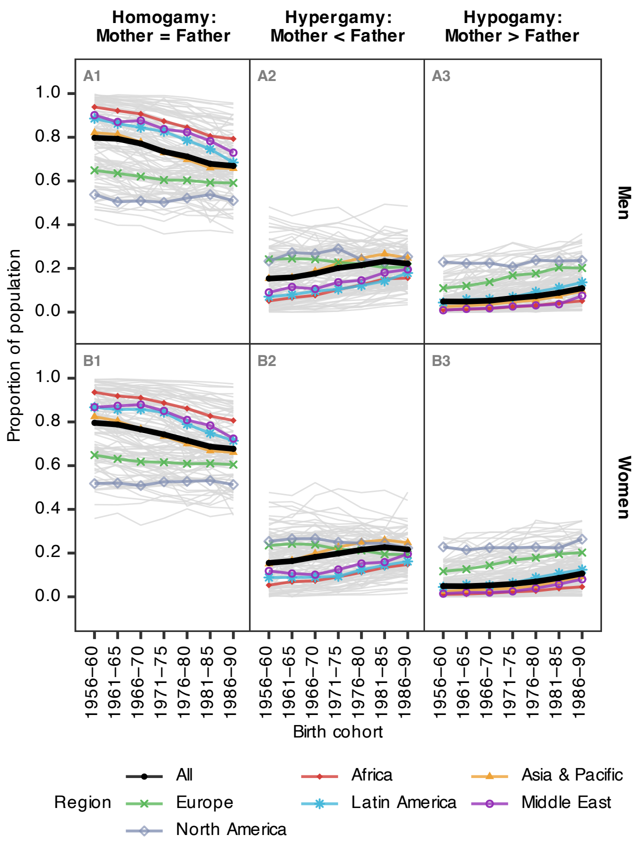


Fig. 2 | Cohort changes in parents' educational pairing patterns, by region and society. Grey lines depict mean cohort trajectories for each society, colour lines depict the mean trajectories for each region, and the bold black line depicts the mean trajectory for the world. ISCED = International Standard Classification of Education, where level 0 = no formal schooling, level 1 = primary education, level 2 = lower secondary education, level 3 = upper secondary education, level 4 = post-secondary education, level 5 = short-cycle tertiary education, level 6 = Bachelor's or equivalent, level 7 = Master's or equivalent, and level 8 = Doctorate or equivalent. *N* = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.

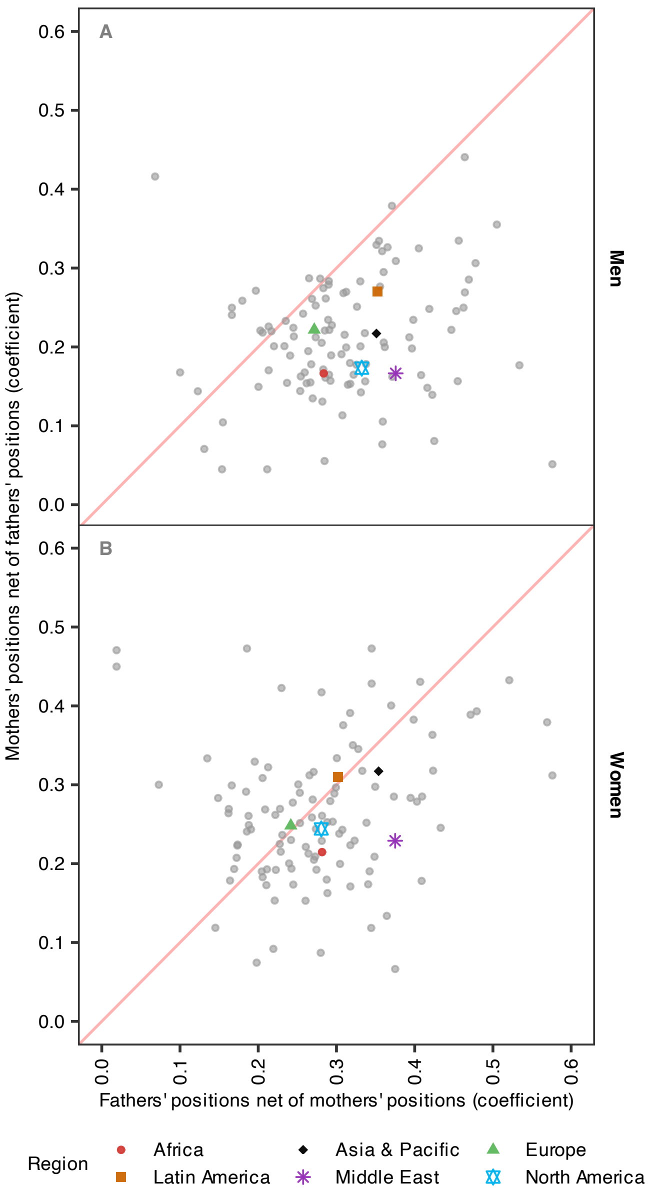


Fig. 3 | Coefficients for mothers' and fathers' educational positions from models predicting men's and women's educational positions, across 106 societies. Each grey dot represents one society, each colour symbol indicates one region, and the red diagonal lines indicate equality in the size of coefficients for the educational positions of the mother and the father. Ordinary least squares regression models controlling for individuals' age and its quadratic term, individuals' birth year dummies, and survey and survey year dummies. Supplementary Table 7 presents detailed results of the statistical tests assessing differences between the coefficients for mothers' and fathers' educational positions. $N = 1{,}785{,}683$ individuals (824,910 men and 960,773 women) across 106 societies.

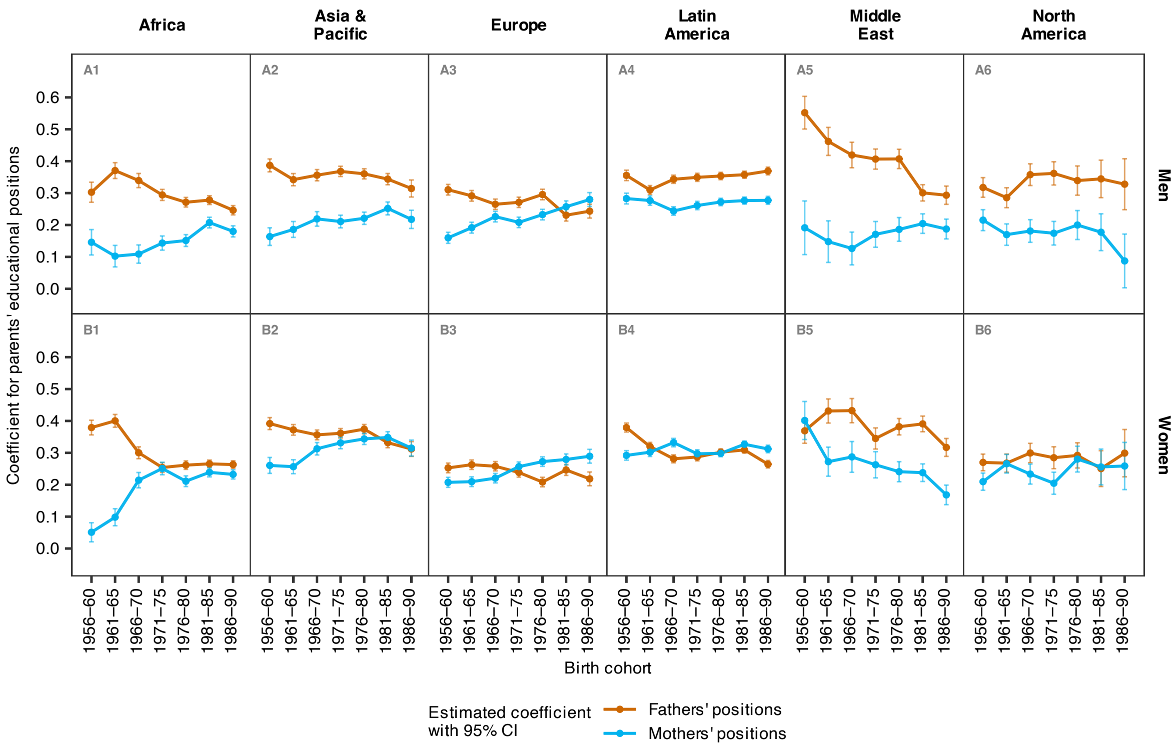


Fig. 4 | Coefficients for mothers' and fathers' educational positions from models predicting men's and women's educational positions, across 1956–1990 birth cohorts. Data points depict estimated coefficients, with error bars indicating 95% confidence intervals. Ordinary least squares regression models controlling for individuals' age and its quadratic term, society dummies, and survey and survey year dummies. Supplementary Table 8 presents the model results underpinning this graph. N = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.

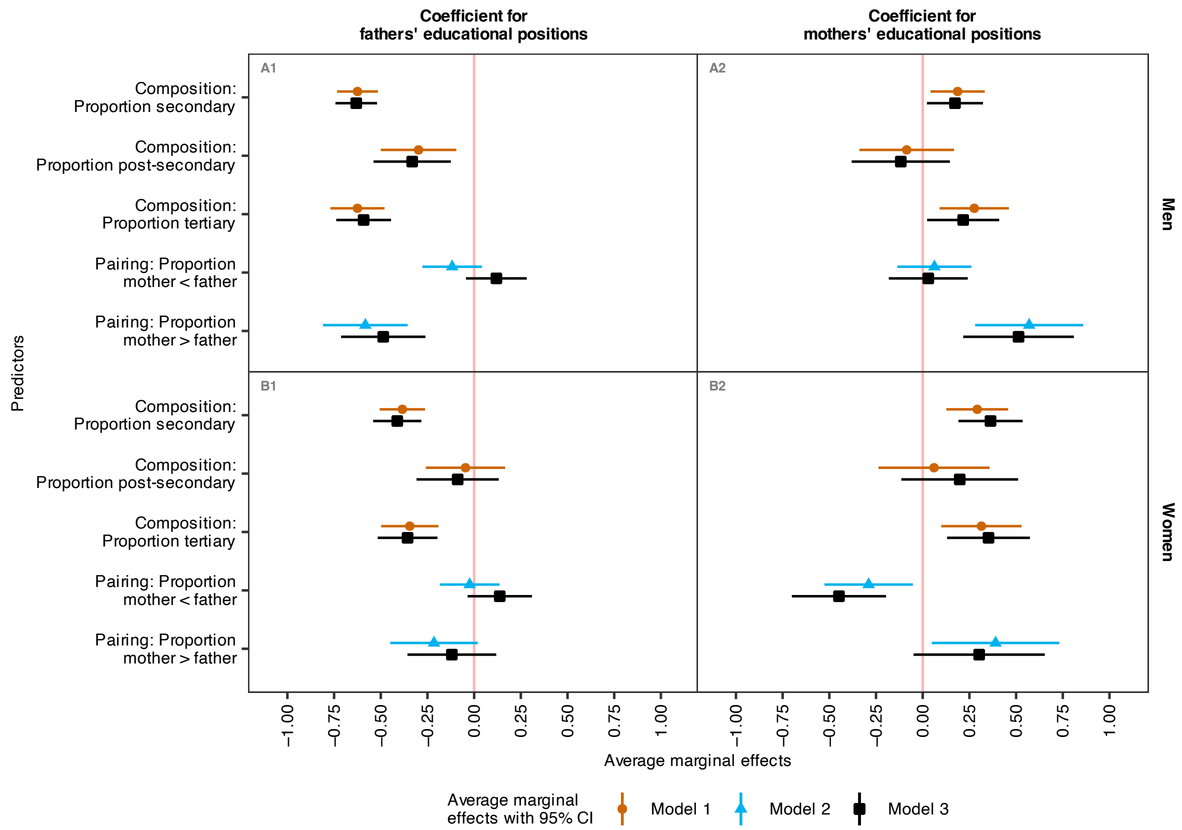


Fig. 5 | Average marginal effects of education expansion and parents' educational pairing patterns on intergenerational educational persistence. Error bars indicate 95% confidence intervals, and red baselines indicate marginal effects equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Model 1 only included education expansion measures, Model 2 only included parents' educational pairing patterns, and Model 3 included both sets of predictors. All models also included society and birth year dummies. See Supplementary Table 9 for model results. *N* = 3,693 and 3,688 society-cohort units for men and women, respectively.

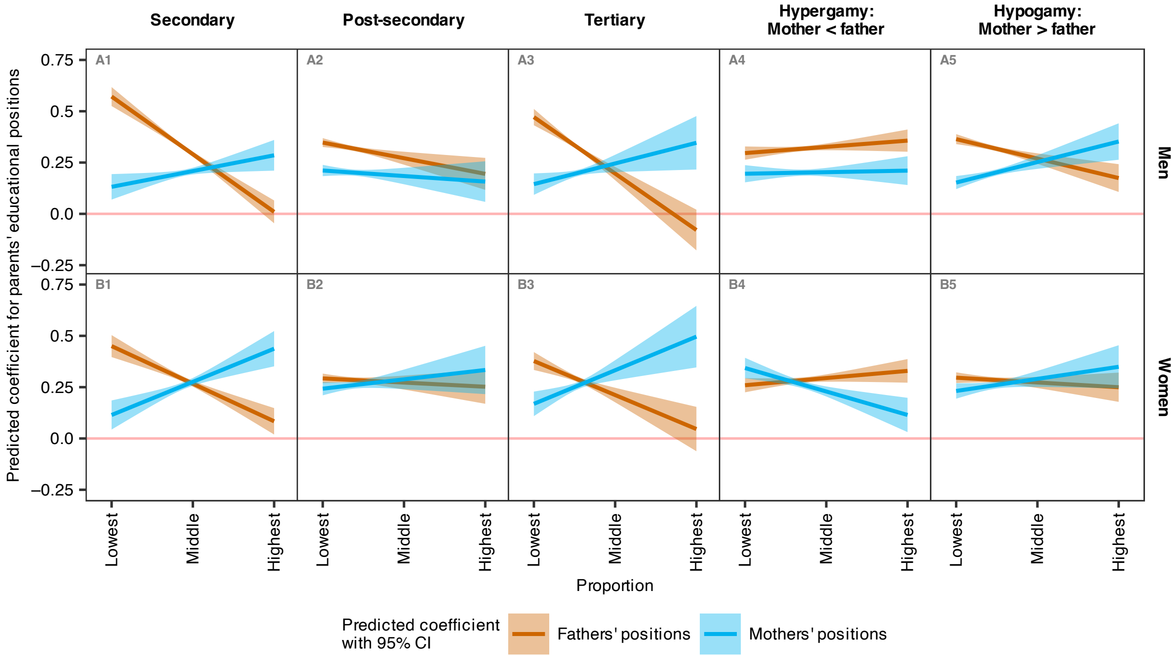


Fig. 6 | Predicted coefficients for parents' educational positions over the distributions of education expansion and parents' educational pairing patterns. Colour lines indicate predicted coefficients, with colour bands indicating 95% confidence intervals, and red baselines indicate coefficients equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Predictions based on Model 3 presented in Fig. 5, holding all non-focal variables at their observed values. Lowest refers to minimum values and highest refers to maximum values: the ranges are 0.018–0.874 for secondary education, 0–0.459 for post-secondary education, 0.003–0.923 for tertiary education, 0–0.504 for hypergamy, and 0–0.385 for hypogamy. See Supplementary Table 9 for model results. $N = 3,693$ and 3,688 society-cohort units for men and women, respectively.

Supplementary Information

Gender, education expansion and intergenerational educational mobility around the world

Author accepted version
Forthcoming in *Nature Human Behaviour*

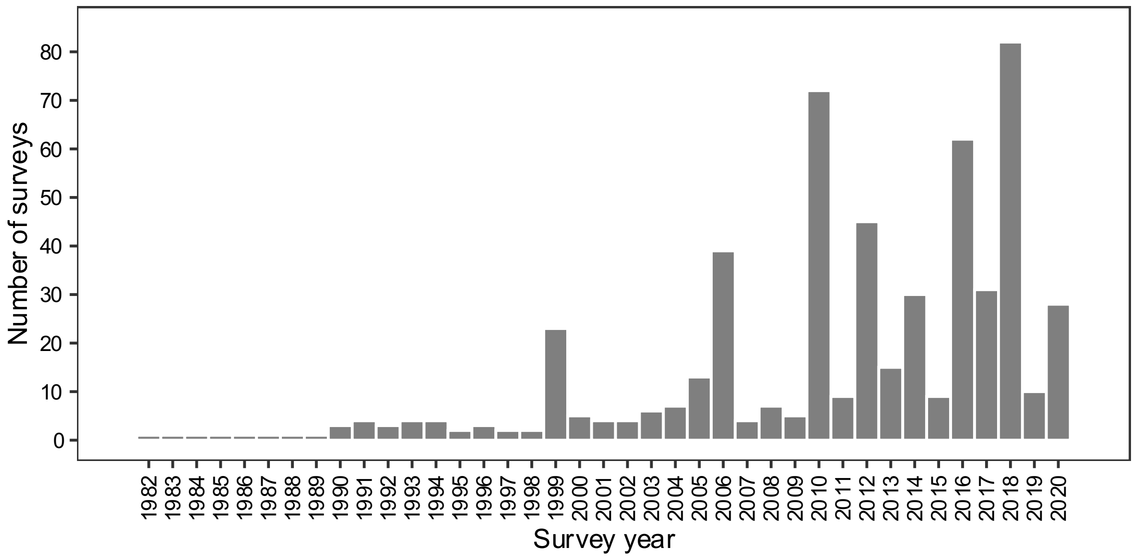
Table of Contents

1. SUPPLEMENTARY METHODS

1.1. Further information on data and sample

To assemble the dataset for our study, we conducted a comprehensive data scoping exercise to identify surveys that collected information on both parents' education. Our data scoping covered a wide range of international repositories, including the World Bank Microdata Library (https://microdata.worldbank.org/index.php/home), International Household Survey Network (http://www.ihsn.org/), Inter-university Consortium for Political and Social Research (ICPSR) (https://www.icpsr.umich.edu/web/pages/index.html), Harvard Data Verse (https://dataverse.harvard.edu/), UK Data Services (https://ukdataservice.ac.uk/), and GESIS Data Archive (https://www.gesis.org/en/home), supplemented by specific national data archives and data-specific initiatives such as the World/European Values Surveys (https://www.worldvaluessurvey.org/wvs.jsp) and Japanese General Social Survey (https://csrda.iss.u-tokyo.ac.jp/english/socialresearch/joint/), among others.

Our data inclusion criteria are specified in the Methods section of the main article. There are several typical reasons why some well-known survey datasets were excluded. For example, although the Latinobarómetro surveys collected information on parents' education, they did not distinguish between mothers' and fathers' education. Although surveys such as E123 (Enquête 1-2-3 sur l'Emploi, le Secteur Informel et les Conditions de Vie des Ménages, Congo) collected information on both parents' education, they were excluded because the education measures were not sufficiently detailed. Surveys such as the DHS (Demographic and Health Surveys) only asked about co-resident parents' education. Although previous research shows that sample selection into co-residence with parents has a relatively small impact on intergenerational mobility estimated without adopting a gender-sensitive approach[1,2], such selection is highly gendered given its underpinning patrilocal traditions in many societies[3]. Thus, we excluded surveys that only collected information on co-resident parents' education.



Supplementary Figure 1 | Distribution of survey year for the datasets analyzed.

Supplementary Figure 1 presents the distribution of the survey years for the datasets included in this study. The skew towards more recent surveys reflects the fact that many earlier surveys only collected data on the father's education or the parents' (highest) education, but not both parents' education. To minimize mortality bias, we limited the age range of individuals included in our analysis to 25–64 at the time of survey. This age range also ensures that (most of) the respondents have completed their education.

For societies in which multiple surveys were available, we only included a limited number of nationally representative surveys that met our inclusion criteria, as long as the combined sample was sufficiently large for a given society. We prioritized surveys with high-quality, detailed education measures. Where possible, we also prioritized (repeated) cross-sectional surveys that followed a simple or multi-stage random sampling strategy over longitudinal panel surveys, as survey designs and sample clustering are more complex for the latter. When a longitudinal panel dataset was used, we randomly selected one observation for each individual to mitigate potential attrition bias. Notably, we use the term "society" rather than "country" throughout this study because some special administrative regions such as Hong Kong and Macau are included in our analysis. The societal configurations in these regions are considerably different from their host countries to warrant separate treatment in our analysis.

Supplementary Table 1 presents a complete list of the societies and surveys included in our study, as well as the analytical sample size for each society after listwise deletion of cases with missing information on the variables used.

Supplementary Table 1. List of societies and surveys covered in this study

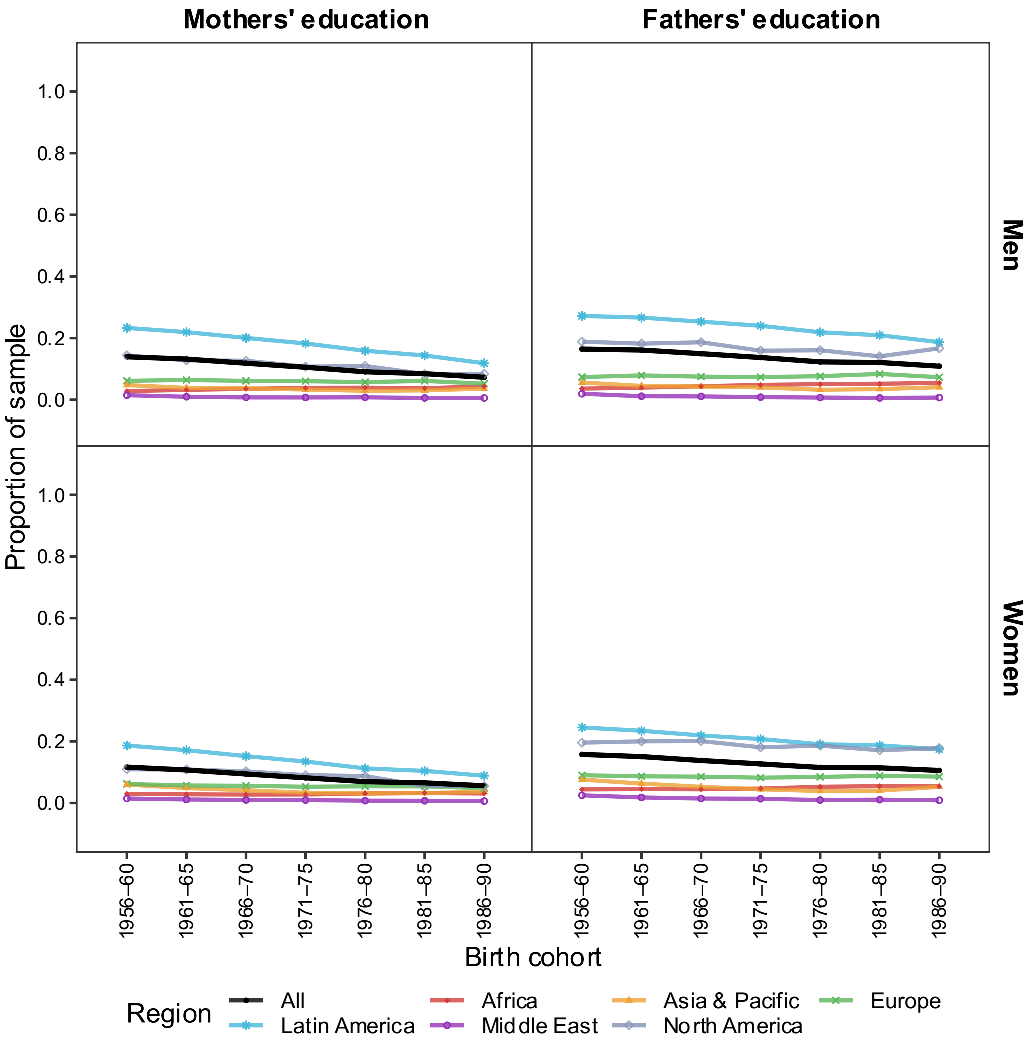
Society (106)	Data source (545 surveys)	Analytical sample size
Albania	EVS 2018; ESS 2012; LITS 2006, 2010, 2016; LSMS 2005	9,858
Argentina	WVS 2017	422
Armenia	EVS 2018; LITS 2006, 2010, 2016; STEP 2013	5,337
Australia	WVS 2018; GGP 2005; ISSP 1999	1,306
Austria	EVS 2018; ESS 2014, 2016, 2018; GGP 2008–2009	8,106
Azerbaijan	EVS 2018; LITS 2006, 2010, 2016	4,114
Bangladesh	WVS 2018	736
Belarus	EVS 2018; GGP 2017; LITS 2006, 2010, 2016	8,737
Belgium	ESS 2010–2018 (biennial); GGP 2008–2010	7,282
Benin	LCS 2018	10,706
Bolivia	EVS 2017; STEP 2012	2,132
Bosnia & Herzegovina	EVS 2019; LITS 2006, 2010, 2016	3,649
Brazil	WVS 2018; LSMS 2006; PNAD 2011, 2012, 2013, 2014, 2015	29,980
Bulgaria	EVS 2017; ESS 2010, 2012, 2018, 2020; GGP 2004; LITS 2006, 2010, 2016	13,548
Burkina Faso	LCS 2018	12,430
Canada	WVS 2020; CaGSS 2001, 2006, 2011; ISSP 1999	28,232
Chile	WVS 2018; CASEN 2009–2017 (biennial); ISSP 1999	262,246
China	WVS 2018; CGSS 2003, 2005, 2006, 2008, 2010, 2012, 2013, 2015, 2017	51,121
Colombia	WVS 2018; ENCV 2010–2019 (annual)	362,123
Côte d'Ivoire	LCS 2018	17,379

Croatia	EVS 2017; ESS 2010, 2018, 2020; LITS 2006, 2010, 2016	5,800
Cyprus	WVS 2019; ESS 2010, 2012, 2018; ISSP 1999; LITS 2016	3,961
Czechia	EVS 2017; ESS 2010–2020 (biennial); GGP 2005; ISSP 1999; LITS 2006, 2010, 2016	14,477
Denmark	EVS 2017; ESS 2010, 2012, 2014, 2018	4,752
Djibouti	EDAM 2017	6,962
Ecuador	WVS 2018; ECV 2013	36,266
Egypt	WVS 2018; LMPS 2006, 2012, 2018	36,210
Estonia	EVS 2018; ESS 2010–2020 (biennial); GGP 2014–2015; LITS 2006, 2010, 2016	7,516
Ethiopia	WVS 2020; SES 2013, 2018	15,772
Finland	EVS 2017; ESS 2010–2020 (biennial)	5,934
France	EVS 2018; ESS 2010–2020 (biennial); ISSP 1999; LITS 2010	6,869
Gambia	IHS 2015	30,765
Georgia	EVS 2018; GGP 2006; LITS 2006, 2010, 2016; STEP 2013	10,073
Germany	WVS 2018; EVS 2017; ESS 2010–2018 (biennial); GGP 2005; ISSP 1999; LITS 2010, 2016	15,411
Ghana	LSMS 2005, 2012, 2017; SES 2010; STEP 2013	54,686
Greece	WVS 2017; ESS 2010; LITS 2016	3,722
Guinea-Bissau	LCS 2018	10,160
Hong Kong	WVS 2018	523
Hungary	EVS 2018; ESS 2010, 2012, 2016, 2018, 2020; GGP 2004–2005; ISSP 1999; LITS 2006, 2010, 2016	7,530
Iceland	EVS 2017; ESS 2012, 2016, 2018	2,295
India	IHDS 2005, 2011	65,978
Indonesia	WVS 2018; ILFS 2000, 2007, 2014	25,807
Iran	WVS 2020	969
Iraq	WVS 2018; SES 2012	53,380
Ireland	ESS 2010–2018 (biennial)	6,198
Israel	ESS 2010–2016 (biennial); ISSP 1999	4,689
Italy	EVS 2018; ESS 2012, 2016, 2018; GGP 2003; LITS 2010, 2016	6,746
Japan	WVS 2019; JGSS 2000–2006 (annual), 2010, 2012, 2015	10,192
Jordan	WVS 2018; LMPS 2016	17,536
Kazakhstan	WVS 2018; GGP 2017–2018; LITS 2006, 2010, 2016	11,600
Kenya	STEP 2013	2,209
Kyrgyzstan	WVS 2020; LITS 2006, 2010, 2016	3,778
Laos	STEP 2012	1,486
Latvia	ESS 2018; ISSP 1999; LITS 2006, 2010, 2016	2,507
Lebanon	WVS 2018	769
Liberia	HIES 2014, 2016	16,534
Lithuania	EVS 2018; ESS 2010–2020 (biennial)	10,792
Macau	WVS 2020	337

Malawi	HIS 2011, 2017, 2020	43,030
Malaysia	WVS 2018	931
Mali	LCS 2018	11,318
Mexico	WVS 2018; EMOVI 2006, 2011, 2017	25,372
Moldova	GGP 2020; LITS 2006, 2010, 2016	7,308
Mongolia	LITS 2006, 2010, 2016	2,915
Montenegro	EVS 2019; LITS 2006, 2010, 2016	3,158
Myanmar	WVS 2020	765
Netherlands	EVS 2017; ESS 2010–2018 (biennial); GGP 2002–2004	8,455
New Zealand	WVS 2020; ISSP 1999	794
Nicaragua	WVS 2020	529
Niger	LCS 2018	6,059
Nigeria	WVS 2018; GH 2010, 2012, 2015, 2018; LSMS 2018	40,068
North Macedonia	EVS 2019; LITS 2006, 2010, 2016; STEP 2013	6,125
Norway	EVS 2018; ESS 2010–2018 (biennial); GGP 2020; ISSP 1999	7,727
Pakistan	WVS 2018	1,368
Peru	WVS 2018	856
Philippines	WVS 2019; ISSP 1999; STEP 2015	3,082
Poland	EVS 2017; ESS 2010–2018 (biennial); GGP 2010–2011; ISSP 1999; LITS 2006, 2010, 2016	15,923
Portugal	EVS 577; ESS 2010–2018 (biennial); ISSP 1999	4,358
Puerto Rico	WVS 2018	477
Romania	WVS 2018; EVS 2018; GGP 2005; LITS 2006, 2010, 2016	8,207
Russia	WVS 2017; EVS 2017; ESS 2010, 2012, 2016; GGP 2004; ISSP 1999; LITS 2006, 2010, 2016	14,400
Senegal	LCS 2018	15,850
Serbia	WVS 2017; EVS 2018; LITS 2006, 2010, 2016	4,199
Singapore	WVS 2020	1,206
Slovakia	EVS 2017; ESS 2010, 2012, 2018, 2020; ISSP 1999; LITS 2006, 2010, 2016	6,650
Slovenia	EVS 2017; ESS 2010–2020 (biennial); ISSP 1999; LITS 2006, 2010, 2016	6,874
South Africa	NIDS 2008, 2010, 2012, 2014, 2017	15,338
South Korea	WVS 2018; KGSS 2003–2014 (annual), 2016	11,290
Spain	EVS 2017; ESS 2010–2018 (biennial); ISSP 1999	6,256
Sri Lanka	STEP 2012	1,665
Sweden	EVS 2017; ESS 2010–2018 (biennial); ISSP 1999; LITS 2010	4,826
Switzerland	EVS 2017; ESS 2010–2018 (biennial)	5,579
Taiwan	WVS 2019; TSCS 1990–2016 (annual)	46,479
Tajikistan	WVS 2020; LITS 2006, 2010, 2016	3,770
Tanzania	KHDS 1991, 1992, 1993, 1994, 2004, 2010	23,934
Thailand	WVS 2018	964
Togo	LCS 2018	7,794
Tunisia	WVS 2019; LMPS 2014	6,618

Turkey	WVS 2018; LITS 2006, 2010, 2016	5,198
Uganda	NPS 2005, 2013	2,167
Ukraine	WVS 2020; EVS 2020; ESS 2010, 2012; LITS 2006, 2010, 2016; STEP 2013	7,660
United Kingdom	EVS 2018; ESS 2010–2018 (biennial); LITS 2010	5,194
United States	WVS 2017; GSS 1982–2016 (annual), 2018; ISSP 1999	16,056
Uzbekistan	LITS 2006, 2010, 2016	3,230
Vietnam	WVS 2020; STEP 2012	2,488
Zimbabwe	WVS 2020	538

As noted in the main article, the overall level of missing data is low, and the surveys used have been widely recognized as nationally representative in their respective societies. Supplementary Figure 2 describes the patterns of missing values for parents' education across world regions (colour lines) and birth cohorts. As the levels of missing values for the other variables (i.e., individuals' education, age, and survey year) are below 0.5% of the original sample, the missing patterns for these variables are not described here.



Supplementary Figure 2 | Patterns of missing data for parents' education across world regions and birth cohorts.

As Supplementary Figure 2 shows, the levels of missing values for parents' education are relatively low and constant across birth cohorts in Asia and the Pacific, Africa, Europe, and the Middle East. By contrast, the levels of missing values are higher in North America and Latin America; and in both regions, the levels of missingness have slightly decreased across cohorts. These patterns concur with existing research noting the high prevalence of single parenthood in the Americas, compared with the other regions[4]. The higher level of missingness for fathers (vs. mothers) in the Americas also aligns with the higher prevalence of single motherhood than single fatherhood[4]. In light of these patterns, we conducted further robustness checks by excluding surveys with over 10% missing data on any of the variables used in our analysis (see Supplementary Figs. 7–8), which yielded findings that are substantively consistent with those reported in the main article. We chose not to impute missing values for parents' education for substantive reasons. For example, respondents in single-parent families are very unlikely to be influenced by their missing parent's education in their educational mobility, and those who have no knowledge of their parents' education are unlikely to be influenced by their parents' education either. In these cases, imputing parents' education would result in a misrepresentation of parental (educational) influence that may well not exist in reality.

As the survey datasets are proprietary and require access permission application, we do not have permission from the original data collectors to share our individual-level data. Instead, we provide links to each of the datasets in Supplementary Table 2 (date accessed: 30 January 2023), to enable readers to download the datasets.

Supplementary Table 2. List of data downloading links

Survey series name	Link for downloading data
CASEN – Encuesta de caracterización socioeconómica nacional	https://www.casen2022.gob.cl/
CaGSS – Canadian General Social Survey	https://www150.statcan.gc.ca/n1/en/catalogue/89F0115X
CGSS – Chinese General Social Survey	http://cgss.ruc.edu.cn/English/Home.htm
ECV – Ecuador Living Conditions Survey	https://www.ecuadorencifras.gob.ec/documentos/web-inec/ECV/ECV_2015/
EDAM – Enquête Djiboutienne auprès des Ménages – Indicateurs sociaux	https://microdata.worldbank.org/index.php/catalog/3463
EMOVI – ESRU Social Mobility Survey in Mexico	https://www.icpsr.umich.edu/web/DSDR/studies/35333
ENCV – Encuesta Nacional de Calidad de Vida	https://www.datos.gov.co/Estad-sticas-Nacionales/Encuesta-Nacional-de-Calidad-de-Vida-ECV-/mz9y-3x9k

ESS – European Social Survey	https://www.europeansocialsurvey.org/
EVS – European Values Survey	https://europeanvaluesstudy.eu/
GGP – Generations and Gender Programme	https://www.ggp-i.org/
GHS – General Household Survey, Nigeria	https://microdata.worldbank.org/index.php/catalog/3557
GSS – General Social Survey, USA	https://gss.norc.org/
HIES – Household Income and Expenditure Survey, Liberia	https://microdata.worldbank.org/index.php/catalog/2986
IHDS – India Human Development Survey	https://ihds.umd.edu/
ILFS – The Indonesian Family Life Survey	https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html
IHS – Integrated Household Survey	Gambia: https://microdata.worldbank.org/index.php/catalog/3323/related-materials Malawi: https://microdata.worldbank.org/index.php/catalog/1003; https://microdata.worldbank.org/index.php/catalog/2936; https://microdata.worldbank.org/index.php/catalog/3818
ISSP – International Social Survey Programme	https://issp.org/
JGSS – Japanese General Social Survey	https://csrda.iss.u-tokyo.ac.jp/english/socialresearch/joint/
KGSS – Korean General Social Survey	https://kossda.snu.ac.kr/handle/20.500.12236/21830
KHDS – Kagera Health and Development Survey	https://microdata.worldbank.org/index.php/catalog/359, https://microdata.worldbank.org/index.php/catalog/79, https://microdata.worldbank.org/index.php/catalog/2251
LCS – Living Conditions Survey	Benin: https://microdata.worldbank.org/index.php/catalog/4291 Burkina Faso: https://microdata.worldbank.org/index.php/catalog/4290 Cote D'Ivoire: https://microdata.worldbank.org/index.php/catalog/2847 Guinea-Bissau: https://microdata.worldbank.org/index.php/catalog/4293 Mali: https://microdata.worldbank.org/index.php/catalog/4295 Niger: https://microdata.worldbank.org/index.php/catalog/4296 Senegal: https://microdata.worldbank.org/index.php/catalog/4297 Togo: https://microdata.worldbank.org/index.php/catalog/4298
LITS – Life in Transitions Survey	https://www.ebrd.com/what-we-do/economic-research-and-data/data/lits.html
LMPS – Labour Market Panel Survey	Egypt: http://www.erfdataportal.com/index.php/catalog/157 Jordan: http://www.erfdataportal.com/index.php/catalog/139 Tunisia: http://www.erfdataportal.com/index.php/catalog/105

LSMS – Living Standard Measurement Survey	Albania: https://microdata.worldbank.org/index.php/catalog/64 Brazil: https://microdata.worldbank.org/index.php/catalog/277 Ghana: https://microdata.worldbank.org/index.php/catalog?sort_by=rank&sort_order=desc&sk=LSMS+ghana+ Nigeria: https://microdata.worldbank.org/index.php/catalog/1002
NIDS – National Income Dynamics Study, South Africa	http://www.nids.uct.ac.za/
NPS – National Panel Survey	Uganda: https://microdata.worldbank.org/index.php/catalog/1001/, https://microdata.worldbank.org/index.php/catalog/2663
PNAD – National Household Sample Survey, Brazil	https://www.ibge.gov.br/en/statistics/social/housing/20620-summary-of-indicators-pnad2.html?=&t=microdados
SES – Socioeconomic Survey	Ethiopia: https://microdata.worldbank.org/index.php/catalog/3823 Ghana: https://microdata.worldbank.org/index.php/catalog/2534 Iraq: https://microdata.worldbank.org/index.php/catalog/2334
STEP – STEP Skills Measurement Household Survey	Armenia: https://microdata.worldbank.org/index.php/catalog/2010 Bolivia: https://microdata.worldbank.org/index.php/catalog/2011 Colombia: https://microdata.worldbank.org/index.php/catalog/2012 Georgia: https://microdata.worldbank.org/index.php/catalog/2013 Ghana: https://microdata.worldbank.org/index.php/catalog/2015 Kenya: https://microdata.worldbank.org/index.php/catalog/2226 Laos: https://microdata.worldbank.org/index.php/catalog/2016 Macedonia: https://microdata.worldbank.org/index.php/catalog/2568 Philippines: https://microdata.worldbank.org/index.php/catalog/3182 Sri Lanka: https://microdata.worldbank.org/index.php/catalog/2017 Ukraine: https://microdata.worldbank.org/index.php/catalog/2572 Vietnam: https://microdata.worldbank.org/index.php/catalog/2018
TSCS – Taiwan Social Change Survey	https://www2.ios.sinica.edu.tw/sc/en/home2.php
WVS – World Values Survey	https://www.worldvaluessurvey.org/wvs.jsp

The data for constructing weights (i.e., the population size of each sex in each birth-year cohort from each society at age 5) in our individual-level analyses were obtained from the World Population Prospects compiled by the United Nations (https://population.un.org/wpp/), separately for men and women:

- United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: 2019 edition. File INT/3-2: male population by single age, major area, region and country, annually for 1950–2100 (thousands). Estimates, 1950–2020.

- United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: 2019 edition. File INT/3-3: female population by single age, major area, region and country, annually for 1950–2100 (thousands). Estimates, 1950–2020.

1.2. Further information on measures

1.2.1. Why did we focus on education rather than other socioeconomic indicators?

Our research focuses on intergenerational mobility in educational status rather than other often-studied dimensions such as occupation and income[5]. We chose to focus on educational status for a number of reasons. First, as a key dimension and indicator of social status, education not only reflects individuals' command of human capital and symbolic status, it also signals people's long-term socioeconomic potential in earnings and wealth accumulation[6,7]. Scholars often refer to education as the first source of stratification in adulthood[8]. Education is a strong predictor of individuals' economic outcomes such as earnings and occupations and non-pecuniary outcomes such as physical and mental health, fertility, delinquent behaviours, and psychological resilience[6]. Indeed, major occupational prestige measurements, such as the widely used International Socio-economic Index of Occupational Status (ISEI), are developed and calibrated based on workers' educational profiles in and across occupations[9].

In addition to its substantive importance in understanding social mobility, educational status is more comparable across different societies, compared with indicators such as occupation and income[10]. For example, occupational profiles and structures vary considerably across countries and regions. Even the most established occupational measurement schemes such as the ISEI and Goldthorpe's class categories (EGP) were developed from and applied primarily in advanced economies[9], which means that their comparative validity in low- and middle-income countries remains an open empirical question. Similar issues can also be found in substantially different modes of production underpinning income generation across distinct contexts[7]. By contrast, despite some cross-national institutional and cultural differences, mass education has expanded worldwide and institutional standards and organizational logic of education have been diffused globally for a long time[11]. Therefore, education is a more comparable indicator for our global study covering 106 societies that host nearly 90% of the world's population (as of 2022), as well as birth cohorts spanning 1956–1990. In addition, compared with income and occupation, education is subject to less recall, refusal, and reporting bias, especially when it comes to survey respondents' retrospective reports of their parental characteristics[6,7]. Characteristics such as income and occupation can change drastically over the life course whereas educational attainment is much more stable given that most people complete their education by early adulthood[5,6,10,12]. Given our focus on education expansion, intergenerational educational mobility is also more directly relevant than income and occupational mobility.

Despite the substantive importance and practical considerations informing our analytical choice, we note the limitations of focusing on educational mobility. The vertical dimension of education only partly captures individuals' social status, as people with the same level of education but with degrees from institutions that differ in prestige may have different social status[13]. Additionally, the correlation between education and other socioeconomic indicators such as earnings and occupational status may not always be linear[12].

1.2.2. Why did we use relative educational positions instead of absolute education?

Following several recent studies[14–16], we measured individuals' and their parents' education using relative rank positions rather than absolute education levels in our analysis of intergenerational mobility. Specifically, we ranked individuals' education among their peers born into the same 7-birth-year cohort, and we similarly ranked the educational positions of one's mother/father among mothers/fathers of individuals born into the same 7-birth-year cohort. Given that peers born in the same year form the most relevant comparative referents and the relevance decreases as one moves further away from the focal birth year, we assigned a full weight of 1 to the focal birth year *t* and decreasing radius weights[14] of 0.75 to *t* +/– 1, 0.5 to *t* +/– 2, and 0.25 to *t* +/– 3.

Several substantive and methodological rationales underpin our use of relative educational positions. Substantively, our key interest is in social mobility in terms of educational status rather than absolute educational achievement. While educational achievement usually refers to the absolute level of education attained by individuals, status is relatively defined through social comparison[17]. As education expansion has led to considerable compositional shifts in the educational structure of the population, the marginal distribution of education varies considerably across societies and cohorts[14,15]. In this case, comparing absolute education is not particularly meaningful for understanding social mobility. For example, in earlier cohorts and societies where education expansion was limited, individuals with tertiary education would have a much higher educational status than their counterparts in cohorts and societies where the expansion of tertiary education is at a high level. Thus, relative educational positions speak directly to the key concern of social mobility and stratification research regarding the extent to which parents' educational status determines that of their children.

Methodologically, relative educational position is particularly suited for estimating the impact of education expansion on intergenerational mobility. Ranking individuals' and parents' educational positions within cohort and society resembles a "standardization" procedure that levels off differentials across societies and cohorts in the marginal distribution (i.e., composition) of education. While such marginal distribution would have formed part of an absolute education measure, the use of relative educational position measures allows us to partition out and create separate variables for education composition. Effectively, we have "decomposed" absolute education measures into relative rank measures (free of marginal distribution) and education composition measures (capturing the marginal distribution).

1.2.3. Why did we measure parents' educational pairing at an aggregate rather than an individual level?

We conceptualized and operationalized parents' educational pairing at an aggregate society-cohort level rather than an individual level, for both methodological and substantive reasons. Methodologically, individual-level measures for parents' educational pairing are calculated by subtracting mothers' absolute education (M_{edu}) from fathers' absolute education (F_{edu}); and statistically, including M_{edu}, F_{edu} and $M_{edu} - F_{edu}$ in the same model would result in perfect collinearity. Although we used relative rank measures for mothers' ($M_{edu'}$) and fathers' ($F_{edu'}$) educational positions at the individual level in our models, the measures were nonetheless strongly correlated with their corresponding absolute education measures. In this case, including both parents' educational positions ($M_{edu'}$ and $F_{edu'}$) and individual-level measures for parents' educational pairing ($M_{edu} - F_{edu}$) would still lead to severe (though not perfect) collinearity.

Substantively, our primary interest is in how intergenerational educational mobility is associated with two macro-level changes: education expansion and shifting patterns of parents' educational pairing. Recent literature suggests that education expansion is a necessary but not sufficient condition for changes in couples' educational pairing patterns[17]. The extent to which education expansion translates into changing educational pairing patterns also hinges on gendered educational opportunity, normative recognition of women's education, and broader gender empowerment in a given context[18,19]. While mainstream gender (in)equality and empowerment indices only started in the late 1990s (i.e., not applicable to our earlier birth cohorts), macro patterns of parents' educational pairing provide a good proxy for capturing gendered institutional and cultural contexts such as opportunities and norms regarding women's (versus men's) education and gender empowerment. In this sense, if changes in parents' educational pairing patterns are solely a result of compositional changes in education owing to education expansion, we would expect the two to mediate each other in predicting intergenerational educational mobility. By contrast, the mediation relationship will be weak or absent if parents' educational pairing patterns capture gendered educational opportunities, gender norms, and gender empowerment, over and above education expansion. Our findings support the latter, showing little mediation between education expansion and parents' educational pairing patterns in predicting intergenerational educational mobility at the society-cohort level. Our findings thus underscore parents' educational pairing patterns as an essential part of a gender-sensitive approach to examining intergenerational mobility and highlight the need for social mobility research to recognize and consider the gendered context in which education expansion takes place.

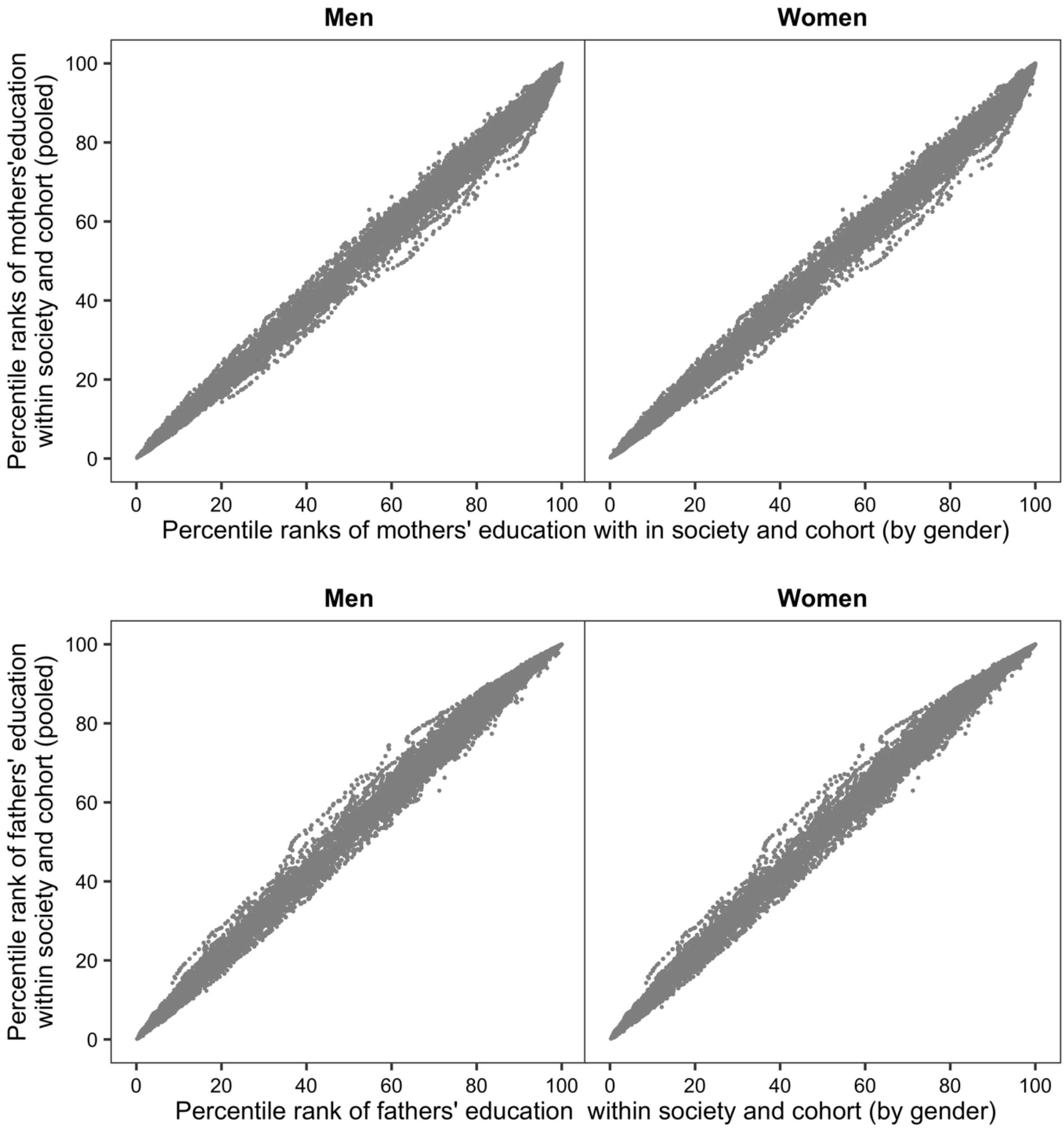
1.2.4. Why did we rank the education of men and women together rather than separately?

While some previous studies on social mobility ranked the education and occupation of men and women separately[14,15], we chose to rank male and female individuals together in one pool for the following reason. As we examined individuals' educational positions as a proxy for their destination of social mobility, we wanted to understand one's overall educational position in a given cohort of a given society rather than one's gender-specific position relative to their same-gender peers. Nonetheless, ranking individuals' education separately for men and women would yield substantively consistent results because educational positions calculated from gender-specific and pooled ranks are highly correlated, as shown in Supplementary Figure 3. The scatterplots depict the bivariate correlation between the percentile ranks of individuals' education ranked with and without gender distinction, with the black lines indicating linear fit and each grey dot representing an individual (N = 824,910 men and 960,773 women; Pearson's $r > 0.99$ for both men and women, two-tailed $P < 0.001$ for both).

Supplementary Figure 3 | Scatterplots of two-way correlations between percentile ranks of individuals' education within society and cohort, ranked without and with gender differentiation.

1.2.5. Why did we rank the education of the mother and the father separately rather than together?

We ranked mothers' and fathers' education separately rather than together for two major reasons. Methodologically, compared with the individuals included in this study (born between 1956 and 1990), education opportunities were much more limited, particularly for women, a generation back for the individuals' parents[11,20]. Ranking mothers' and fathers' educational positions separately helps ensure that our measures are not confounded by gender differences in educational distribution[15]. Substantively, a key argument of our study is the additional role that mothers' educational positions play, net of fathers' educational positions, in shaping individuals' educational positions. Thus, we ranked mothers' educational positions on their own as a separate origin of individuals' intergenerational mobility. Nevertheless, ranking mothers' and fathers' education separately and together would yield substantively consistent results because the two are strongly correlated, as shown in Supplementary Figure 4. The scatterplots depict the bivariate correlation between the percentile ranks of parents' education ranked with and without distinguishing the parents' gender, with the black lines indicating linear fit and each grey dot representing an individual (N = 824,910 men and 960,773 women; Pearson's $r > 0.99$ for both parents' educational positions among both men and women, two-tailed $P < 0.001$ for all).



Supplementary Figure 4 | Scatterplots of two-way correlations between percentile ranks of parents' education within society and cohort, ranked without and with gender differentiation.

1.3.Further information on weighting

We weighted all analyses underpinning Figs. 1–4 (in the main article) and the step-1 models underpinning Figs. 5–6 (in the main article) such that the weighted sample for each sex in each birth year from each society was equal to the corresponding population size of the same birth year and sex at age 5 (i.e., school entry age) in that society. We used population sizes at age 5 rather than at birth to account for considerable differences in infant and early childhood mortality rates across cohorts and societies[21]. We did not apply weights in the second step of the multilevel regression models underpinning Figs. 5–6. With each observation representing 1 society-cohort unit in the step-2 models, not weighting the analysis meant that each society-cohort unit was counted equally in the analysis. Therefore, the results were not driven by societies and/or cohorts with large populations.

1.4. Further information on modelling

1.4.1. Two-step versus one-step multilevel regression models

We chose to fit two-step rather than one-step multilevel regression models for several reasons. First, our primary interest lies in the higher-level results regarding how the association between mothers' (versus fathers') educational positions and individuals' positions varies across cohorts and societies (rather than the individual-level results)[22]. If we were to estimate one-step mixed-effects two-level regression models, we would need to include cross-level interactions between mothers'/fathers' educational positions and each of the education composition measures, as well as random slopes for mothers' and fathers' educational positions. Given our large sample at the individual level ($N = {\sim}1.79$ million), estimating such models would be very time-consuming, but the results are very similar to those estimated using the more computationally efficient two-step procedure. Second, in fitting one-step mixed-effects models, we would need to additionally scale the individual-level weights such that the weighted sample sizes are equal across all society-cohort units[22], to ensure that the results are not driven by populous societies and cohorts; but this step is automatically implemented in the two-step strategy by not weighting step-2 models. Third, the two-step strategy has the added advantage of allowing for the inclusion of two-way society and cohort fixed effects, which helps account for unobserved heterogeneities across cohorts and societies.

1.4.2. Additional information on the step-2 model specification

We chose to fit generalized least squares rather than ordinary least squares regression models in the second step of our multilevel analysis because tests show notable heteroskedasticity and within-society autocorrelation in the step-2 data[23]. As shown in Supplementary Table 3, the Breusch-Pagan tests (χ^2) rejected the null hypothesis of no heteroskedasticity and the Wooldridge tests (F) for autocorrelation also rejected the null hypothesis of no autocorrelation in the data.

In fitting step-2 generalized least squares models (for Figs. 5–6 in the main article), we allowed for society-specific patterns of autocorrelation using the *psar1* standard error specification provided as part of the *xtgls* command in Stata. This means that our analysis took account of potential variations in the patterns of autocorrelation across different societies. To minimize the influence of outlier cases, we bottom- and top-coded the coefficients for mothers' and fathers' educational positions predicting individuals' educational positions from step-1 models at the 1st and 99th percentiles, respectively, before entering them into the step-2 models as dependent variables. The results are robust to excluding rather than bottom-/top-coding cases falling below the 1st percentile and above the 99th percentile. To aid the interpretation of results, we graphed average marginal effects for the main effects (Fig. 5 in the main article) and the predicted values of the dependent variables over the distributions of our key predictors (Fig. 6 in the main article). The average marginal effects for each predictor and the predictive values of the dependent variables were calculated by holding all other variables at their observed values.

Supplementary Table 3. Heteroskedasticity and autocorrelation tests for the generalized least squares models

Tests	Men – DV: Coefficient for mothers' educational positions	Men – DV: Coefficient for fathers' educational positions	Women – DV: Coefficient for mothers' educational positions	Women – DV: Coefficient for fathers' educational positions
Breusch-Pagan heteroskedasticity test: χ^2 (P)	2.31 (0.128)	30.87 (< 0.001)	223.35 (< 0.001)	40.72 (< 0.001)
Wooldridge autocorrelation test: F (P)	50.85 (< 0.001)	23.82 (< 0.001)	45.66 (< 0.001)	42.00 (< 0.001)

In the step-2 models, we only included individuals' education composition measures to capture education expansion experienced by the individuals but not their parents, to avoid the problem of multicollinearity. Given the strong correlation between the education composition measures for individuals and their parents, the presence of multicollinearity would have substantially inflated the standard errors of the predictors concerned[24]. Specifically, it would be problematic to include education composition measures for both the mother and the father, as the bolded numbers in Supplementary Table 4 show that the two are closely correlated.

Supplementary Table 4. Correlation matrix of compositional measures for mothers' and fathers' education

Measure (Pearson's r)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(1) % of mothers: secondary education	1.000				
(2) % of mothers: post-secondary education	0.405	1.000			
(3) % of mothers: tertiary education	0.411	0.558	1.000		
(4) % of fathers: secondary education	**0.970**	0.388	0.388	1.000	
(5) % of fathers: post-secondary education	0.421	**0.907**	0.537	0.377	1.000
(6) % of fathers: tertiary education	0.550	0.558	**0.929**	0.492	0.539

Given the above results, we then calculated parents' education composition measures without distinguishing between the mother and the father. As shown by the bolded numbers in Supplementary Table 5, there is a strong correlation between the education composition measures for the individuals and their parents.

Supplementary Table 5. Correlation matrix of compositional measures for individuals' and parents' education

Measure (Pearson's r)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(1) % of individuals: secondary education	1.000				
(2) % of individuals: post-secondary education	0.047	1.000			
(3) % of individuals: tertiary education	0.055	0.275	1.000		
(4) % of parents: secondary education	**0.602**	0.302	0.540	1.000	
(5) % of parents: post-secondary education	0.035	**0.672**	0.468	0.411	1.000
(6) % of parents: tertiary education	0.005	0.259	**0.832**	0.473	0.571

In addition to the correlation matrices presented above, we conducted variance inflation factor (VIF) tests to assess the level of multicollinearity between individuals' and their parents' education composition measures. The uncentred VIF scores for parents' education composition measures ranged between 15.73 and 62.01, which are much higher than the rule-of-thumb threshold of 2.5 that could allow for safely assuming the absence of multicollinearity (https://statisticalhorizons.com/multicollinearity/). Therefore, parents' education composition measures were not included in our analysis.

1.5.How to use the replication codes?

Full replication codes are available through the Open Science Framework: https://osf.io/3q75x/. To use the codes to reproduce our results, one will need to download all datasets using the links listed in Supplementary Table 2. The data files should be placed in their respective (society and year) folders that are named and structured as shown in Supplementary Table 6. To replicate the analysis, one also needs to download and compile a dataset for population sizes at age 5 by sex, birth year (1956–1990), and society from the World Population Prospects (https://population.un.org/wpp/), name the data file "cohort_population_size_by_gender.dta", and place the file in the root folder ("*/Data/").

Supplementary Table 6. Replication data storage folder paths

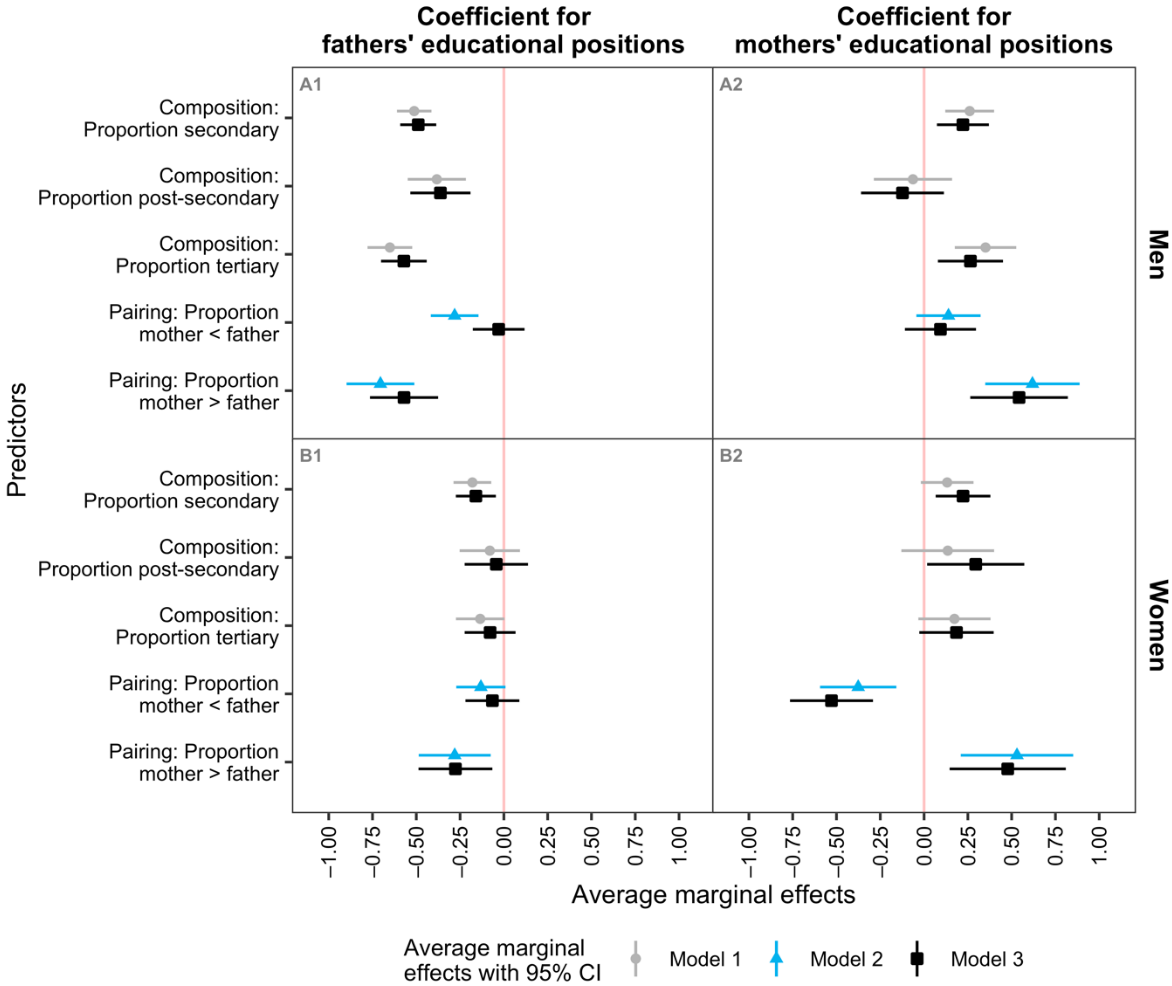
Root folder	First-level folders	Second-level folders	Third-level folders
*/Data/	CASEN_Chile	2006 2009 2011 2013 2015 2017	–
	CGSS_China	–	–
	EDAM_Djibouti	2002 2012 2017	–
	EMOVI_Mexico	2012	–
	ENCV_Colombia	2010 2011 2012 2013 2014 2015 2016 2017 2018 2019	–
	ESS	–	–
	EVC_Ecuador	–	–
	GGP	–	–
	GHS_Nigeria	2010 2012 2015 2018	–
	GSS_Canada	–	–
	GSS_USA	–	–
	HIES_Liberia	2014 2016	–
	IFLS_Indonesia	2000 2007 2014	–
	IHDS_India	2005 2011	–
	IHS	Gambia Malawi	2015 2010-11 2016-17

	Sierra Leone	2019-20 2003 2011
ISSP	1999	–
JGSS_Japan	–	–
KGSS_Korea	–	–
KHDS_Tanzania	1991 1992 1993 1994 2004 2010	–
LCS	Benin Burkina Faso Côte d'Ivoire Guinea-Bissau Mali Niger Senegal Togo	2018 2018 2018 2018 2018 2018 2018 2018
LITS	–	–
LMPS	–	–
LS(M)S	Albania Brazil Ghana Nigeria	2005 1996 2005 2012 2017 2018
NIDS_South Africa	2008 2010 2012 2014 2017	–
NPS	Tanzania Uganda	2008-2015 2019 2005 2013
PNAD_Brazil	–	–
SES	Ethiopia Ghana Iraq	2013 2018 2010 2012
STEP	Armenia 2013 Bolivia 2012 Colombia 2012 Georgia 2013 Ghana 2013 Kenya 2013 Laos 2012 Macedonia 2013 Philippines 2015 Sri Lanka 2012 Ukraine 2013 Vietnam 2012	–
TSCS_Taiwan	–	–
WVS_EVS	–	–

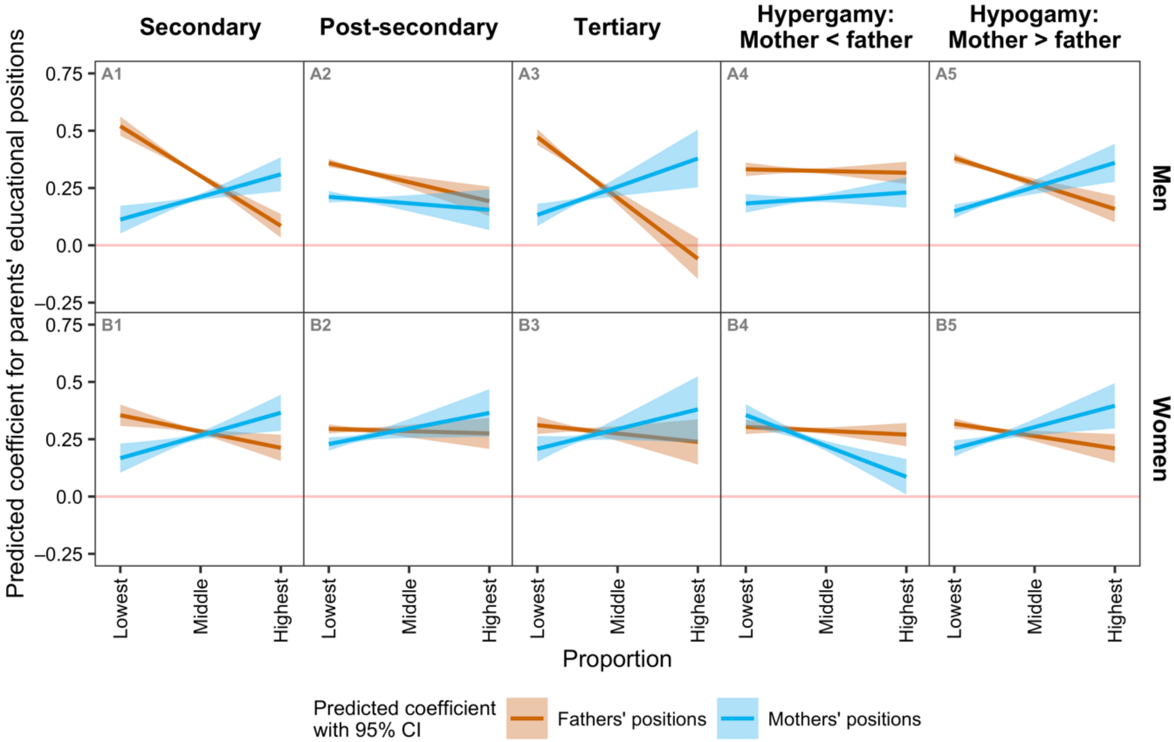
The Stata do-files contain codes for harmonizing, cleaning, preparing, and analyzing data. Data for producing all figures are exported from Stata, in the *.dta format, for graphing in R. The "1. MASTER.do" file integrates and calls for all specific do-files and R scripts for the full workflow. While the data cleaning do-files include files for cleaning specific datasets, one does not need to manually run through each of the specific data cleaning do-files as they are incorporated into the main data cleaning do-file "2. Data_cleaning_all.do". Readers who wish to use our codes for replication, however, will need to change the file paths for Stata in the "1. MASTER.do" file and the work directory for R at the beginning of the R script "5. Producing_figures (Figs. 1-6 & S1-22).R" based on the file and folder paths one uses locally. To replicate the main and supplementary analyses, all Stata do files and R scripts will need to be executed following the numeric order of the files such that necessary data files are produced for subsequent analyses. All our analyses were conducted using Stata 17 MP (4-core) and replicated using Stata 16 MP (4-core). The graphs were produced using the *ggplot2* package (version 3.4.0) in R Studio (version 2022.07.1, build 554).

2. SUPPLEMENTARY RESULTS

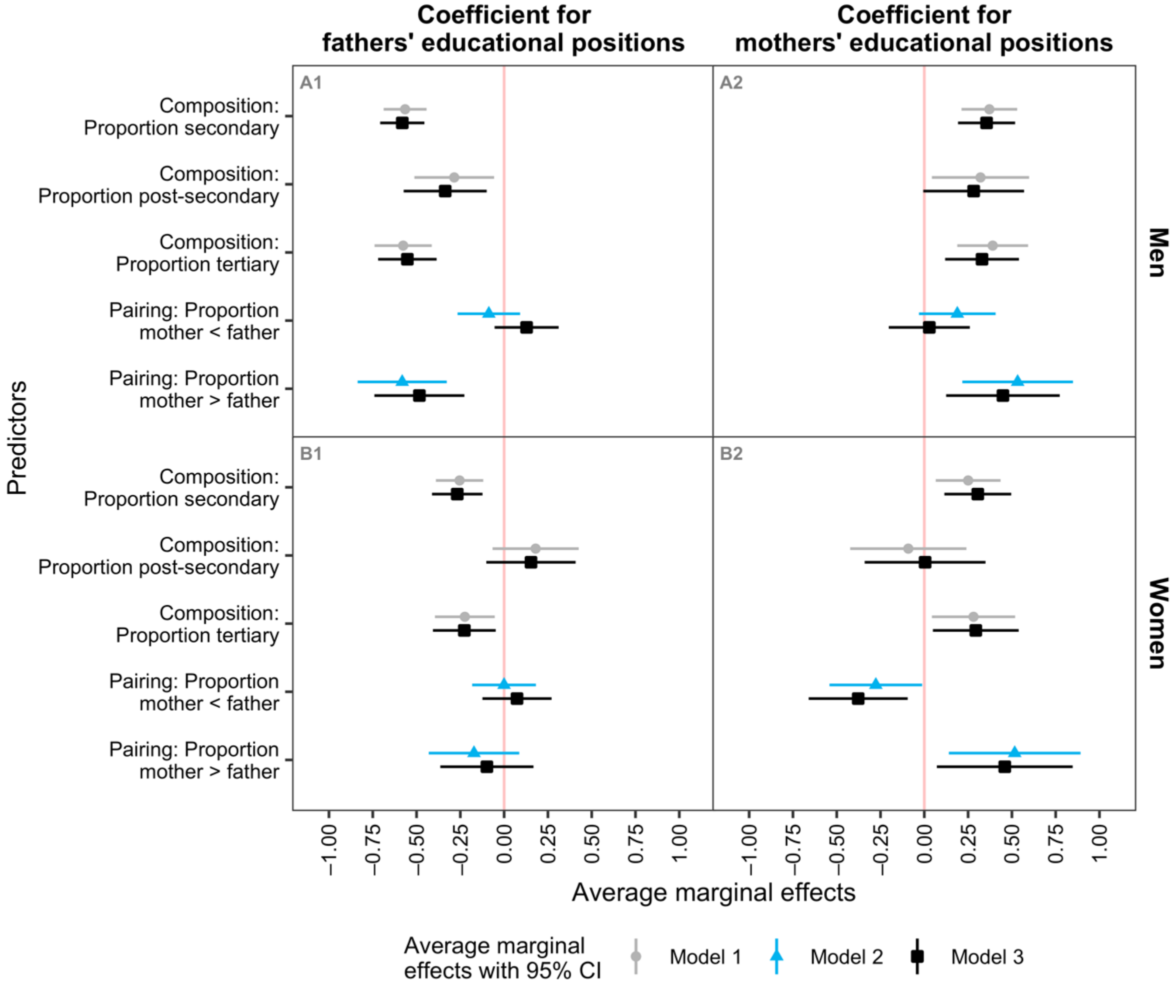
2.1.Supplementary Figures 5–22



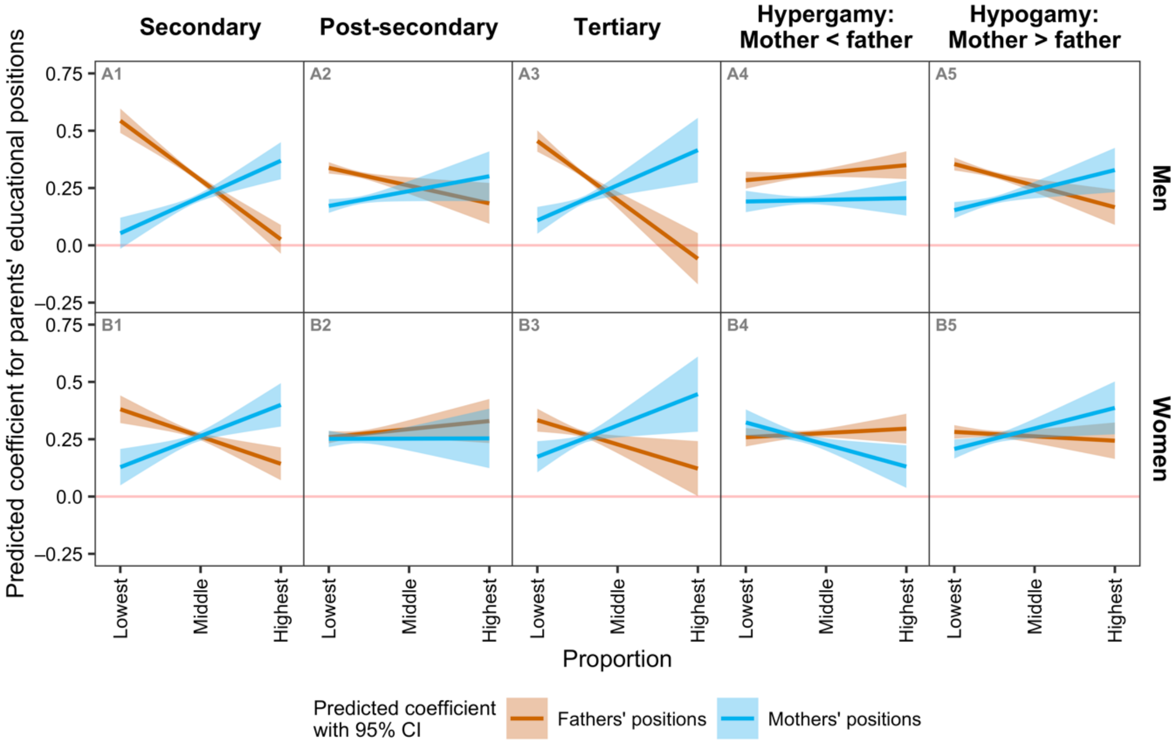
Supplementary Figure 5 | Excluding "small" societies: Average marginal effects of education expansion and parents' educational pairing patterns on intergenerational educational persistence. Error bars indicate 95% confidence intervals, and red baselines indicate marginal effects equal to zero. Model 1 only included education expansion measures, Model 2 only included parents' educational pairing patterns, and Model 3 included both sets of predictors. All models also included society and birth year dummies. The sample sizes for a few societies included in our analysis were relatively small. In our sensitivity analysis, we excluded 6 societies where $N < 700$ (i.e., excluding a total of 2,826 individuals – 0.2% of the full individual-level analytical sample, and 419 society-cohorts – 5.7% of the full society-cohort level sample): Argentina, Hong Kong, Macau, Nicaragua, Puerto Rico, and Zimbabwe. The results from the robustness analysis are substantively consistent with those reported in the main article, and they are also robust to alternative "small society" cut-offs such as $N < 500$ or $N < 1,000$. $N = 3,483$ and 3,479 society-cohort units for men and women, respectively.



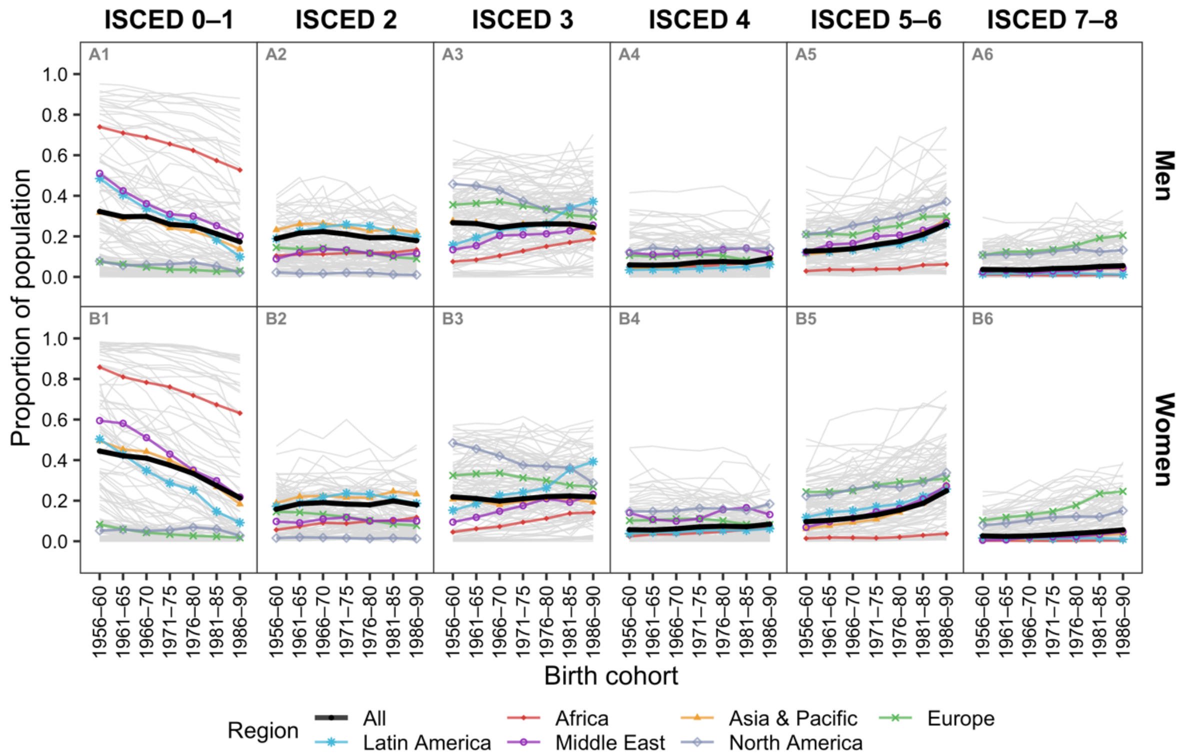
Supplementary Figure 6 | Excluding "small" societies: Predicted coefficients for parents' educational positions over the distributions of education expansion and parents' educational pairing patterns. The lines indicate predicted coefficients, with colour bands indicating 95% confidence intervals, and red baselines indicate coefficients equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Predictions based on Model 3 presented in Supplementary Fig. 5, holding all non-focal variables at their observed values. Lowest refers to minimum values and highest refers to maximum values: the ranges are 0.018–0.874 for secondary education, 0–0.459 for post-secondary education, 0.003–0.923 for tertiary education, 0–0.504 for hypergamy, and 0–0.385 for hypogamy. The sample sizes for a few societies included in our analysis were relatively small. In our sensitivity analysis, we excluded 6 societies where $N < 700$ (i.e., excluding a total of 2,826 individuals – 0.2% of the full individual-level analytical sample, and 419 society-cohorts – 5.7% of the full society-cohort level sample): Argentina, Hong Kong, Macau, Nicaragua, Puerto Rico, and Zimbabwe. The results from the robustness analysis are substantively consistent with those reported in the main article, and they are also robust to alternative "small society" cut-offs such as $N < 500$ or $N < 1{,}000$. $N =$ 3,483 and 3,479 society-cohort units for men and women, respectively.



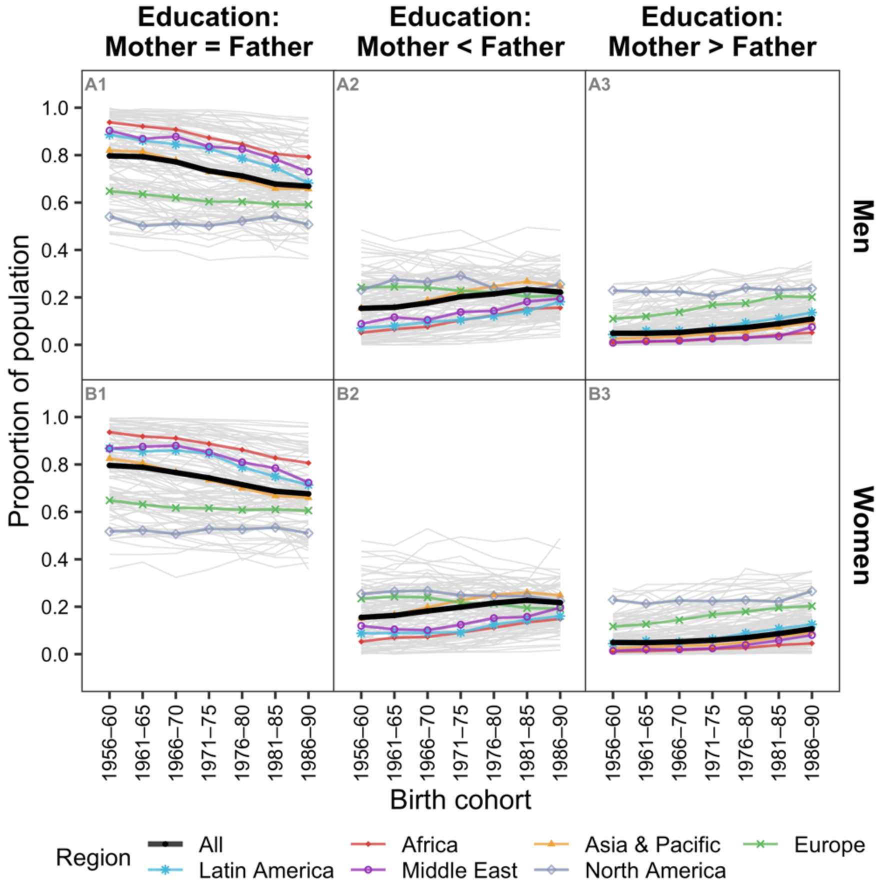
Supplementary Figure 7 | Excluding surveys with > 10% missing data: Average marginal effects of education expansion and parents' educational pairing patterns on intergenerational educational persistence. Error bars indicate 95% confidence intervals, and red baselines indicate marginal effects equal to zero. Model 1 only included education expansion measures, Model 2 only included parents' educational pairing patterns, and Model 3 included both sets of predictors. All models also included society and birth year dummies. To test whether surveys with relatively high levels of missing data affected our results, we re-ran all analyses excluding surveys with > 10% missing data. A total of 461,024 individuals and 269 society-cohort units were deleted from the analysis. The results are substantively consistent with those reported in the main article. N = 3,559 and 3,553 society-cohort units for men and women, respectively.



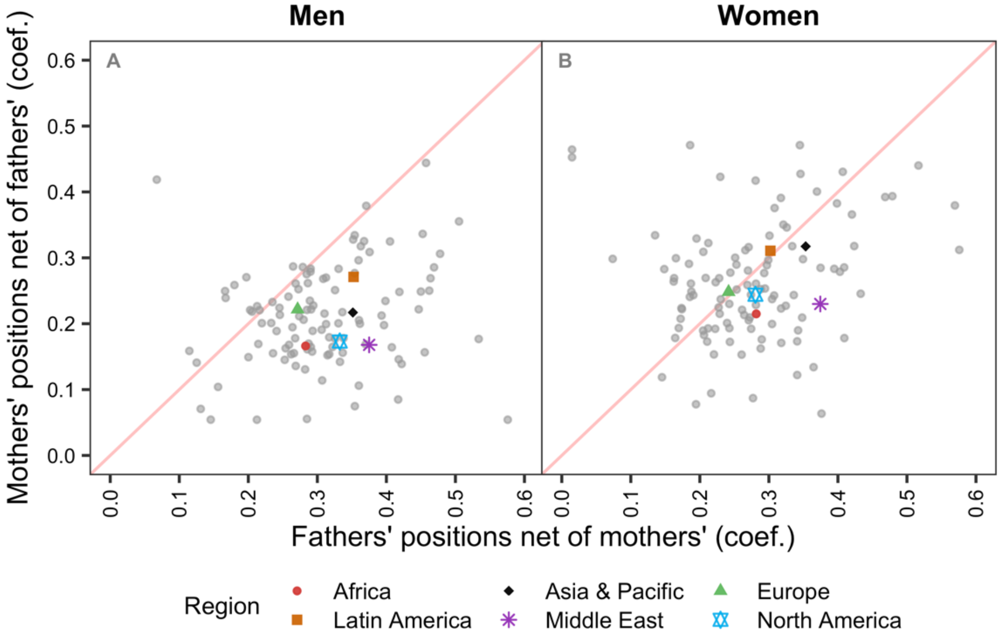
Supplementary Figure 8 | Excluding surveys with > 10% missing data: Predicted coefficients for parents' educational positions over the distributions of education expansion and parents' educational pairing patterns. Colour lines indicate predicted coefficients, with colour bands indicating 95% confidence intervals, and red baselines indicate coefficients equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Predictions based on Model 3 presented in Supplementary Fig. 7, holding all non-focal variables at their observed values. Lowest refers to minimum values and highest refers to maximum values: the ranges are 0.018–0.874 for secondary education, 0–0.459 for post-secondary education, 0.003–0.923 for tertiary education, 0–0.504 for hypergamy, and 0–0.385 for hypogamy. To test whether surveys with relatively high levels of missing data affected our results, we re-ran all analyses excluding surveys with > 10% missing data. A total of 461,024 individuals and 269 society-cohort units were deleted from the analysis. The results are substantively consistent with those reported in the main article. N = 3,559 and 3,553 society-cohort units for men and women, respectively.



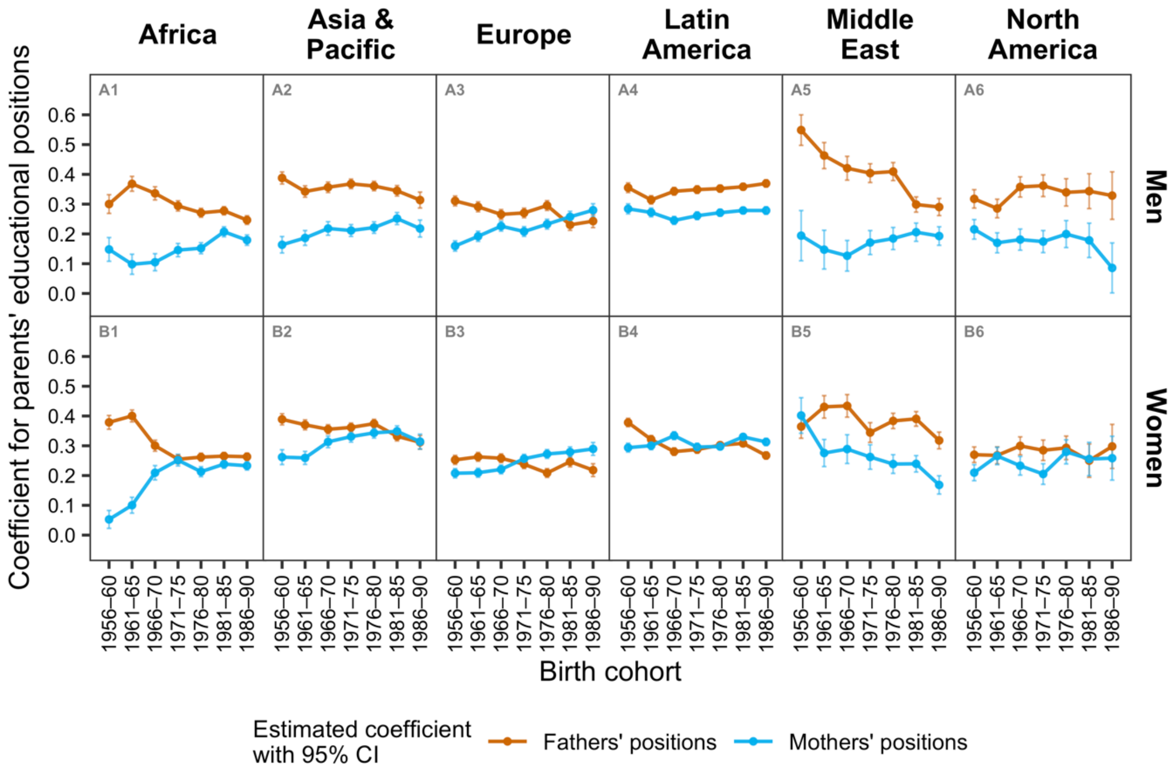
Supplementary Figure 9 | 5-birth-year instead of 7-birth-year rolling calculation: Cohort changes in education composition, by region and society. Grey lines depict mean cohort trajectories for each society, colour lines depict the mean trajectories for each region, and the bold black line depicts the mean trajectory for the world. ISCED = International Standard Classification of Education, where level 0 = no formal schooling, level 1 = primary education, level 2 = lower secondary education, level 3 = upper secondary education, level 4 = post-secondary education, level 5 = short-cycle tertiary education, level 6 = Bachelor's or equivalent, level 7 = Master's or equivalent, and level 8 = Doctorate or equivalent. In the main article, we calculated the education composition measures based on 7-birth-year rolling samples with decreasing radius weighting. This was to ensure sufficient cell sizes for the analyses. Nonetheless, our results are robust to using alternative 5-birth-year rolling calculations, with decreasing radius weighting that assigns 1 to *t*, 0.67 to *t* +/– 1, and 0.34 to *t* +/– 2. The results based on the 5-birth-year rolling samples are consistent with those reported in Fig. 1 in the main article. *N* = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.



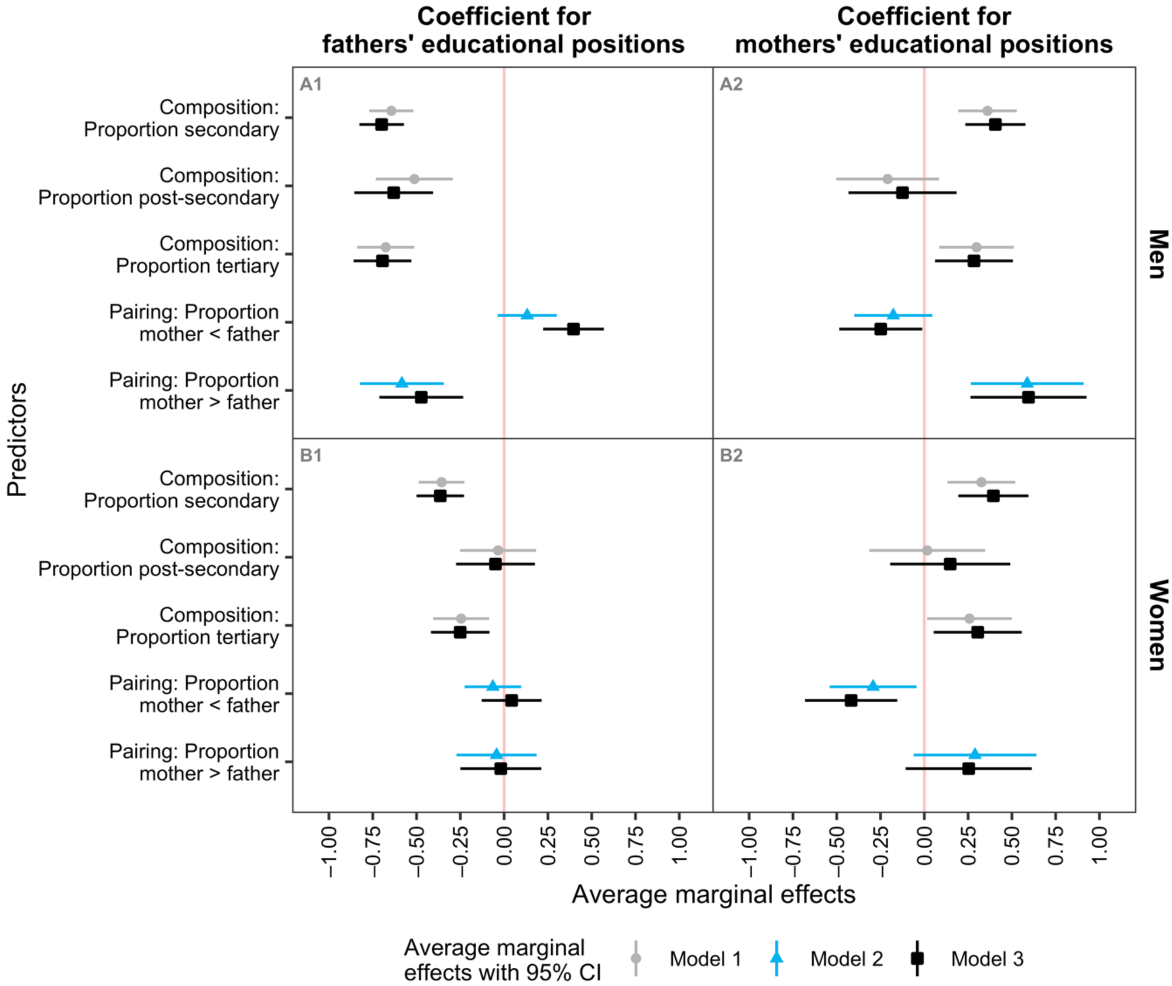
Supplementary Figure 10 | 5-birth-year instead of 7-birth-year rolling calculation: Cohort changes in parents' educational pairing patterns, by region and society. Grey lines depict mean cohort trajectories for each society, colour lines depict the mean trajectories for each region, and the bold black line depicts the mean trajectory for the world. ISCED = International Standard Classification of Education, where level 0 = no formal schooling, level 1 = primary education, level 2 = lower secondary education, level 3 = upper secondary education, level 4 = post-secondary education, level 5 = short-cycle tertiary education, level 6 = Bachelor's or equivalent, level 7 = Master's or equivalent, and level 8 = Doctorate or equivalent. In the main article, we calculated parents' educational pairing patterns based on 7-birth-year rolling samples with decreasing radius weighting. This was to ensure sufficient cell sizes for the analyses. Nonetheless, our results are robust to using alternative 5-birth-year rolling calculations, with decreasing radius weighting that assigns 1 to t, 0.67 to t +/– 1, and 0.34 to t +/– 2. The results based on the 5-birth-year rolling samples are consistent with those reported in Fig. 2 in the main article. N = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.



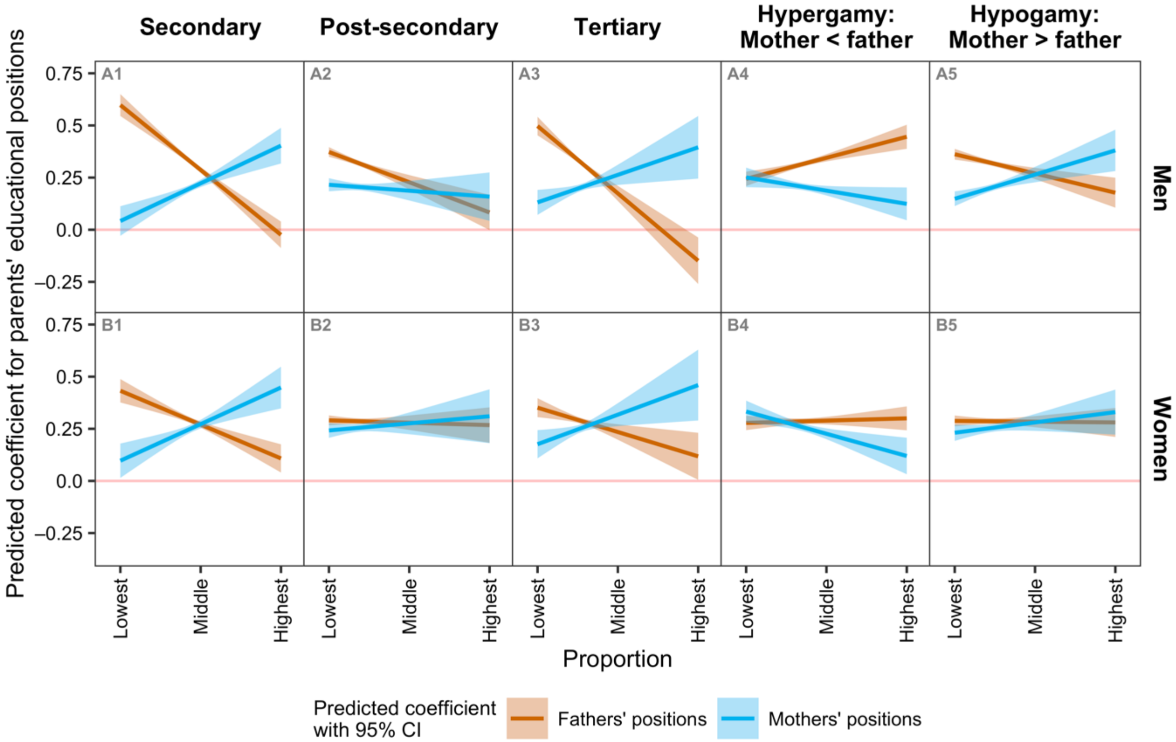
Supplementary Figure 11 | 5-birth-year instead of 7-birth-year rolling calculation: Coefficients for mothers' and fathers' educational positions from models predicting men's and women's educational positions, across 106 societies. Each grey dot represents one society, each colour symbol indicates one region, and the red diagonal lines indicate equality in the size of coefficients for the educational positions of the mother and the father. In the main article, we calculated the educational position measures based on 7-birth-year rolling samples with decreasing radius weighting. This was to ensure sufficient cell sizes for the analyses. Nonetheless, our results are robust to using alternative 5-birth-year rolling calculations, with decreasing radius weighting that assigns 1 to *t*, 0.67 to *t* +/– 1, and 0.34 to *t* +/– 2. The results based on the 5-birth-year rolling samples are consistent with those reported in Fig. 3 in the main article. N = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.



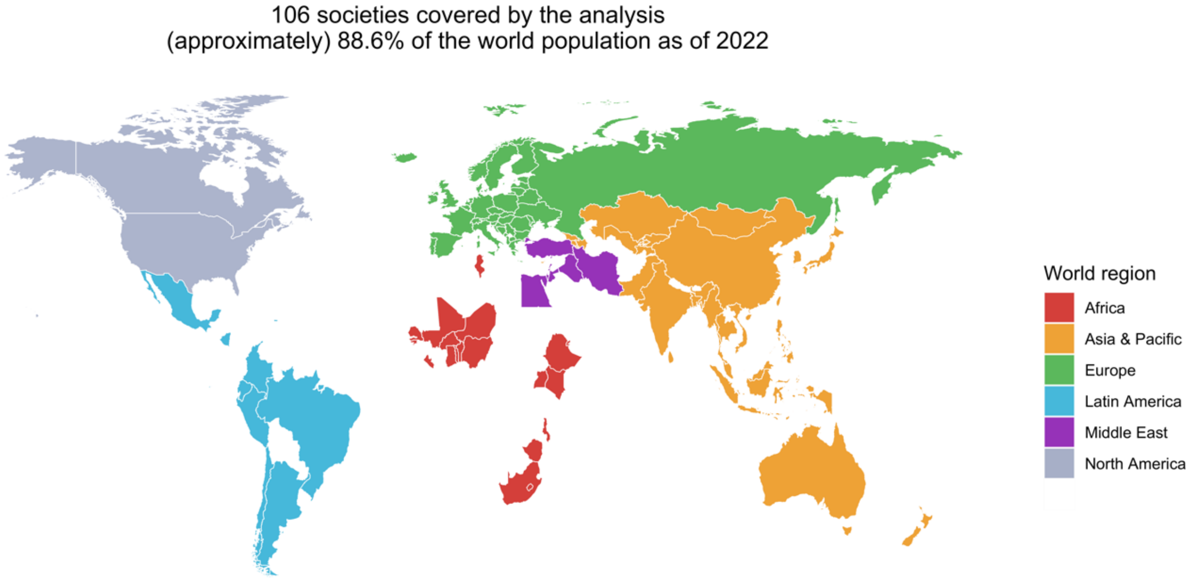
Supplementary Figure 12 | 5-birth-year instead of 7-birth-year rolling calculation: Coefficients for mothers' and fathers' educational positions from models predicting men's and women's educational positions, across birth cohorts 1956–1990. Data points depict estimated coefficients, with error bars indicating 95% confidence intervals. In the main article, we calculated the educational position measures based on 7-birth-year rolling samples with decreasing radius weighting. This was to ensure sufficient cell sizes for the analyses. Nonetheless, our results are robust to using alternative 5-birth-year rolling calculations, with decreasing radius weighting that assigns 1 to t, 0.67 to t +/– 1, and 0.34 to t +/– 2. The results based on the 5-birth-year rolling samples are consistent with those reported in Fig. 4 in the main article. N = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.



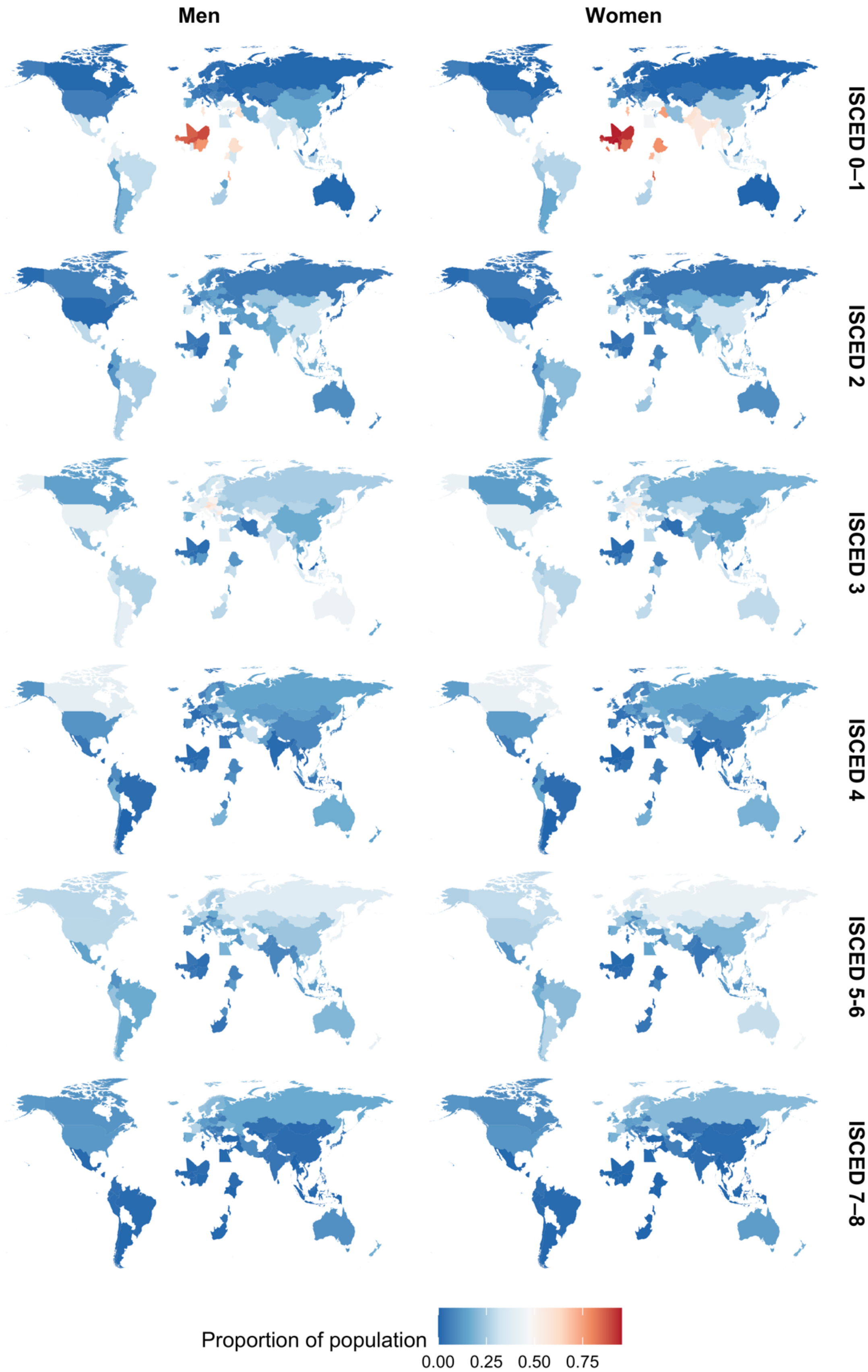
Supplementary Figure 13 | 5-birth-year instead of 7-birth-year rolling calculation: Average marginal effects of education expansion and parents' educational pairing patterns on intergenerational educational persistence. Error bars indicate 95% confidence intervals, and red baselines indicate marginal effects equal to zero. Model 1 only included education expansion measures, Model 2 only included parents' educational pairing patterns, and Model 3 included both sets of predictors. All models also included society and birth year dummies. In the main article, we calculated the educational position measures and fitted the step-1 models based on 7-birth-year rolling samples with decreasing radius weighting. This was to ensure sufficient cell sizes for the analyses. Nonetheless, our results are robust to using alternative 5-birth-year rolling calculations, with decreasing radius weighting that assigns 1 to t, 0.67 to t +/– 1, and 0.34 to t +/– 2. The results based on the 5-birth-year rolling samples are consistent with those reported in Fig. 5 in the main article. N = 3,693 and 3,688 society-cohort units for men and women, respectively.



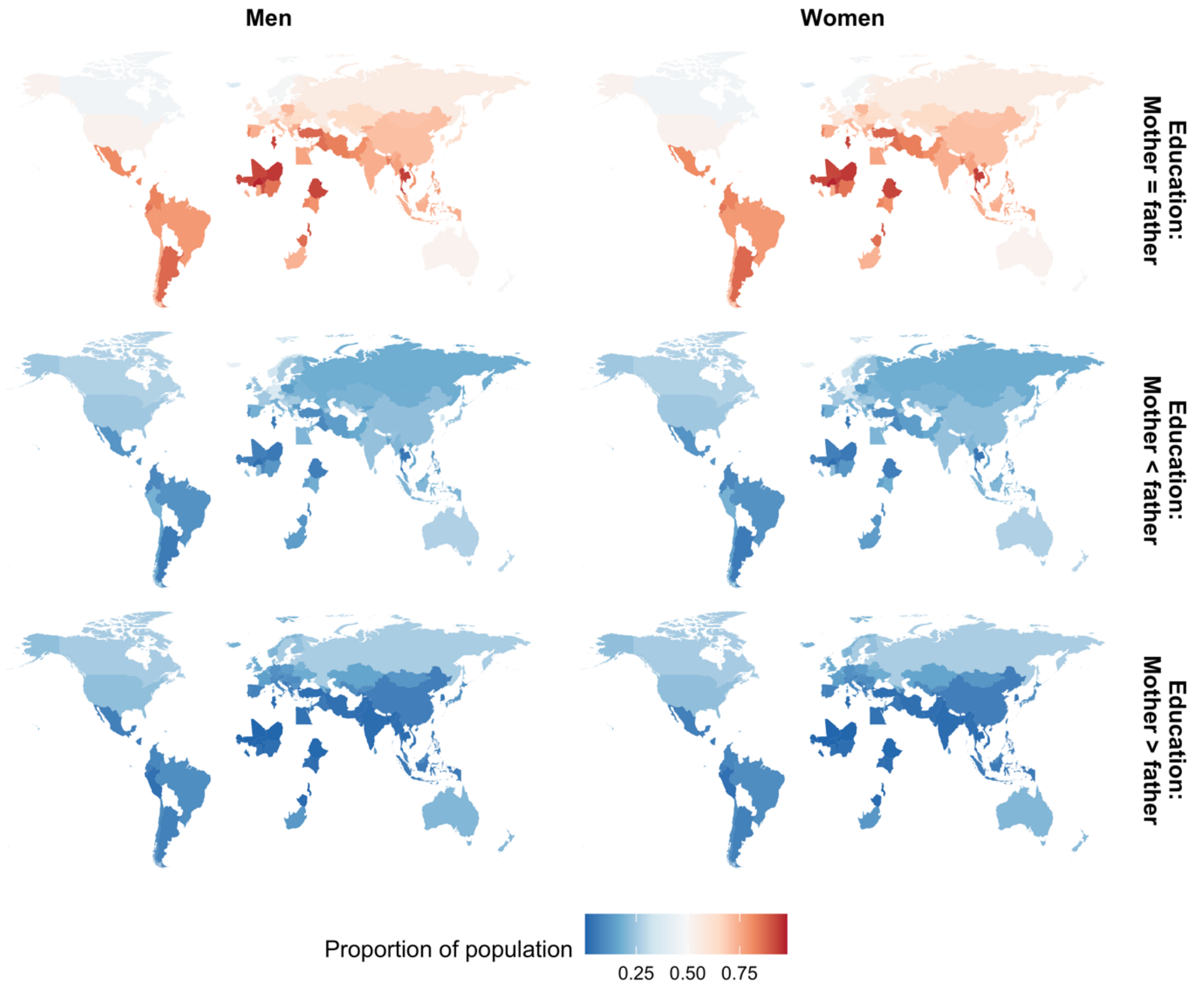
Supplementary Figure 14 | 5-birth-year instead of 7-birth-year rolling calculation: Predicted coefficients for parents' educational positions over the distributions of education expansion and parents' educational pairing patterns. Colour lines indicate predicted coefficients, with colour bands indicating 95% confidence intervals, and red baselines indicate coefficients equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Predictions based on Model 3 presented in Supplementary Fig. 13, holding all non-focal variables at their observed values. Lowest refers to minimum values and highest refers to maximum values: the ranges are 0.018–0.874 for secondary education, 0–0.459 for post-secondary education, 0.003–0.923 for tertiary education, 0–0.504 for hypergamy, and 0–0.385 for hypogamy. In the main article, we calculated the educational position measures and fitted the step-1 models based on 7-birth-year rolling samples with decreasing radius weighting. This was to ensure sufficient cell sizes for the analyses. Nonetheless, our results are robust to using alternative 5-birth-year rolling calculations, with decreasing radius weighting that assigns 1 to t, 0.67 to t +/– 1, and 0.34 to t +/– 2. The results based on the 5-birth-year rolling samples are consistent with those reported in Fig. 6 in the main article. N = 3,693 and 3,688 society-cohort units for men and women, respectively.



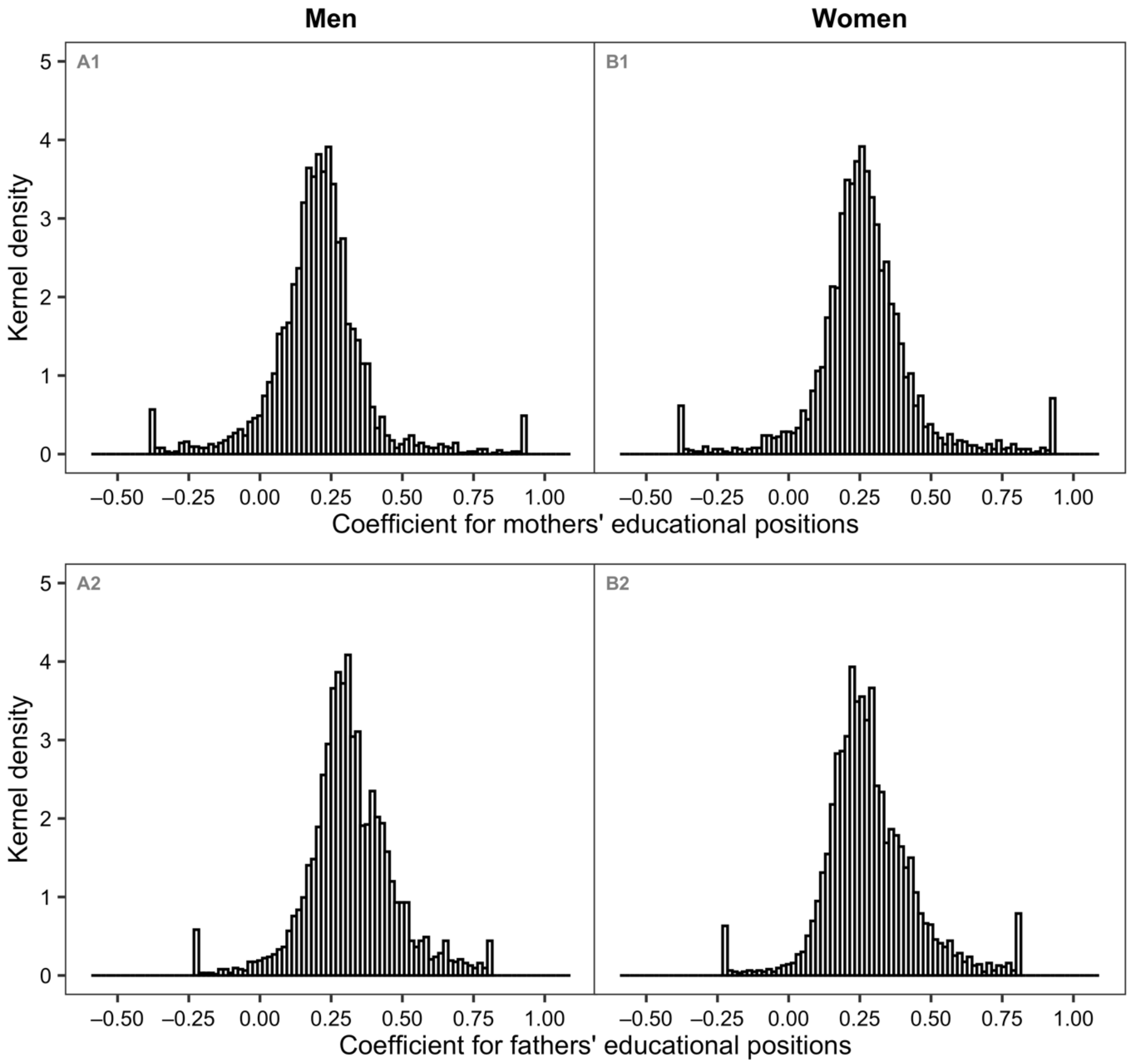
Supplementary Figure 15 | Societies and regions covered by the analysis. The proportion of the world population covered is based on population data from the 2022 United Nations Population Fund (https://www.unfpa.org/data/world-population-dashboard). Map produced using the 'maps' package (version 3.4.1) in R.



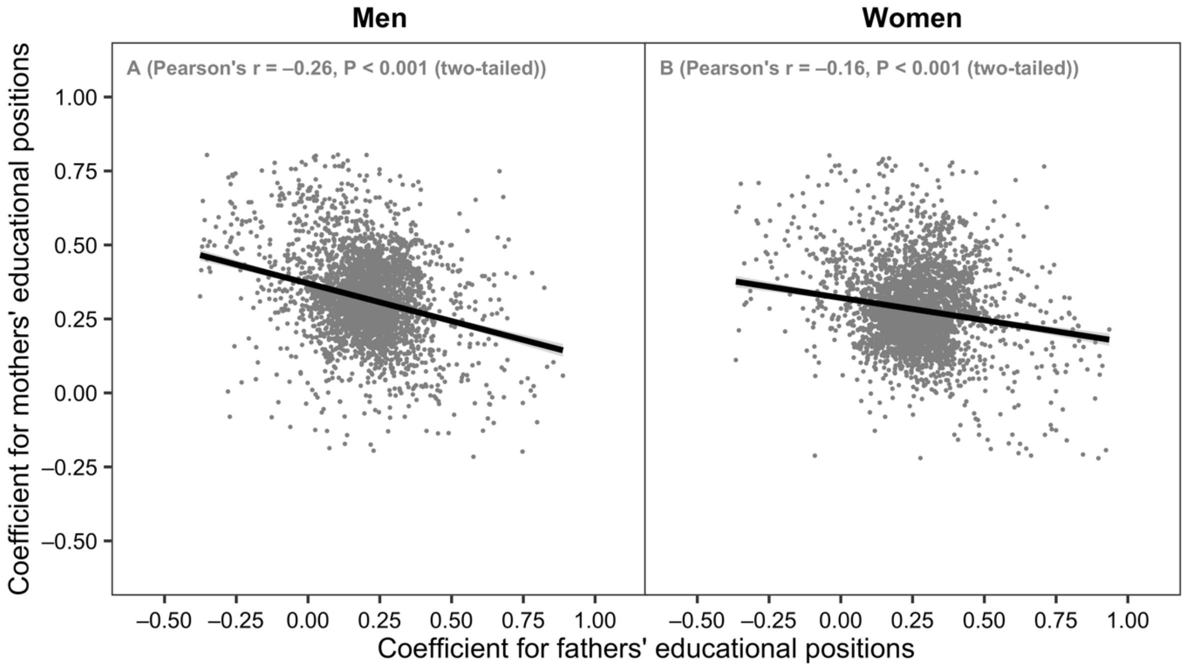
Supplementary Figure 16 | Education composition across societies. Maps produced using the 'maps' package (version 3.4.1) in R. N = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.



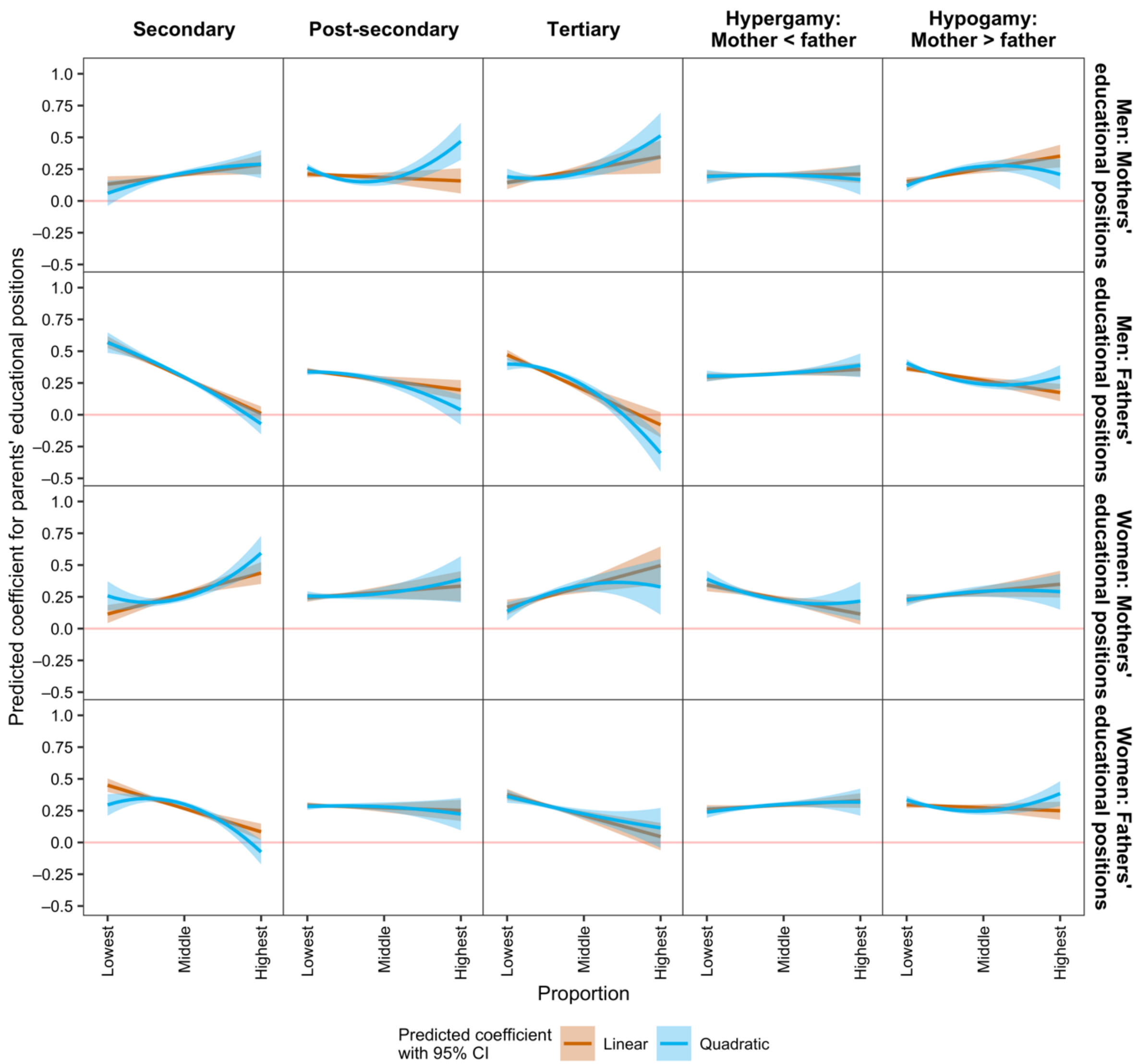
Supplementary Figure 17 | Parents' educational pairing patterns across societies. Maps produced using the 'maps' package (version 3.4.1) in R. N = 1,785,683 individuals (824,910 men and 960,773 women) across 106 societies.



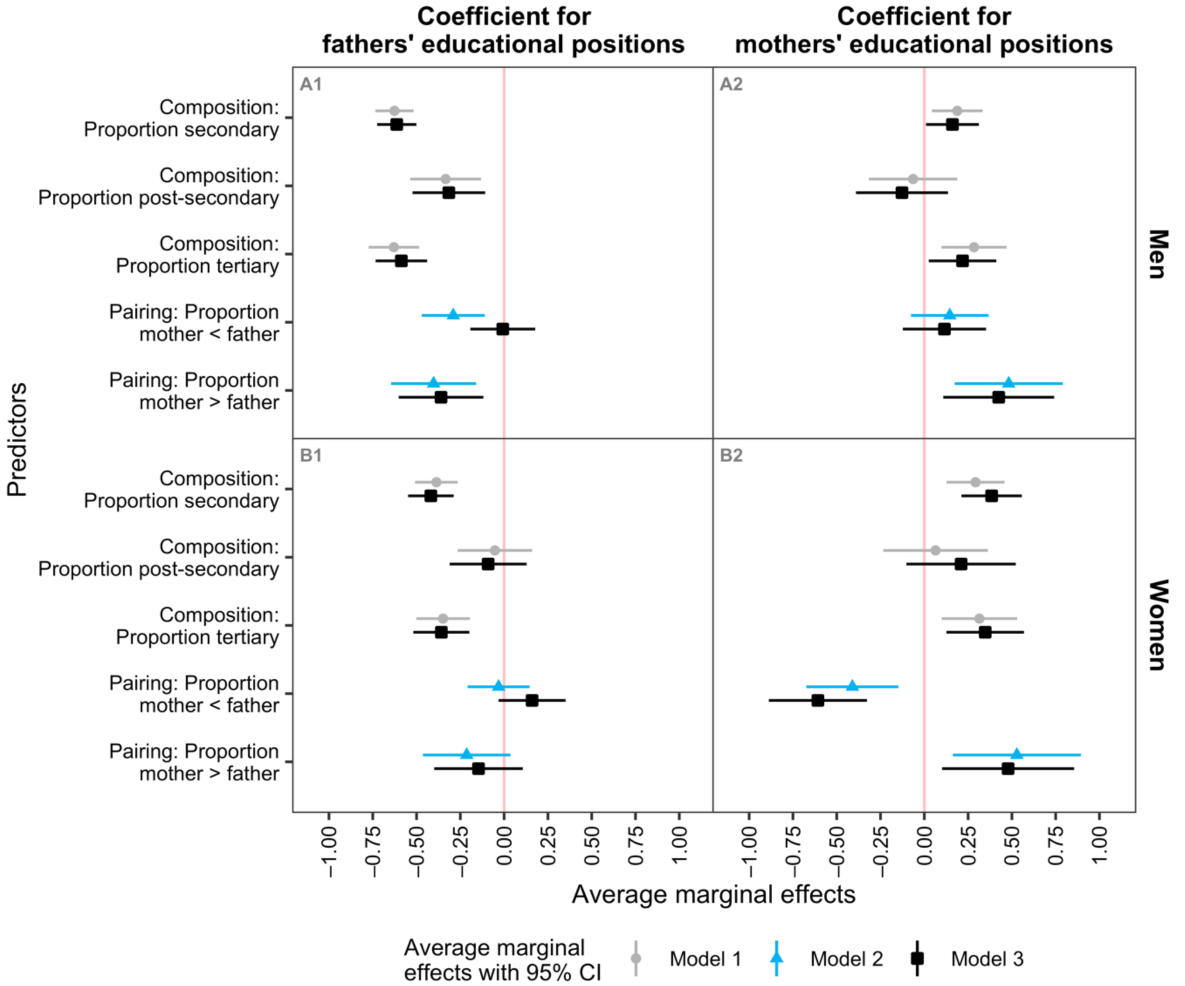
Supplementary Figure 18 | Histograms of the coefficients for mothers' and fathers' educational positions from step-1 models, across society-cohort units. The coefficients were bottom- and top-coded at the 1st and 99th percentile. $N = 3{,}693$ and 3,688 society-cohort units for men and women, respectively.



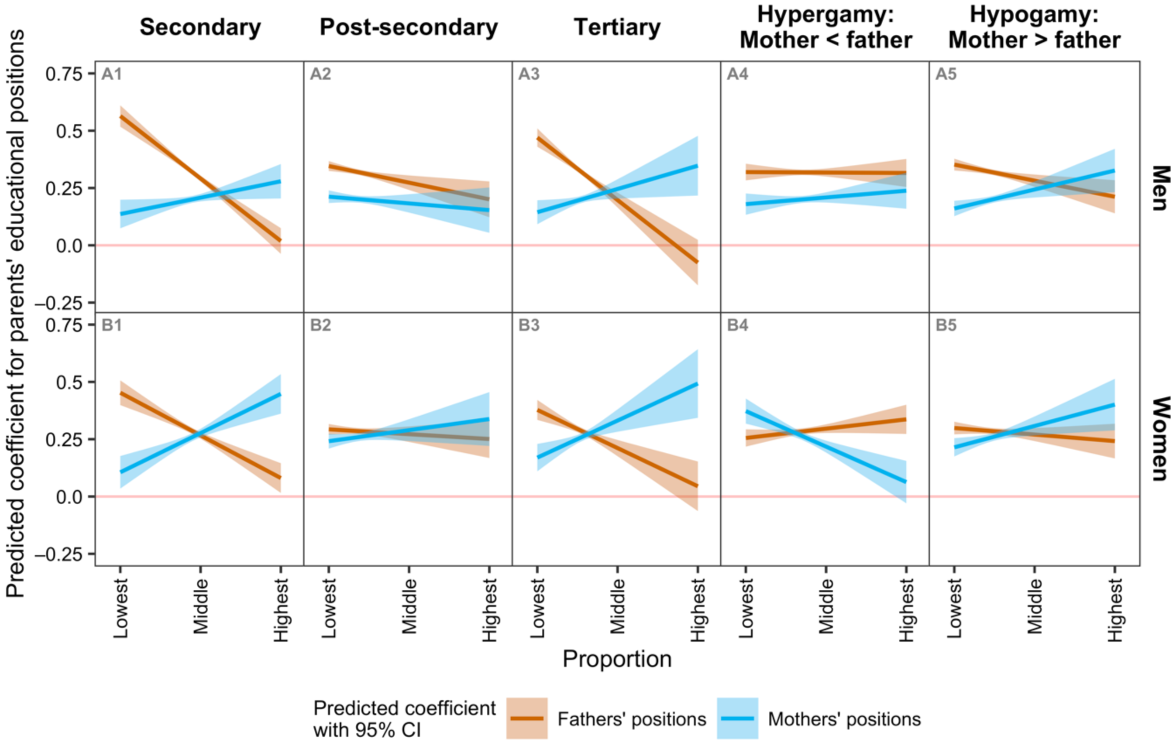
Supplementary Figure 19 | Scatterplots depicting the bivariate correlation between the coefficients for mothers' and fathers' educational positions from step-1 models, across society-cohort units. Each dot represents an individual, and the bold black lines indicate bivariate linear fit. For presentation purposes, we discarded top and bottom 1% of the coefficients from the plots. The results show that the roles of mothers' and fathers' educational positions in intergenerational educational mobility are negatively associated. Panels A and B are based on different samples. *N* = 3,693 and 3,688 society-cohort units for men (Panel A) and women (Panel B), respectively.



Supplementary Figure 20 | Linear versus quadratic specification for key predictors in step-2 models. Colour lines indicate predicted coefficients, with colour bands indicating 95% confidence intervals, and red baselines indicate coefficients equal to zero. The results show that the quadratic estimations largely overlap with the linear estimations presented in the main article (Model 3, Fig. 6). For parsimony, we reported results from the linear estimations in the main article. N = 3,693 and 3,688 society-cohort units for men and women, respectively.



Supplementary Figure 21 | Control for patterns of parents' relative educational position pairing: Average marginal effects of education expansion and parents' educational pairing patterns on intergenerational educational persistence. Error bars indicate 95% confidence intervals, and red baselines indicate marginal effects equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Parents' relative educational position pairing is measured as the mother's education percentile rank within society and cohort minus the corresponding father's rank, where a higher positive value indicates that the mother has a higher relative educational status than the father (hypogamy). Model 1 only included education expansion measures, Model 2 only included parents' educational pairing patterns, and Model 3 included both sets of predictors. All models also included society and birth year dummies. It is possible that education expansion and shifting patterns of parents' absolute educational pairing may be associated with intergenerational mobility through changes in the patterns of parents' relative educational position pairing. To test this possibility, we created a measure capturing the mean value of differences in educational positions between the mother and the father (i.e., mothers' positions – fathers' positions) for each society-cohort unit and included this measure in all models. The results show that with the inclusion of parents' relative educational position pairing patterns, our findings remain substantively consistent with those reported in Fig. 5 in the main article. *N* = 3,693 and 3,688 society-cohort units for men and women, respectively.



Supplementary Figure 22 | Control for patterns of parents' relative educational position pairing: Predicted coefficients for parents' educational positions over the distributions of education expansion and parents' educational pairing patterns. Colour lines indicate predicted coefficients, with colour bands indicating 95% confidence intervals, and red baselines indicate coefficients equal to zero. Generalized least squares regression models accounting for heteroskedasticity and within-society autocorrelation. Parents' relative educational position pairing is measured as the mother's education percentile rank within society and cohort minus the corresponding father's rank, where a higher positive value indicates that the mother has a higher relative educational status than the father (hypogamy). Predictions based on Model 3 presented in Supplementary Fig. 21, holding all non-focal variables at their observed values. Lowest refers to minimum values and highest refers to maximum values: the ranges are 0.018–0.874 for secondary education, 0–0.459 for post-secondary education, 0.003–0.923 for tertiary education, 0–0.504 for hypergamy, and 0–0.385 for hypogamy. It is possible that education expansion and shifting patterns of parents' absolute educational pairing may be associated with intergenerational mobility through changes in the patterns of parents' relative educational position pairing. To test this possibility, we created a measure capturing the mean value of differences in educational positions between the mother and the father (i.e., mothers' positions – fathers' positions) for each society-cohort unit and included this measure in all models. The results show that with the inclusion of parents' relative educational position pairing patterns, our findings remain substantively consistent with those reported in Fig. 6 in the main article. $N = 3{,}688$ and 3,693 society-cohort units for women and men, respectively.

2.2.Supplementary Tables 7–10

Supplementary Table 7. Comparing coefficients for fathers' and mothers' educational positions for men and women separately, by society

	Men				Women			
Society	*P* value (*F* test)	M > F	M = F	M < F	*P* value (*F* test)	M > F	M = F	M < F
Albania	0.0004			Yes	0.1223		Yes	
Argentina	0.9079		Yes		0.6237		Yes	
Armenia	0.1415		Yes		0.7174		Yes	
Australia	0.0694		Yes		0.7966		Yes	
Austria	0.0005			Yes	0.1567		Yes	
Azerbaijan	0.0001			Yes	0.0118	Yes		
Bangladesh	0.2135		Yes		0.6229		Yes	
Belarus	0.7106		Yes		0.6389		Yes	
Belgium	0.2176		Yes		0.7617		Yes	
Benin	0.1455		Yes		0.0000	Yes		
Bolivia	0.4555		Yes		0.6836		Yes	
Bosnia & Herzegovina	0.1896		Yes		0.4181		Yes	
Brazil	0.6302		Yes		0.0212	Yes		
Bulgaria	0.1814		Yes		0.0194	Yes		
Burkina Faso	0.1704		Yes		0.0000			Yes
Canada	0.0000			Yes	0.0107			Yes
Chile	0.0000			Yes	0.7500		Yes	
China	0.0916		Yes		0.0363	Yes		
Colombia	0.2290		Yes		0.0000	Yes		
Côte d'Ivoire	0.0007			Yes	0.5202		Yes	
Croatia	0.0008			Yes	0.5969		Yes	
Cyprus	0.7129		Yes		0.0200			Yes
Czechia	0.0000			Yes	0.0002			Yes
Denmark	0.0049			Yes	0.0472	Yes		
Djibouti	0.0122			Yes	0.0357	Yes		
Ecuador	0.3433		Yes		0.0000	Yes		
Egypt	0.0000			Yes	0.0000			Yes
Estonia	0.3487		Yes		0.0000	Yes		
Ethiopia	0.0000			Yes	0.0000			Yes
Finland	0.1877		Yes		0.5039		Yes	
France	0.7263		Yes		0.0014	Yes		
Gambia	0.0035			Yes	0.0000			Yes
Georgia	0.5207		Yes		0.0690		Yes	
Germany	0.0000			Yes	0.0000			Yes
Ghana	0.0000			Yes	0.0000			Yes
Great Britain	0.1520		Yes		0.8799		Yes	
Greece	0.0604		Yes		0.2582		Yes	
Guinea-Bissau	0.0044			Yes	0.1046		Yes	
Hong Kong	0.0898		Yes		0.2468		Yes	
Hungary	0.0322			Yes	0.7954		Yes	
Iceland	0.3637		Yes		0.6574		Yes	
India	0.0000			Yes	0.0587		Yes	
Indonesia	0.0000			Yes	0.0000			Yes
Iran	0.2765		Yes		0.9127		Yes	
Iraq	0.0000			Yes	0.3319		Yes	

Ireland	0.8564	Yes		0.0002	Yes		
Israel	0.7594	Yes		0.0197	Yes		
Italy	0.0003		Yes	0.0011			Yes
Japan	0.0009		Yes	0.5841		Yes	
Jordan	0.0167		Yes	0.3066		Yes	
Kazakhstan	0.0045		Yes	0.0277	Yes		
Kenya	0.0398		Yes	0.0003			Yes
Kyrgyzstan	0.0251		Yes	0.8298		Yes	
Laos	0.8353	Yes		0.0537		Yes	
Latvia	0.2054	Yes		0.3521		Yes	
Lebanon	0.0131		Yes	0.0499			Yes
Liberia	0.2724	Yes		0.1253		Yes	
Lithuania	0.5433	Yes		0.0714		Yes	
Macau	0.7647	Yes		0.0095	Yes		
Malawi	0.0000		Yes	0.3356		Yes	
Malaysia	0.6040	Yes		0.2325		Yes	
Mali	0.0000		Yes	0.0002			Yes
Mexico	0.0000		Yes	0.0560		Yes	
Moldova	0.0540	Yes		0.0033	Yes		
Mongolia	0.9654	Yes		0.4434		Yes	
Montenegro	0.0908	Yes		0.2765		Yes	
Myanmar	0.4143	Yes		0.9231		Yes	
Netherlands	0.0000		Yes	0.0176			Yes
New Zealand	0.0139		Yes	0.1415		Yes	
Nicaragua	0.8252	Yes		0.2786		Yes	
Niger	0.0003		Yes	0.5202		Yes	
Nigeria	0.0000		Yes	0.0622		Yes	
North Macedonia	0.0012		Yes	0.0095			Yes
Norway	0.0040		Yes	0.3005		Yes	
Pakistan	0.0157		Yes	0.4407		Yes	
Peru	0.0003		Yes	0.6624		Yes	
Philippines	0.2840	Yes		0.2919		Yes	
Poland	0.4224	Yes		0.0000	Yes		
Portugal	0.5233	Yes		0.1763		Yes	
Puerto Rico	0.6004	Yes		0.3572		Yes	
Romania	0.8214	Yes		0.1971		Yes	
Russia	0.4852	Yes		0.0117	Yes		
Senegal	0.6195	Yes		0.1129		Yes	
Serbia	0.0009		Yes	0.2457		Yes	
Singapore	0.4413	Yes		0.0299	Yes		
Slovakia	0.0046		Yes	0.0866		Yes	
Slovenia	0.0082		Yes	0.2514		Yes	
South Africa	0.7154	Yes		0.0827		Yes	
South Korea	0.0000		Yes	0.0003			Yes
Spain	0.0000		Yes	0.0006			Yes
Sri Lanka	0.1634	Yes		0.0245	Yes		
Sweden	0.9599	Yes		0.3654		Yes	
Switzerland	0.1159	Yes		0.0788		Yes	
Taiwan	0.0000		Yes	0.0000			Yes
Tajikistan	0.0110		Yes	0.3022		Yes	
Tanzania	0.7948	Yes		0.9006		Yes	
Thailand	0.6035	Yes		0.2239		Yes	
Togo	0.0000		Yes	0.0439	Yes		

Tunisia	0.2543		Yes		0.0513		Yes	
Turkey	0.0000			Yes	0.0002			Yes
Uganda	0.4662		Yes		0.2604		Yes	
Ukraine	0.0600		Yes		0.9368		Yes	
United States	0.0000			Yes	0.0784		Yes	
Uzbekistan	0.4151		Yes		0.1365		Yes	
Vietnam	0.0021			Yes	0.1557		Yes	
Zimbabwe	0.9202		Yes		0.1231		Yes	
Total number of societies		0	57	49		21	65	20

Note: When discussing Fig. 3 in the main article, we enumerated the number of societies, for men and women separately, in which the coefficient for mothers' educational positions is greater than, comparable with, and smaller than that for fathers' educational positions. This table provides a detailed list of the societies enumerated as well as P values from two-tailed F tests. Models were fitted using different subsamples by society and gender; and within each society-gender sample, the pair of coefficients for the mother and the father was compared using the *test* function (F test) in Stata. The cut-off point was taken at the 0.05 level of statistical significance for the enumeration of number of societies reported in the last row.

Supplementary Table 8. Ordinary least squares regression models predicting individuals' educational positions, by world region

	Men						Women					
	Africa	Asia & the Pacific	Europe	Latin America	Middle East	North America	Africa	Asia & the Pacific	Europe	Latin America	Middle East	North America
Cohort (ref. = 1956–1960)												
1961–1965	–0.868	0.388	–1.256	1.553	11.190	2.708	–1.471	–1.090	–1.340	1.506	–2.098	–2.508
	(1.141)	(0.978)	(0.631)	(0.517)	(2.160)	(1.554)	(0.932)	(0.860)	(0.572)	(0.488)	(1.696)	(1.389)
	[0.446]	[0.689]	[0.047]	[0.003]	[0.000]	[0.081]	[0.114]	[0.205]	[0.019]	[0.002]	[0.216]	[0.071]
1966–1970	0.420	–4.078	–1.991	0.069	13.734	–3.164	–1.505	–5.455	–1.353	1.706	–6.849	–1.002
	(1.127)	(1.029)	(0.761)	(0.557)	(2.146)	(1.893)	(0.937)	(0.917)	(0.691)	(0.532)	(1.789)	(1.732)
	[0.709]	[0.000]	[0.009]	[0.902]	[0.000]	[0.095]	[0.108]	[0.000]	[0.050]	[0.001]	[0.000]	[0.563]
1971–1975	1.332	–4.173	–0.549	–0.504	14.883	–5.531	–1.072	–7.871	–1.887	4.184	–3.407	1.968
	(1.153)	(1.149)	(0.930)	(0.623)	(2.247)	(2.301)	(0.952)	(1.026)	(0.841)	(0.594)	(1.872)	(2.076)
	[0.248]	[0.000]	[0.555]	[0.420]	[0.000]	[0.016]	[0.260]	[0.000]	[0.025]	[0.000]	[0.069]	[0.343]
1976–1980	1.758	–5.884	–2.428	1.200	12.981	–5.799	0.922	–9.803	–0.099	4.476	–5.072	–1.151
	(1.211)	(1.305)	(1.123)	(0.708)	(2.406)	(2.797)	(1.004)	(1.165)	(1.021)	(0.659)	(2.024)	(2.501)
	[0.147]	[0.000]	[0.031]	[0.090]	[0.000]	[0.038]	[0.358]	[0.000]	[0.923]	[0.000]	[0.012]	[0.645]
1981–1985	–1.507	–7.303	–0.016	–1.796	19.085	–8.401	–1.030	–9.082	–1.860	2.532	–5.964	2.965
	(1.308)	(1.473)	(1.330)	(0.808)	(2.583)	(3.275)	(1.075)	(1.309)	(1.210)	(0.755)	(2.220)	(2.973)
	[0.249]	[0.000]	[0.990]	[0.026]	[0.000]	[0.010]	[0.338]	[0.000]	[0.124]	[0.001]	[0.007]	[0.319]
1986–1990	1.016	–5.286	–0.167	–0.979	19.322	–6.005	–1.193	–7.176	0.155	5.684	2.692	–0.777
	(1.432)	(1.664)	(1.548)	(0.915)	(2.817)	(3.819)	(1.176)	(1.487)	(1.408)	(0.859)	(2.453)	(3.447)
	[0.478]	[0.001]	[0.914]	[0.286]	[0.000]	[0.116]	[0.310]	[0.000]	[0.913]	[0.000]	[0.273]	[0.822]
Mothers' educational positions	0.150	0.170	0.158	0.289	0.164	0.217	0.060	0.268	0.206	0.296	0.401	0.206
	(0.021)	(0.016)	(0.009)	(0.009)	(0.038)	(0.019)	(0.017)	(0.014)	(0.008)	(0.008)	(0.030)	(0.017)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Fathers' educational positions	0.311	0.382	0.309	0.354	0.570	0.319	0.384	0.394	0.253	0.379	0.367	0.271
	(0.016)	(0.011)	(0.009)	(0.009)	(0.023)	(0.018)	(0.013)	(0.010)	(0.008)	(0.008)	(0.020)	(0.016)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Mothers' educational positions ×												
1961–1965	–0.046	0.018	0.030	–0.013	–0.038	–0.047	0.034	–0.011	0.003	0.004	–0.147	0.055
	(0.027)	(0.021)	(0.013)	(0.012)	(0.048)	(0.028)	(0.022)	(0.018)	(0.011)	(0.011)	(0.038)	(0.025)
	[0.090]	[0.394]	[0.018]	[0.302]	[0.434]	[0.094]	[0.120]	[0.531]	[0.805]	[0.734]	[0.000]	[0.027]

1966–1970	–0.041	0.050	0.065	–0.044	–0.041	–0.041	0.154	0.049	0.015	0.034	–0.112	0.026
	(0.026)	(0.020)	(0.013)	(0.012)	(0.046)	(0.029)	(0.021)	(0.017)	(0.011)	(0.011)	(0.038)	(0.026)
	[0.114]	[0.012]	[0.000]	[0.000]	[0.371]	[0.157]	[0.000]	[0.005]	[0.182]	[0.002]	[0.003]	[0.301]
1971–1975	–0.008	0.043	0.052	–0.026	0.009	–0.046	0.191	0.063	0.051	0.004	–0.127	–0.000
	(0.024)	(0.019)	(0.012)	(0.011)	(0.044)	(0.028)	(0.019)	(0.017)	(0.011)	(0.010)	(0.036)	(0.025)
	[0.737]	[0.023]	[0.000]	[0.024]	[0.836]	[0.101]	[0.000]	[0.000]	[0.000]	[0.716]	[0.000]	[0.993]
1976–1980	0.002	0.051	0.076	–0.018	0.023	–0.014	0.150	0.073	0.068	0.007	–0.155	0.063
	(0.023)	(0.019)	(0.013)	(0.011)	(0.043)	(0.029)	(0.019)	(0.017)	(0.011)	(0.010)	(0.034)	(0.025)
	[0.933]	[0.007]	[0.000]	[0.095]	[0.582]	[0.632]	[0.000]	[0.000]	[0.000]	[0.491]	[0.000]	[0.013]
1981–1985	0.056	0.082	0.099	–0.012	0.038	–0.046	0.178	0.079	0.076	0.033	–0.166	0.042
	(0.023)	(0.018)	(0.012)	(0.011)	(0.041)	(0.028)	(0.018)	(0.016)	(0.011)	(0.010)	(0.034)	(0.025)
	[0.013]	[0.000]	[0.000]	[0.275]	[0.359]	[0.103]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.092]
1986–1990	0.035	0.045	0.121	–0.015	0.022	–0.118	0.177	0.039	0.086	0.016	–0.238	0.072
	(0.022)	(0.018)	(0.013)	(0.010)	(0.040)	(0.027)	(0.018)	(0.016)	(0.012)	(0.009)	(0.033)	(0.024)
	[0.117]	[0.015]	[0.000]	[0.157]	[0.592]	[0.000]	[0.000]	[0.018]	[0.000]	[0.085]	[0.000]	[0.003]
Fathers' educational positions ×												
1961–1965	0.062	–0.042	–0.014	–0.043	–0.099	–0.033	0.023	–0.020	0.011	–0.057	0.073	–0.003
	(0.021)	(0.015)	(0.012)	(0.012)	(0.031)	(0.026)	(0.017)	(0.014)	(0.011)	(0.010)	(0.028)	(0.024)
	[0.003]	[0.006]	[0.244]	[0.000]	[0.001]	[0.201]	[0.168]	[0.147]	[0.297]	[0.000]	[0.009]	[0.911]
1966–1970	0.032	–0.023	–0.043	–0.006	–0.149	0.031	–0.079	–0.037	0.006	–0.090	0.063	0.025
	(0.020)	(0.015)	(0.012)	(0.011)	(0.031)	(0.027)	(0.016)	(0.013)	(0.011)	(0.010)	(0.027)	(0.025)
	[0.117]	[0.114]	[0.001]	[0.614]	[0.000]	[0.254]	[0.000]	[0.006]	[0.612]	[0.000]	[0.020]	[0.306]
1971–1975	–0.014	–0.017	–0.037	–0.007	–0.169	0.045	–0.127	–0.036	–0.011	–0.093	–0.019	0.018
	(0.019)	(0.014)	(0.012)	(0.011)	(0.029)	(0.027)	(0.015)	(0.013)	(0.011)	(0.010)	(0.026)	(0.025)
	[0.450]	[0.235]	[0.002]	[0.555]	[0.000]	[0.100]	[0.000]	[0.007]	[0.301]	[0.000]	[0.474]	[0.475]
1976–1980	–0.040	–0.022	–0.015	–0.005	–0.167	0.015	–0.124	–0.024	–0.045	–0.075	0.015	0.023
	(0.018)	(0.014)	(0.012)	(0.011)	(0.028)	(0.028)	(0.015)	(0.013)	(0.011)	(0.009)	(0.024)	(0.025)
	[0.030]	[0.134]	[0.230]	[0.656]	[0.000]	[0.589]	[0.000]	[0.069]	[0.000]	[0.000]	[0.537]	[0.342]
1981–1985	–0.034	–0.038	–0.079	0.003	–0.268	0.026	–0.121	–0.059	–0.009	–0.072	0.023	–0.020
	(0.018)	(0.014)	(0.012)	(0.010)	(0.027)	(0.027)	(0.014)	(0.013)	(0.011)	(0.009)	(0.024)	(0.024)
	[0.054]	[0.006]	[0.000]	[0.798]	[0.000]	[0.344]	[0.000]	[0.000]	[0.399]	[0.000]	[0.341]	[0.408]
1986–1990	–0.063	–0.065	–0.070	0.019	–0.279	0.016	–0.123	–0.074	–0.034	–0.114	–0.049	0.027
	(0.018)	(0.015)	(0.012)	(0.010)	(0.027)	(0.026)	(0.014)	(0.013)	(0.012)	(0.009)	(0.023)	(0.024)
	[0.000]	[0.000]	[0.000]	[0.058]	[0.000]	[0.535]	[0.000]	[0.000]	[0.004]	[0.000]	[0.039]	[0.261]

Age	–0.160	0.252	1.285	1.906	0.328	0.664	–0.411	–0.094	1.258	1.748	1.061	1.523
	(0.077)	(0.097)	(0.088)	(0.056)	(0.160)	(0.208)	(0.064)	(0.087)	(0.080)	(0.055)	(0.142)	(0.193)
	[0.039]	[0.010]	[0.000]	[0.000]	[0.040]	[0.001]	[0.000]	[0.281]	[0.000]	[0.000]	[0.000]	[0.000]
Age^2	0.002	–0.004	–0.013	–0.021	0.001	–0.010	0.005	–0.004	–0.014	–0.019	–0.018	–0.015
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
	[0.033]	[0.000]	[0.000]	[0.000]	[0.736]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Survey fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Society fixed effects (within region)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	46.122	43.347	2.067	–23.239	–4.847	29.008	39.283	37.508	1.994	–20.253	7.546	–8.786
	(2.804)	(8.220)	(3.513)	(1.952)	(5.469)	(8.084)	(2.300)	(7.285)	(3.193)	(1.842)	(4.904)	(7.363)
	[0.000]	[0.000]	[0.556]	[0.000]	[0.375]	[0.000]	[0.000]	[0.000]	[0.532]	[0.000]	[0.124]	[0.233]

Notes: Standard errors are in round brackets and *P* values (two-tailed) are in square brackets. Ordinary least squares regression models weighting society-cohort-gender samples to their corresponding population sizes. Models underpinning Fig. 4 in the main article.

Supplementary Table 9. Two-way fixed effects generalized least squares regression models estimating the relationships between education expansion, parents' educational pairing patterns, and intergenerational educational persistence

	Predicting the coefficient for fathers' educational positions			Predicting the coefficient for mothers' educational positions		
Predictor	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Men (*N* = 3,693 society-cohort units)						
Composition: secondary	–0.624		–0.631	0.187		0.173
	(0.056)		(0.057)	(0.074)		(0.077)
	[0.000]		[0.000]	[0.012]		[0.024]
Composition: post-secondary	–0.298		–0.332	–0.085		–0.117
	(0.103)		(0.106)	(0.129)		(0.134)
	[0.004]		[0.002]	[0.511]		[0.383]
Composition: Tertiary	–0.625		–0.592	0.276		0.217
	(0.074)		(0.075)	(0.095)		(0.098)
	[0.000]		[0.000]	[0.004]		[0.028]
Education: mother < father		–0.118	0.119		0.063	0.030
(hypergamous parents)		(0.081)	(0.083)		(0.101)	(0.108)
		[0.147]	[0.152]		[0.535]	[0.782]
Education: mother > father		–0.582	–0.487		0.570	0.513
(hypogamous parents)		(0.116)	(0.115)		(0.148)	(0.151)
		[0.000]	[0.000]		[0.000]	[0.001]
Society fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	0.812	0.363	0.814	0.005	0.109	–0.005
	(0.072)	(0.049)	(0.064)	(0.085)	(0.082)	(0.082)
	[0.000]	[0.000]	[0.000]	[0.955]	[0.187]	[0.956]
Women (*N* = 3,688 society-cohort units)						
Composition: secondary	–0.384		–0.412	0.292		0.363
	(0.062)		(0.066)	(0.084)		(0.088)
	[0.000]		[0.000]	[0.001]		[0.000]
Composition: post-secondary	–0.046		–0.088	0.061		0.198
	(0.108)		(0.112)	(0.152)		(0.160)
	[0.669]		[0.431]	[0.687]		[0.214]
Composition: Tertiary	–0.345		–0.356	0.314		0.352
	(0.078)		(0.082)	(0.110)		(0.113)
	[0.000]		[0.000]	[0.004]		[0.002]
Education: mother < father		–0.024	0.137		–0.289	–0.448
(hypergamous parents)		(0.082)	(0.088)		(0.121)	(0.129)
		[0.771]	[0.119]		[0.017]	[0.000]
Education: mother > father		–0.215	–0.119		0.390	0.302
(hypogamous parents)		(0.120)	(0.121)		(0.174)	(0.179)
		[0.073]	[0.325]		[0.025]	[0.092]
Society fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	0.589	0.320	0.594	0.036	0.292	0.036
	(0.065)	(0.043)	(0.065)	(0.082)	(0.055)	(0.084)
	[0.000]	[0.000]	[0.000]	[0.658]	[0.000]	[0.670]

Notes: Standard errors are in round brackets and *P* values (two-tailed) are in square brackets. Generalized least squares models accounting for heteroscedasticity and autocorrelation. Models underpinning Figs. 5 and 6 in the main article.

Supplementary Table 10. Two-way fixed effects generalized least squares regression models estimating the relationships between education expansion, parents' educational pairing patterns, and intergenerational educational persistence, using alternative education expansion measure (i.e., society-cohort mean level of education)

	Predicting the coefficient for fathers' educational positions			Predicting the coefficient for mothers' educational positions		
Predictor	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Men (*N* = 3,693 society-cohort units)						
Society-cohort mean level of education	–0.115		–0.106	0.036		0.023
	(0.017)		(0.018)	(0.021)		(0.022)
	[0.000]		[0.000]	[0.088]		[0.304]
Education: mother < father (hypergamous parents)		–0.118	0.008		0.063	0.032
		(0.081)	(0.082)		(0.101)	(0.103)
		[0.147]	[0.922]		[0.535]	[0.758]
Education: mother > father (hypogamous parents)		–0.582	–0.465		0.570	0.517
		(0.116)	(0.117)		(0.148)	(0.150)
		[0.000]	[0.000]		[0.000]	[0.001]
Society fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	0.292	0.363	0.312	0.156	0.109	0.123
	(0.062)	(0.049)	(0.053)	(0.080)	(0.082)	(0.077)
	[0.000]	[0.000]	[0.000]	[0.052]	[0.187]	[0.112]
Women (*N* = 3,688 society-cohort units)						
Society-cohort mean level of education	–0.062		–0.059	0.065		0.072
	(0.018)		(0.018)	(0.025)		(0.026)
	[0.000]		[0.012]	[0.009]		[0.006]
Education: mother < father (hypergamous parents)		–0.024	0.042		–0.289	–0.361
		(0.082)	(0.084)		(0.121)	(0.123)
		[0.771]	[0.615]		[0.017]	[0.003]
Education: mother > father (hypogamous parents)		–0.215	–0.125		0.390	0.279
		(0.120)	(0.123)		(0.174)	(0.178)
		[0.073]	[0.311]		[0.025]	[0.118]
Society fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	0.287	0.320	0.287	0.280	0.292	0.329
	(0.043)	(0.043)	(0.044)	(0.051)	(0.055)	(0.056)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Notes: Standard errors are in round brackets and *P* values (two-tailed) are in square brackets. Generalized least squares models accounting for heteroscedasticity and autocorrelation.

3. SUPPLEMENTARY REFERENCES

1. Narayan, A., Van der Weide, R., Cojocaru, A., Lakner, C., Redaelli, S., Mahler, D. G., Ramasubbaiah, R. G. N. & Thewissen, S. *Fair Progress?: Economic Mobility across Generations around the World* (World Bank, 2018).
2. van der Weide, R., Lakner, C., Mahler, D, G., Narayan, A. & Ramasubbaiah, R. *Intergenerational Mobility around the World* (World Bank, 2021).
3. Carol, R. E., Droe, A. & Russell, D. *Residence and Kinship*. https://hraf.yale.edu/ehc/assets/summaries/pdfs/residence-and-kinship.pdf (2022).
4. Duncan, S. & Edwards, R. *Single Mothers in International Context: Mothers or Workers?* (Routledge, 2013).
5. Torche, F. Analyses of intergenerational mobility: An interdisciplinary review. *Ann. Am. Acad. of Polit. Soc. Sci.* **657**, 37–62 (2015).
6. Torche, F. in *Social Mobility in Developing Countries* (eds Iversen, V., Krishna, A. & Sen, K.) 139–171 (Oxford Univ. Press, 2021).
7. Azomahou, T. T. & Yitbarek, E. A. *Intergenerational Education Mobility in Africa: Has Progress Been Inclusive?* (World Bank, 2016).
8. Song, X. & Mare, R. D. Short-term and long-term educational mobility of families: A two-sex approach. *Demography* **54**, 145–173 (2017).
9. Ganzeboom, H. B. G., De Graaf, P. M. & Treiman, D. J. A standard international socio-economic index of occupational status. *Soc. Sci. Res.* **21**, 1–56 (1992).
10. Blanden, J. Cross-country rankings in intergenerational mobility: A comparison of approaches from economics and sociology. *J. Econ. Surv.* **27**, 38–73 (2013).
11. Meyer, J. W., Ramirez, F. O. & Soysal, Y. N. World expansion of mass education, 1870–1980. *Sociol. Educ*. **65**, 128–149 (1992).
12. Hertz, T., Tamara, J., Piraino, P., Sibel, S. & Nicole, S. The inheritance of educational inequality: International comparisons and fifty-year trends. *B.E. J. Econ. Anal. Policy* **7**, 1–30 (2007).
13. Theodore P. Gerber & Sin Yi Cheung. Horizontal stratification in postsecondary education: Forms, explanations, and implications. *Annu. Rev. Sociol.* **34**, 299–318.
14. Song, X., Massey, C. G., Rolf, K. A., Ferrie, J. P., Rothbaum, J. L. & Xie, Y. Long-term decline in intergenerational mobility in the United States since the 1850s. *Proc. Natl. Acad. Sci.* **117**, 251–258 (2020).
15. Xie, Y., Dong, H., Zhou, X. & Song, X. Trends in social mobility in postrevolution China. *Proc. Natl. Acad. Sci.* **119**, e2117471119 (2022).
16. Xie, Y. & Dong, H. A New Methodological Framework for Studying Status Exchange in Marriage. *Am. J. Sociol.* **126**, 1179–1219 (2021).
17. Ridgeway, C. L. Why status matters for inequality. *Am. Sociol. Rev.* **79**, 1–16 (2014).
18. Han, S. W. Is it only a numbers game? A macro-level study of educational hypogamy. *Demography* **59**, 1571–1593 (2022).

19. Raymo, J. M. & Iwasawa, M. Marriage market mismatches in Japan: An alternative view of the relationship between women's education and marriage. *Am. Sociol Rev.* **70**, 801–822 (2005).

20. Benavot, A. & Riddle, P. The expansion of primary education, 1870–1940: Trends and issues. *Sociol. Educ.* **61**, 191–210 (1988).

21. Bhatia, A., Krieger, N. & Subramanian, S. V. Learning from history about reducing infant mortality: Contrasting the centrality of structural interventions to early 20th-century successes in the United States to their neglect in current global initiatives. *Milbank Q.* **97**, 285–345 (2019).

22. Snijders, T. A. & Bosker, R. J. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling* (Sage, 2011).

23. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data* (MIT Press, 2010).

24. Mason, C. H. & Perreault, W. D. Collinearity, power, and interpretation of multiple regression analysis. *J. Marketing Res*. **28**, 268–280 (1991).