Not on the same track?

Tracking age and gender inequality in education

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Appendix

Appendix A. Descriptive statistics per country

Figure A.1. Descriptive statistics of completed years of education separated for gender per country

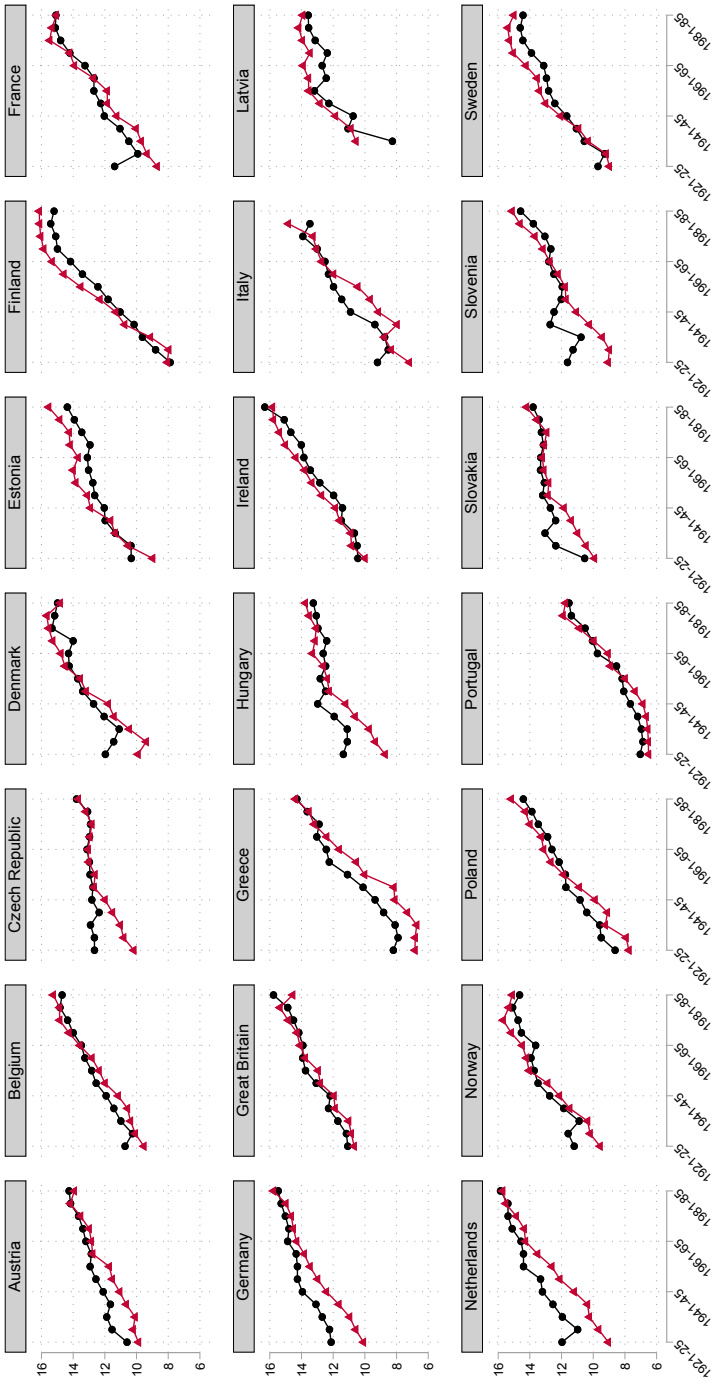
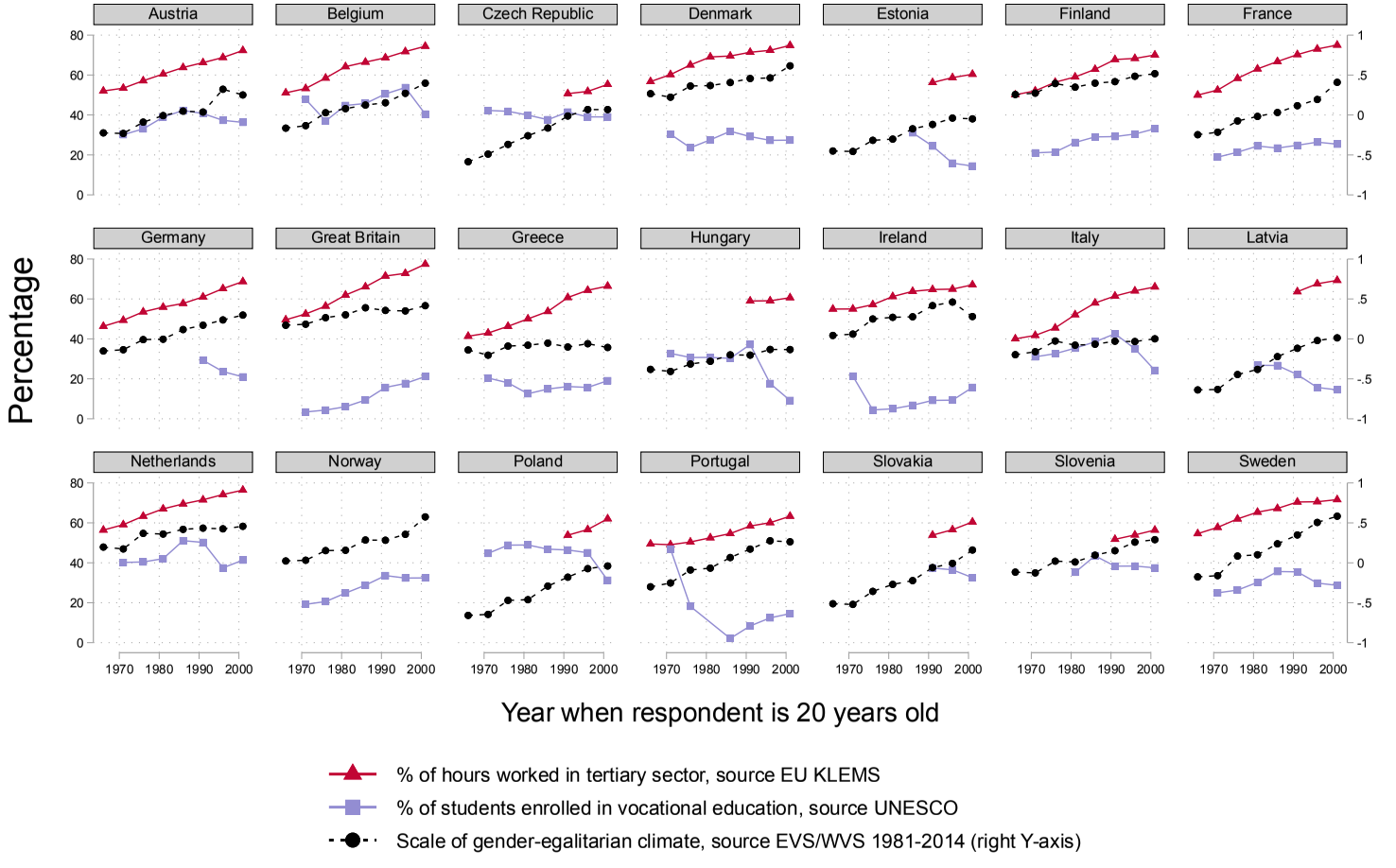


Figure A.2. Descriptive statistics of all contextual-level variables per country



Appendix B. Methods and outcomes for different model specifications

Methods

To examine whether the results are sensitive to different model specifications, we also performed the analysis with the use of two other multilevel modelling approaches. First, we implement a cross-classified model. This model treats country-cohorts as cross-classified within countries and cohorts. It does not assume hierarchical nesting of countries and cohorts, and thus takes into account that although country-cohorts are nested within countries and cohorts, countries and cohorts are not nested within each other. Individuals in this model are, though, nested within country-cohorts. The general equation for this model is the following:

$$\begin{aligned} Y_{ij(kl)=}\beta_0 + \beta_1 gender_{ij(kl)} + \beta_2 trackage_{j(kl)} + \beta_3 gender_{ij(kl)} * trackage_{j(kl)} \\ + \beta_4 X_{ij(kl)} + u_{0j(kl)} + u_{1k} + u_{2l} + u_{3j(kl)} gender_{ij(kl)} + e_{ij(kl)} \end{aligned}$$

Compared to the equation of the two-level multilevel model used in the paper, this model includes random effects for cohorts (k) and countries (l) instead of including both as fixed effects. Hence, this model includes two more error terms, one at the cohort level (u_{1k}) and one at the country level (u_{2l}).

Second, we employ a three-level hierarchical mixed model—a so-called hybrid model—in which individuals are nested within country-cohorts that are nested within countries. The benefit of this model over the other two specifications is that here we can estimate both between-country effects (effects based on cross-national variation) as well as within-country effects (effects based on within-country over-time variation). Due to the inclusion of between-country parameters, this model controls for time-invariant unobserved heterogeneity between countries, making sure the within-country estimates are not spurious to time-constant unmeasured country characteristics. In this model we also include cohort fixed effects controlling for a common time trend. The general equation for this model is the following:

$$\begin{aligned} Y_{ijl=}\beta_0 + \sum_{k=k-1} \beta_k K_{jl} + \beta_2 gender_{ijl} + \beta_3 trackage_l^{between} + \beta_4 trackage_{jl}^{within} \\ + \beta_5 gender_{ijl} * trackage_l^{between} + \beta_6 gender_{ijl} * trackage_{jl}^{within} \\ + \beta_7 X_{ijl} + u_{0l} + u_{1jl} + u_{2l} gender_{ijl} + u_{3jl} gender_{ijl} + e_{ijl} \end{aligned}$$

In this model contextual-level variables are entered twice; a between-country component, which measures the country-average across the cohorts, and a within-country component, which measures the deviation of the country-cohort relative to the country-average across the cohorts. Hence, β_3 and β_5 are at the country level (l) and estimate the between-country main and interaction effects of tracking age. β_4 and β_6 are at the country-cohort level (j) and estimate the within-country main and interaction effects of tracking age. This equation includes an error term at the country level (u_{0l}), at the country-cohort level (u_{1jl}), and at the individual level (e_{ijl}), as well as two error terms of the slope variation in gender: one at the country level ($u_{2l}gender_{ijl}$) and one at the country-cohort level ($u_{3jl}gender_{ijl}$).

Results

The results of the cross-classified model of years of education are presented in Table B.1. The baseline model, including no parameters, shows that 18.4% of the variance is at the cohort-level, 7.7% at the country-level and 2.1% at the country/cohort-level. The results are strikingly similar compared to the results of the two-level multilevel model used in the paper. We find positive and significant main effects of being male and tracking age and a significant negative cross-level interaction. Hence again men, on average, complete more years of education than women when the tracking age is 10. However, the gender effect becomes smaller and even reverses when the tracking age increases, because the positive effect of tracking age on educational attainment is much weaker for men than for women.

Second, we employ a three-level hybrid model including cohort fixed effects. When this model only includes cohort fixed effects, 9.2% of the variance is at the country-level and 2.4% at the country/cohort-level. Table B.1 presents the results of the three-level hybrid model of years of education. Tracking age is now included both at the within- and between-level. The negative and significant cross-level interaction between tracking age (between) and gender signifies that in countries with a higher tracking age the positive effect of being male on education is smaller and can even become negative compared to countries with a low tracking age. The negative and significant cross-level interaction between tracking age (within) and gender indicates—again—that raising the tracking age within a country decreases and even reverses the positive effect of being male on years of education.

It is striking how consistent the estimates are for different models: for every one-year increase in tracking age, the effect of being male on years of education decreases by a quarter of a year. These outcomes also provide us with confidence that our results are not sensitive to different model specifications.

Table B.1. Multilevel linear regression models of years of education

	Cross-classified model		Hybrid model	
	B	SE	B	SE
Individual-level variables				
Father's years of education	.214 ***	.004	.214 ***	.004
Mother's years of education	.213 ***	.004	.212 ***	.004
Father's occupation				
Routine manual and service	ref.		ref.	
Semi-routine/manual/service	.172 ***	.025	.172 ***	.025
Technical and craft	.463 ***	.023	.463 ***	.023
Clerical and intermediate	1.320 ***	.028	1.320 ***	.028
Higher administrator	1.583 ***	.043	1.583 ***	.043
Professional and technical	1.545 ***	.036	1.545 ***	.036
Male	.992 ***	.084	.922 ***	.207
Contextual-level variables				
Tracking age	.255 ***	.035		
Tracking age (BE)			.132	.124
Tracking age (WI)			.255 ***	.037
Cross-level interactions				
Tracking age * male	-.235 ***	.022		
Tracking age (BE) * male			-.216 ***	.059
Tracking age (WI) * male			-.267 ***	.029
Constant	6.792 ***	.336	5.430 ***	.458
Country fixed effects				
Cohort fixed effects			Yes	
Variance components				
Country	.580 ***		.649 ***	
Cohort	.858 ***			
Country-cohort	.488 ***		.389 ***	
Individuals	9.201 ***		9.201 ***	
Random slope male				
Country			.126 ***	
Country-cohort	.412 ***		.274 ***	
N(observations)	143,883		143,883	
N(country-cohorts)	270		270	

Two-tailed test: * p<.05. ** p < .01. *** p < .001.

Appendix C. Replication of our analyses measuring the dependent variable educational attainment as the level of educational attainment

Table C.1. Multilevel linear regression model of level of education

	Level of education (ISCED)	
	B	SE
Individual-level variables		
Father's years of education	.079 ***	.001
Mother's years of education	.072 ***	.001
Father's occupation		
Routine manual and service	ref.	
Semi-routine/manual/service	.065 ***	.009
Technical and craft	.165 ***	.008
Clerical and intermediate	.451 ***	.010
Higher administrator	.517 ***	.015
Professional and technical	.455 ***	.013
Male	.338 ***	.030
Contextual-level variables		
Tracking age	.105 ***	.013
Cross-level interactions		
Tracking age * male	-.089 ***	.008
Constant	.544 ***	.079
Country fixed effects	Yes	
Cohort fixed effects	Yes	
Variance components		
Country-cohort	.056 ***	
Individuals	1.101 ***	
Random slope male		
Country-cohort	.055 ***	
N(observations)	143,448	
N(country-cohorts)	270	

Two-tailed test: * p<.05. ** p < .01. *** p < .001.

To examine whether the outcomes are comparable when using different measures of educational attainment, we have replicated our analyses measuring education as the level of educational attainment. In this model, the level of education is a 5-point measure (1 = ISCED 0-1; 2 = ISCED 2; 3 = ISCED 3; 4 = ISCED 4; 5 = ISCED 5-6), and is treated as a continuous measure. Table C.1 presents the results of the multilevel model of level of education including country and cohort fixed effects. Again, the results are highly similar,

and our central finding remains the same. The negative and significant cross-level interaction indicates that the advantage of being male weakens as tracking age increases. This model predicts that the effect of being male on level of education even reverses when the tracking age surpasses 14 years. When the tracking age is 16, girls outperform boys in education, with a difference of approximately 0.15 of a standard deviation on level of education. This suggests that our results are not sensitive to the measurement of the dependent variable.