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Research Article

Demographic convergence in marriage timing: Intersecting gender and educational expansion

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Abstract

BACKGROUND
Considering the massive educational expansion and dramatic changes in marriage timing the world is undergoing, this study explores whether the timing of marriage has become increasingly similar across countries amid educational expansion at different levels.

OBJECTIVE
First, we focus on convergence in marital timing, a core family demography indicator often overlooked in the convergence literature. Second, we shift the focus from demographic convergence over time to convergence over educational expansion. Third, we incorporate a gender perspective into the analysis, taking into consideration gender differences in educational expansion and union formation.

METHODS
We combine time-series data from 1950 to 2015 covering 144 countries from two data sources: (1) sex-specific singulate mean age at marriage (SMAM) from World Marriage Data; (2) sex-specific educational attainment by age from Barro and Lee.
Methodologically, we explore whether convergence in marriage indicators has occurred over educational attainment by testing for β-convergence.

RESULTS
Age at marriage has strongly converged over measures of educational attainment, with far stronger convergence among women. We uncover two types of educational gradients: (1) convergence is stronger the higher the level of education (tertiary > secondary > primary); (2) within each level, completion of education contributes more to convergence in SMAM relative to just attendance.

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CONCLUSIONS
The study is unique in showing that convergence in SMAM masks fundamental heterogeneity, pointing to the growing importance of secondary and tertiary education worldwide. Relatedly, results call for a shift in policy focus from school attendance to successful school cycle completion.

CONTRIBUTION
Findings provide important insights for addressing key challenges in global development and demography.

1. Introduction

The classic perspective of the demographic transition, whereby mortality and fertility rates fall from high to relatively low levels, supports the idea of global demographic convergence – that is, countries around the world becoming increasingly similar to each other in terms of selected population characteristics. Some scholars have hypothesized that with economic development, social progress, modernization, and globalization taking place worldwide, low- and middle-income countries (LMICs) may follow a path of mortality and fertility decline similar to that witnessed by today's high-income countries (HICs) during the 19th and early 20th centuries (Goode 1963). Social scientists have had a long-standing interest in debating the occurrence of such demographic convergence on either a regional or global scale and have leveraged a variety of data and methods to examine demographic trends over time, with a focus on convergence in either mortality and health (Atance et al. 2024; McMichael et al. 2004; Moser, Shkolnikov, and Leon 2005; Neumayer 2004; Vallin and Meslé 2004), fertility (Casterline 2001; Dorius 2008; Goesling and Firebaugh 2004; Strulik and Vollmer 2015; Wu and Pesando 2024), or both (Wilson 2001, 2011; Gabrielli et al. 2021).

Extensive work has found evidence of an overall improvement in life expectancy in many countries since the end of World War II, suggesting global convergence in health and mortality (Atance et al. 2024; Ram 1998). However, such convergence was interrupted by health crises emerging from the late 1980s, such as the collapse of the Soviet Union in the Eastern European context and the HIV/AIDS epidemic in sub-Saharan Africa (Ram 2006). Compared with mortality, the pace and magnitude of fertility changes are more heterogeneous across the world. Many sub-Saharan African (SSA) countries lagged behind other LMICs in terms of fertility decline (Bongaarts and Casterline 2013), and a reversal of fertility decline started to be observed in some advanced economies (Myrskylä, Kohler, and Billari 2009), both contributing to a more divergent inter-country trajectory of fertility transition.

Existing studies on the topic share a series of commonalities. First, with few exceptions (e.g., Clark and Agnant 2025; Gabrielli et al. 2021; Pesando and GFC Team 2019), studies focus primarily on fertility and mortality (and/or health), while important resulting demographic phenomena – such as family formation and changes in household composition – have been largely overlooked. Second, previous studies predominantly explore demographic processes, as well as convergence and divergence among them, over a specified time frame. Given findings that demographic convergence has mainly occurred among places sharing similar economic and sociopolitical contexts (Azomahou, Diebolt, and Mishra 2009; Wang and Sun 2016), there is a missed opportunity to shift analyses toward other key socioeconomic dimensions that may not change linearly as time goes by. Third, with few exceptions in the context of mortality (e.g., Atance et al. 2024), rarely do convergence studies incorporate a gender lens using indicators collected similarly for men and women.

The present study aims to fill these gaps by investigating cross-country convergence in a core indicator of family change – namely, age at first marriage – over educational attainment. Educational attainment is a crucial indicator in this context. It is often considered the most important component of development (Lutz 2009; Lutz et al. 2021), yet it has received little attention in the demographic convergence literature. Over the past century, the world has experienced considerable educational expansion and dramatic improvements in educational attainment of people in both HICs and LMICs (Barro and Lee 2015). Relatedly, the gender gap in education has also narrowed (Bertocchi and Bozzano 2020; Psaki, McCarthy, and Mensch 2018). That is, levels of education have become increasingly similar both between countries and between women and men (Zhang and Li 2002).

Exploring whether convergence in education may underlie convergence in marriage timing is crucial, given that education is among the strongest determinants of transition-to-adulthood timing (Buchmann and Kriesi 2011; Hogan and Astone 1986; Juárez and Gayet 2014; Pesando et al. 2021; Shanahan 2000). This has long been the case in HICs but is also increasingly the case in contexts characterized by early marriage as the norm, primarily in LMICs (Batyra 2024), where marriage timing has witnessed gradual shifts toward postponement of first unions (Clark and Agnant 2025; Mensch, Singh, and Casterline 2005; Pesando et al. 2021). This is also true in contexts where marriage remains nearly universal, such as large parts of South and Southeast Asia (Jones and Yeung 2014). While mechanisms are manifold – and beyond the scope of this research – the underlying idea is that educational expansion boosts human capital opportunities, increasing labour market returns and raising opportunity costs of forming families, which correlate with a higher likelihood of postponing couple formation.

This study contributes to the existing demographic literature on convergence in multiple ways. First, we shift the theoretical focus from fertility and mortality to marital timing, enriching the growing literature on global comparative trends in family dynamics (Batyra et al. 2023; Bongaarts, Mensch, and Blanc 2017; Clark and Agnant 2025; Pesando and GFC Team 2019). Second, we move beyond existing literature assessing convergence over time (e.g., Dorius 2008) or levels of development (e.g., Pesando and GFC Team 2019) by isolating the role of educational attainment. In doing so, we separate continuous measures of education, such as years of schooling and categorical boundaries, namely primary, secondary, and tertiary education, alongside an often-neglected 'horizontal' differentiation between education *attended* and education *completed*. Third, we incorporate an explicit gender lens into the analysis, taking into account gender differences in both timing of union formation and educational expansion. As far as the former is concerned, we explore convergence in female marital timing, male marital timing, and the resulting gender gap. Lastly, to reflect the fact that some LMICs have caught up with HICs in terms of education, we conduct a truly global study covering 144 countries – accounting for more than 80% of the world's population.

Cross-national variation in age at marriage keeps receiving extensive scholarly attention, primarily because marital timing is thought to mark the beginning of the family formation process (Batyra 2024; Bongaarts, Mensch, and Blanc 2017; Ikamari 2005), having important implications for timing of first birth and labour force participation rates (Clark and Agnant 2025). While this remains true in most LMICs, the same does not hold in other (mostly Western) societies, where both the meaning and timing of marriage have been 'deinstitutionalised,' paving the way for different family arrangement alternatives and different values, often symbolic and status-related (Cherlin 2004, 2020; Sassler and Miller 2023). Therefore the role that education plays for timing of marriage may differ between LMICs and HICs, being more relevant for the former. A recent study on the Global South documented that, despite some similarities across LMICs, little evidence remains on convergence across or within regions with respect to finishing school, becoming sexually active, forming a union, having a child, and working for pay (Clark and Agnant 2025). In light of this mixed evidence, adopting a global long-term perspective and sub-setting analyses by geographical macro area has the potential to unravel whether even in societies where marriage is now the capstone of family formation, educational expansion has the potential to drive cross-country convergence or divergence.

In terms of broader implications, analysing convergence in marriage timing could help us better understand convergence in fertility rates, given that marriage timing is closely related to the proportion married in a population, itself a proximate determinant of fertility (Bongaarts 1978; Marini and Hodsdon 1981; Ruzicka 1976). Furthermore, age at first marriage has been linked with marital stability and quality (Booth and Edwards 1985; Garcia-Hombrados and Özcan 2024; Glenn, Uecker, and Love Jr. 2010; Lee 1977; Lehrer 2008; Lehrer and Son 2017), labour market outcomes (Dhamija and

Roychowdhury 2020; Wang and Wang 2017), child well-being (Chari et al. 2017; Sekhri and Debnath 2014), female economic independence (Yount, Crandall, and Cheong 2018), gender role attitudes (Asadullah and Wahhaj 2019), violence against women (Roychowdhury and Dhamija 2021), and bargaining power (Tauseef and Sufian 2024). Thus understanding whether and how the timing of marriage converges between countries as education expands is a first useful step in shedding light on cross-country variation in other policy-relevant socioeconomic and developmental outcomes. Considering these correlations, while a convergence trajectory in marital timing is not desirable per se, it may be beneficial to the extent that it signals more time spent in school – in turn conducive to higher human capital investments, more equal gender attitudes and norms, higher female independence, and growing female labour force participation rates (Chae et al. 2020).

2. Data and methods

2.1 Data and operationalisation

The analysis combines two data sources. The first is the latest World Marriage Data (WMD), compiled by the Population Division of the Department of Economic and Social Affairs, United Nations (2019). The WMD presents comparable data on the marital status of women and men for 232 countries from around 1950 onward. The dataset builds on multiple sources, including population registers, censuses, nationally representative surveys, and official estimates made by statistical offices. In this study, we focus on marriage timing by looking at a key marriage indicator in the WMD, the singulate mean age at marriage (SMAM), defined as the mean age at first marriage among those who marry before age 50. Originally developed by Hajnal (1953), it is a synthetic cohort indicator calculated from the marital status of women and men. It measures the average years lived as single by a hypothetical cohort for which the proportions of never married at each age remain the same as those observed in a given year for a given population. SMAM is the most readily available measure of the timing of marriage at the international level and has been widely utilized in cross-country analyses of both historical and contemporary nuptiality (Ausubel et al. 2022; Carmichael 2011; Dixon 1971; Engelen and Puschmann 2011; Ortega 2014; Saardchom and Lemaire 2005; Yeung 2022). The WMD provides SMAM separately for women and men, from which we can calculate gender differences in SMAM (men minus women).

The second source is the Barro–Lee Educational Attainment Dataset (Barro and Lee 2013), which collected information on educational attainment by gender and age for 146 countries in five-year intervals between 1950 and 2015 from more than 600 censuses and surveys. For this study, we extracted seven indicators of educational attainment from the Barro–Lee data, including the average years of schooling for a given country as well as the percentages of that country's adult population (aged 25–64) who ever attended or completed primary, secondary, or tertiary education at a given moment in time.

We combined information on marriage timing from the WMD with information on educational attainment from the Barro–Lee Dataset. Compared to education data available on a quinquennial basis, marriage data are sparser. To increase the number of countries and time points under consideration, we matched SMAM to the closest years in which education data are available. For example, data on SMAM are available for Afghan women in 1973 and 1979, and these two data points were matched with education data in 1975 and 1980. We did not match any data points that were more than two years apart. For example, SMAM is available for Barbados in 2012, but because 2012 is three years apart from 2015, we did not match the 2012 SMAM data point with the 2015 education data point (therefore 2015 was not included in the analysis for Barbados). In the end, our matching procedure delivered 144 countries, and in each country at least two data points are available for both education and SMAM.

2.2 Estimation

We explored whether convergence in marriage indicators had occurred over educational attainment by testing for β-convergence – that is, the catching-up of countries 'lagging behind' in SMAM. Originally proposed in the economic growth literature (Barro and Sala-i-Martin 1992; Sala-i-Martin 1996) and later adopted in the demographic literature (Dorius 2008, among others), a simple β-convergence specification is commonly estimated through the following equation:

$$\frac{\ln(Y_{i,t2})-\ln(Y_{i,t1})}{(t_2-t_1)} = \alpha + \beta Y_{j,t1} + \varepsilon_i \qquad (1)$$

Consider the example in Dorius (2008), which, in its most general form, analysed fertility convergence between 1955 and 2005. The left-hand side of Equation (1) is a quotient, where the numerator is change in (natural logged) total fertility rate (TFR) for country i from 1955 ($Y_{i,1955}$) to 2005 ($Y_{i,2005}$) and the denominator is the number of years elapsed between 1955 and 2005: 50 ($t_1 = 1955$ and $t_2 = 2005$, so $t_2 - t_1 = 2005 - 1955 = 50$, defined as T in his paper). Accordingly, the dependent variable represents the annualized rate of change in TFR over 1955–2005 – in other words, the average rate of change in TFR per unit of time. In Equation (1), this rate is regressed on the initial TFR in 1955. A positive sign on its coefficient indicates β-convergence, which occurs when the rate of change in TFR in high-fertility countries is greater than the rate of change in low-fertility countries.

Equation (1) is often used to test for convergence over time. In this study we took time out of the picture, which adds to the model the assumption that education may expand linearly. While this might not be true, it is a reasonable assumption. We thus examined convergence in SMAM over education, in line with Pesando and the GFC Team (2019), by fitting the following equation:

$$\frac{\ln(SMAM_{i,t2}) - \ln(SMAM_{i,t1})}{(EDU_{i,t2} - EDU_{i,t1})} = \alpha + \beta SMAM_{i,t1} + \gamma_i + \varepsilon_i \qquad (2)$$

As with Equation (1), the dependent variable on the left-hand side of Equation (2) is a quotient, in which the numerator is the change in (natural logged) SMAM for country i between the years t_1 and t_2, and the denominator is the change in an education indicator for the same country over the same period. Unlike Equation (1), wherein the dependent variable is the average rate of change per unit of time, the dependent variable in Equation (2) denotes the average rate of change in SMAM per unit of an education indicator (for example, per year of schooling or per 1% of population with primary, secondary, and tertiary education). In Equation (2), α is a constant, γ_i denotes country dummies controlling for between-country heterogeneity, and ε_i is the error clustered at the country level. With the addition of country fixed effects – which we exclude in a robustness check to ensure closer comparability with Dorius's specification – our model assumes different intercepts for each country yet common speed of convergence (the same slope). In terms of strict definitions, the dependent variable is not a rate, as time is not in the picture, but given that education changes as time goes by, it is akin to a rate, making the notion of convergence applicable to this context. The independent variable is SMAM for country i in base year t_1, and its coefficient β is the convergence coefficient of interest. A negative β suggests that countries are becoming increasingly similar to each other with regard to timing of marriage as education expands. Conversely, a positive sign indicates divergence – countries are becoming increasingly dissimilar in marriage timing as education expands.

It is important to highlight that growth convergence techniques are meant not to estimate causal relationships – in this case between educational change and marriage timing – but to identify empirical regularities describing whether specific variables become increasingly similar or dissimilar across units (countries in this case) as time goes by (or as education changes in this case).

As the computation of growth rates of SMAM over education may yield extreme values due to small changes in educational attainment across years, we excluded outliers in dependent variables falling outside the first quartile minus three times the interquartile range (IQR) and the third quartile plus three times the IQR (results including outliers are provided in the appendix). In addition, because the numbers of years with available data are different between countries, all estimates are weighted by the number of data points available per country. For instance, Afghanistan was observed at three time points, so each country wave observation was weighted one-third.

We conducted separate analyses for women and men – that is, examining convergence in female SMAM over female education and male SMAM over male education. With respect to gender differences in SMAM, we examined convergence over gender difference in average years of schooling (men minus women).

3. Results

3.1 Main findings

We start by presenting pooled summary statistics of SMAM and indicators of educational attainment for all 144 countries grouped across six subregions (Table 1): Europe and North America (37 countries), sub-Saharan Africa (31 countries), North Africa and West Asia (19 countries), South and Central Asia (11 countries), East and Southeast Asia (16 countries), and Latin America and the Caribbean (25 countries). The subregional classification is provided by the UN Population Division and names of countries are listed in Table A-1.

Overall, in line with the existing literature on the topic (Casterline, Williams, and McDonald 1986; Ausubel et al. 2022), men marry later than women (the gap globally is 3.65 years), and the gender gap in marriage timing is particularly pronounced in sub-Saharan Africa (5.39) and South and Central Asia (4.16). In addition, in these two subregions we observe appreciably younger ages at first marriage compared to the global average, especially for women (21.23 for sub-Saharan Africa, 20.78 for South and Central Asia). Men exhibit more years of schooling than women worldwide (7.33 vs. 6.45), and female disadvantage is smallest in Europe and North America (0.35) and in Latin America and the Caribbean (0.36). It is largest in sub-Saharan Africa (1.29), North Africa and West Asia (1.32), and South and Central Asia (1.54). Europe and North America feature the highest average years of schooling (10.02 years for women, 10.30 years for men), while sub-Saharan Africa features the lowest (3.21 for women, 4.49 for men). More than half of European and North American women and men have received some secondary education, and nearly one-fifth of them have received some tertiary education. These proportions are substantially larger than in other parts of the world. For instance, in SSA only 1.7% of women and 3% of men received some form of tertiary education.

Table 1: Summary statistics

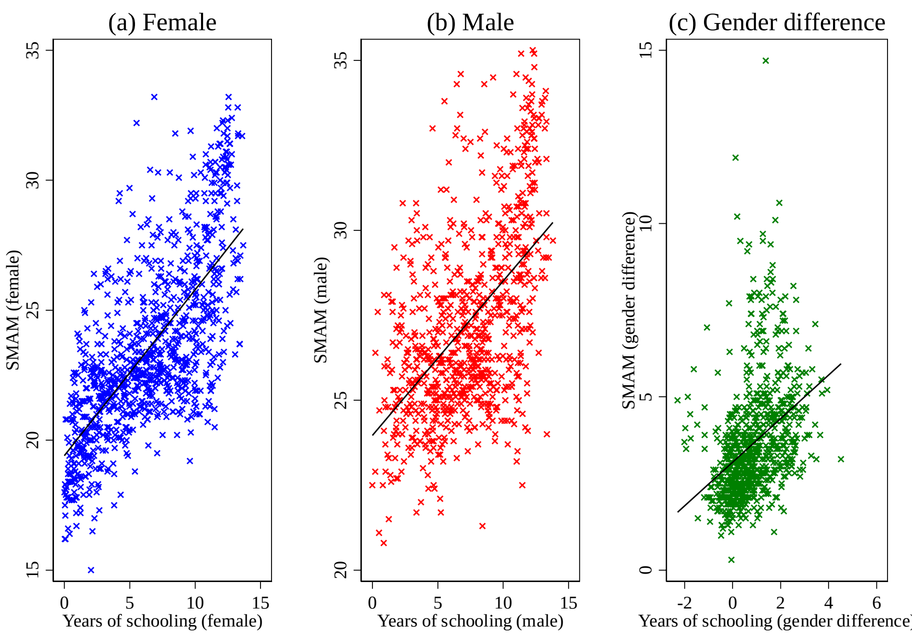
	All countries		Europe & North America		Sub-Saharan Africa		North Africa & West Asia		South & Central Asia		East & Southeast Asia		Latin America & the Caribbean	
	Mean or %	(SD)	Mean or %	(SD)	Mean or %	(SD)	Mean or %	(SD)	Mean or %	(SD)	Mean or %	(SD)	Mean or %	(SD)
Singulate mean age at marriage														
Women	23.52	(3.40)	26.13	(3.35)	21.23	(2.73)	23.69	(2.58)	20.78	(2.14)	24.55	(2.67)	22.77	(2.42)
Men	27.29	(2.78)	28.89	(3.09)	26.60	(2.22)	27.53	(2.13)	24.70	(1.75)	27.40	(2.56)	26.31	(2.35)
Gender difference	3.65	(1.68)	2.68	(0.74)	5.39	(1.89)	3.96	(1.63)	4.16	(1.38)	2.78	(0.85)	3.38	(1.24)
Years of schooling														
Women	6.45	(3.75)	10.02	(2.24)	3.21	(2.41)	4.95	(3.54)	5.11	(3.95)	6.57	(3.05)	6.42	(2.50)
Men	7.33	(3.28)	10.30	(1.94)	4.49	(2.27)	6.44	(3.16)	5.90	(3.14)	7.58	(2.78)	6.75	(2.23)
Gender difference	0.84	(1.01)	0.35	(0.62)	1.29	(1.11)	1.32	(1.16)	1.54	(1.11)	0.97	(0.84)	0.36	(0.74)
Primary education attended (%)														
Women	28.98	(19.71)	27.05	(22.23)	28.36	(18.24)	18.08	(14.46)	15.42	(11.61)	35.48	(16.95)	42.95	(15.43)
Men	31.57	(19.43)	24.86	(20.42)	35.22	(16.74)	25.29	(16.49)	19.60	(10.23)	36.56	(19.08)	46.39	(15.30)
Primary education completed (%)														
Women	16.05	(12.99)	19.65	(16.64)	12.20	(10.01)	11.19	(11.13)	9.26	(6.74)	18.62	(9.33)	20.42	(12.09)
Men	17.61	(12.96)	18.73	(15.92)	15.84	(17.44)	15.25	(12.73)	11.41	(6.43)	19.02	(9.09)	21.94	(12.97)
Secondary education attended (%)														
Women	31.74	(22.72)	50.13	(17.58)	14.69	(16.56)	22.55	(17.40)	32.47	(27.43)	33.44	(19.19)	29.01	(16.92)
Men	36.27	(21.56)	52.98	(18.08)	21.19	(17.44)	29.83	(16.47)	36.61	(21.06)	38.00	(17.82)	29.76	(17.16)
Secondary education completed (%)														
Women	19.19	(17.30)	31.90	(16.28)	6.40	(8.83)	15.52	(14.25)	23.72	(24.98)	19.43	(14.20)	15.53	(10.39)
Men	22.06	(17.45)	35.77	(17.81)	10.16	(9.83)	18.98	(13.65)	23.66	(21.16)	21.27	(12.37)	15.61	(10.54)
Tertiary education attended (%)														
Women	10.69	(12.20)	19.76	(14.13)	1.69	(2.56)	10.80	(11.74)	6.82	(7.68)	10.92	(11.12)	8.94	(7.78)
Men	12.30	(11.07)	19.54	(10.52)	3.04	(2.78)	13.53	(10.39)	8.96	(6.99)	14.06	(11.91)	9.62	(7.18)
Tertiary education completed (%)														
Women	6.68	(7.74)	11.86	(8.62)	0.96	(1.55)	6.87	(7.71)	4.53	(5.13)	7.33	(7.94)	5.93	(5.64)
Men	8.24	(7.52)	13.16	(6.61)	1.77	(1.58)	9.17	(7.32)	6.37	(5.40)	9.94	(9.19)	6.48	(5.53)

Notes: SD = standard deviation. Gender difference = male – female.

We continue by depicting correlations between timing of marriage and educational attainment. Figure 1 shows SMAM against years of schooling, separately for women, men, and the gender difference. We see a clear positive relationship: Women's and men's SMAM increases as schooling increases, and the gender gap in SMAM becomes wider as the gender gap in schooling widens. Figure 2 replicates Figure 1 but breaks down years of schooling into each level of educational attainment, shown separately for women (left) and men (right). We document positive associations of SMAM with both secondary and tertiary education for both women and men and for both education attended and education completed. These positive associations are stronger for tertiary relative to secondary education and for education completed relative to education attended. The direction of the marriage–education correlation is reversed when primary education is considered:

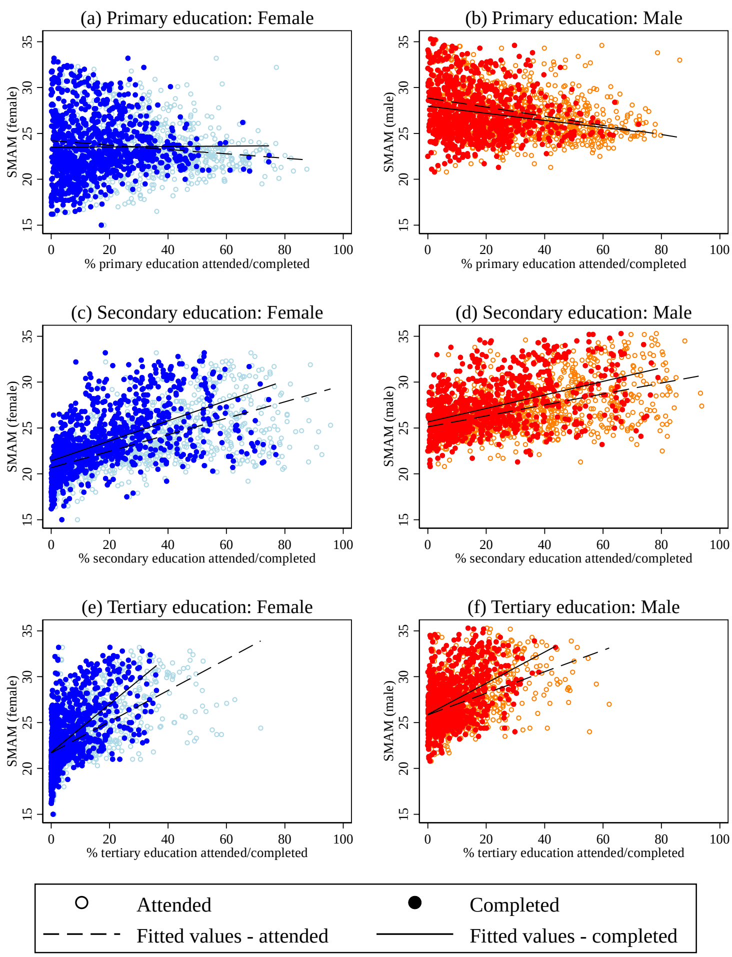
The larger a country's percentage of the male population with just primary education, the earlier the age at marriage of the country's men. Conversely, no clear association is apparent for women.

Figure 1: Scatter plots showing (a) female SMAM against female years of schooling; (b) male SMAM against male years of schooling; (c) gender difference in SMAM against gender difference in years of schooling



Note: Gender difference = male – female.

Figure 2: Scatter plots showing (a) female SMAM against female primary education attended/completed; (b) male SMAM against male primary education attended/completed; (c) female SMAM against female secondary education attended/completed; (d) male SMAM against male secondary education attended/completed; (e) female SMAM against female tertiary education attended/completed; (f) male SMAM against male tertiary education attended/completed



While informative, these associations are not conclusive in terms of whether countries have become increasingly similar to (or dissimilar from) each other on marriage timing as education expands. Therefore in Table 2 we present estimates of β-convergence coefficients using data from all 144 countries. For both women and men, there is neat evidence of convergence in their ages at first marriage over total education measured by years of schooling, and convergence is more pronounced for women than men in terms of effect size (double in size). Furthermore, all β-coefficients estimated from regression models analyzing convergence in female SMAM over educational thresholds exhibit negative signs, indicating that convergence in women's marriage timing is observed not only over total years of schooling but also for educational attainment at different thresholds. More importantly, we uncover two types of educational gradients: (1) the effect size of convergence coefficients is greater (more negative) for higher levels of education (tertiary > secondary > primary); and (2) within each educational boundary, completion of education contributes more to convergence in SMAM relative to just attendance. These two educational gradients are observed among both women and men. Nonetheless, evidence for convergence in male SMAM over primary education is weaker, and convergence coefficients are larger in magnitude (more negative) for women than for men. For instance, a one-year increase in female SMAM is associated with a 1.4% reduction in the growth rate of SMAM over years of schooling, while a one-year increase in male SMAM is associated with a reduction in the growth rate by 0.7%.

Table 2: β-convergence coefficients with 95% confidence intervals in brackets; SMAM over educational attainment, all countries

	Female SMAM over female education		Male SMAM over male education	
Years of schooling	−0.014	[−0.019, −0.009]	−0.007	[−0.014, −0.001]
N	739		652	
Primary education				
Attended	−0.001	[−0.002, 0.000]	0.000	[−0.001, 0.001]
N	730		638	
Completed	−0.002	[−0.004, −0.000]	−0.001	[−0.002, 0.001]
N	714		637	
Secondary education				
Attended	−0.003	[−0.003, −0.002]	−0.003	[−0.004, −0.002]
N	722		635	
Completed	−0.004	[−0.005, −0.003]	−0.003	[−0.004, −0.002]
N	709		634	
Tertiary education				
Attended	−0.005	[−0.007, −0.003]	−0.004	[−0.006, −0.002]
N	664		616	
Completed	−0.010	[−0.014, −0.006]	−0.006	[−0.009, −0.003]
N	657		599	

Notes: Standard errors clustered at the country level. Estimates weighted by the number of data points available per country. All models controlled for country dummies and excluded outliers. Gender difference = male – female.

Examining gender difference in SMAM and how it changes over gender difference in average years of schooling provides different results (shown in Table 3). Rather than a convergent trend, we find that if the gender gap in schooling becomes wider, differences between women's and men's SMAM become more pronounced between countries (Panel A). Specifically, if the initial difference in SMAM between women and men increases by one year, the average growth rate of SMAM over gender difference in years of schooling would increase by 17.2%.

Table 3: β-convergence coefficients with 95% confidence intervals, in brackets; gender difference in SMAM over gender difference in years of schooling

	β-coefficient	
Panel A		
All countries	0.172	[0.009, 0.335]
N	629	
Panel B		
Excl. Europe & North America	0.140	[−0.022, 0.301]
N	455	
Excl. sub-Saharan Africa	0.346	[0.126, 0.566]
N	489	
Excl. North Africa & West Asia	0.153	[−0.058, 0.364]
N	551	
Excl. South & Central Asia	0.171	[0.003, 0.339]
N	581	
Excl. East & Southeast Asia	0.142	[−0.024, 0.309]
N	552	
Excl. Latin America & the Caribbean	0.149	[−0.009, 0.308]
N	541	

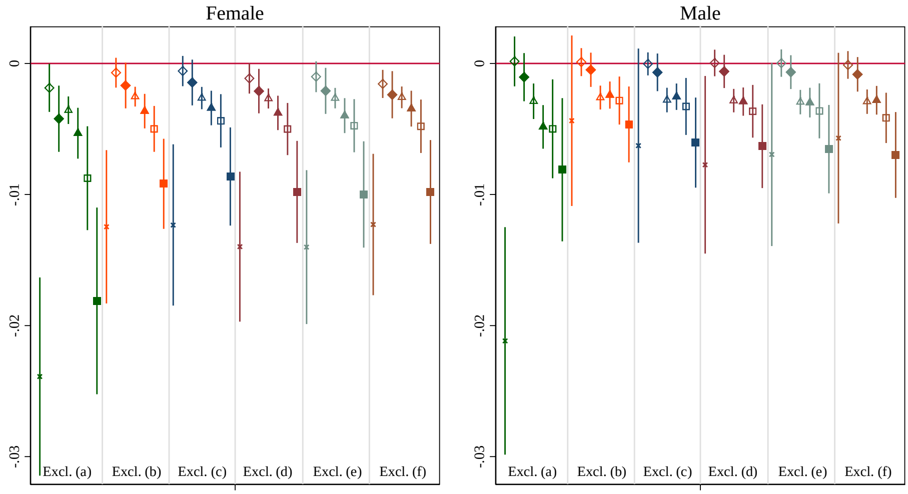
Notes: Standard errors clustered at the country level. Estimates weighted by the number of data points available per country. All models controlled for country dummies and excluded outliers. Gender difference = male – female.

3.2 Subregional heterogeneity

To identify whether subregions contribute differently to convergence trends in SMAM, we conducted additional analyses excluding one subregion at a time from our analytical sample. Figure 3 visualises the results for women (left) and men (right) separately. Concerning total years of schooling (×), excluding South and Central Asia or East and Southeast Asia does not change the convergence coefficient for women, while excluding sub-Saharan Africa, North Africa and West Asia, or Latin America and the Caribbean slightly decreases the magnitude of convergence coefficients. (They become less negative.) The most notable change is associated with excluding Europe and North

America, which makes convergence in SMAM over years of schooling among women stronger, suggesting higher cross-country variability in female SMAM within Europe and North America. Similar patterns are observed for men.

Figure 3: *β*-convergence coefficients with 95% confidence intervals; SMAM over educational attainment; subregional analyses excluding (a) Europe & North America, (b) sub-Saharan Africa, (c) North Africa & West Asia, (d) South & Central Asia, (e) East & Southeast Asia, (f) Latin America & the Caribbean



Notes: Standard errors clustered at the country level. Estimates weighted by the number of data points available per country. All models controlled for country dummies and excluded outliers. Gender difference = male – female. Cross symbol (×) = years of schooling; diamond symbol (◆) = primary education; triangle symbol (▲) = secondary education; square symbol (■) = tertiary education; hollow marker = education attended; filled marker = education completed.

Focusing on educational thresholds, the two educational gradients documented in the pooled analysis (tertiary [■] > secondary [▲] > primary [◆]; completion > attendance) hold robust across almost all subregional analyses. For both women and men, excluding a subregion does not make any substantial change to the convergence coefficient over primary education (attended or completed). The same finding holds when considering secondary education, except that excluding Europe and North America leads to stronger divergence in both female and male SMAM. The role of Europe and North America is particularly pronounced with respect to tertiary education, as excluding this subregion makes female SMAM substantially more convergent over tertiary education, while the impact on male SMAM is much more contained.

Overall, there are two main takeaways from the subregional analysis. First, the two educational gradients identified are robust, as they are observed among both men and women and hold irrespective of which subregion is excluded. Second, convergence in marriage timing is stronger among women across virtually all subregions of the world.

Table 3 (Panel B) presents results of subregional convergence analyses in gender difference in SMAM over gender difference in years of schooling. Divergence holds robust across all subsamples, yet the role of SSA is remarkable, as excluding it leads to even further divergence (coefficient doubles in size).

3.3 Additional analyses

We conducted a range of additional analyses as robustness checks. Table A-2 presents the share of outliers across various analytical samples. Outliers account for 7% to 18% of the total sample, depending on which dependent variable is examined. Although these percentages are not excessively large, we re-estimated the convergence coefficients with full observations (all outliers included) to assess whether results are driven by the exclusion of outliers (Table A-3). For women, the finding on convergence in SMAM over education remains robust, as all convergence coefficients are still negative. For men, β-convergence coefficients turn positive with regard to both attendance and completion of primary education, as well as completion of secondary education, suggesting that outliers have a larger impact on the male sample. Finally, divergence in gender difference in SMAM over gender difference in years of schooling holds robust. By including outliers, we included more extreme values in dependent variables, reducing statistical power and widening confidence intervals.

After excluding outliers from the sample, the number of country-year observations for all-country analyses ranges from 599 to 739 (see Table 2 for female and male samples, and Table 3 for the gender difference sample), suggesting that adding fixed effects for 144 countries should leave enough degrees of freedom for estimation. Nevertheless, we reran all models without country dummies (Table A-4). Signs of β-convergence coefficients are almost identical to those shown in Tables 2 and 3, yet effect sizes are attenuated and confidence intervals are wider.

Due to the sparseness of data on marriage timing, we matched SMAM from WMD to the closest years in which education measures are available from the Barro–Lee dataset. The matching results in 946 country-year observations in the female sample and 848 in the male sample. Of these, a certain percentage of observations are based on matched data (56% female sample, 55% male sample). Generally, HICs with better population statistics and registration systems, such as the Nordic countries, have less matched data. However, in some other HICs, such as Australia, almost all observations are matched. Observations for some LMICs, such as China, are entirely or almost entirely based on original data. We re-estimated the convergence coefficients only using original and unmatched data (Table A-5). Despite sizable reductions in sample size and wider confidence intervals, the coefficients hold virtually unchanged.

As marriage has been largely deinstitutionalised (Cherlin 2004), alternative forms of partnerships, such as cohabitation and living apart together, have become more widespread globally (Lesthaeghe 2014). As a result, at least in some countries, marriage has ceased to be the stepping stone of family formation. By solely focusing on marriage timing, our study may be ignoring family formation processes other than marriage, also correlated with educational expansion. As comprehensive global data allowing us to examine cross-country convergence in alternative forms of union formation are still scant, we conclude by complementing analyses on age at marriage with analyses on proportion married. We test for convergence in marriage prevalence using time-series data on the percentage of married women among all women of reproductive ages, which are provided in the WMD and available for 223 countries from 1970 onward (Table A-6). We document similar evidence of convergence in marriage prevalence over all seven education indicators.

4. Conclusions

Using macro-level time-series data on timing of marriage and educational attainment for 144 countries, this study has explored whether, globally, the timing of marriage has become increasingly similar across countries as they have witnessed rapid educational expansion. Using separate indicators for women and men, as well as a broad range of educational attainment variables, we have shown that marriage timing has become increasingly similar across countries for both women and men, with a faster pace of convergence among women. Separate analyses by level of education have demonstrated that convergence dynamics are increasingly driven by educational expansion at the secondary and tertiary levels, as well as by the extent to which individuals complete educational cycles. Therefore we documented two types of educational gradients in marital timing convergence, one in terms of *educational boundary* and the other in terms of *educational cycle completion*. Overall, cross-regional heterogeneity is low, suggesting that convergence in marital timing is becoming a global phenomenon, yet we do observe even stronger convergence in the absence of Europe and North America. This latter finding, implying that LMICs are most responsible for driving convergence in timing of marriage, departs from previous fertility scholarship on the topic, which shows that

LMICs – SSA countries foremost – tend to drive results away from convergence (Dorius 2008; Pesando and GFC Team 2019). The discrepancy in turn signals that, while there remains high cross-country variability in timing and quantum of fertility in LMICs, cross-country variability in marital timing in these same countries is becoming smaller. In turn, this finding may lead scholars to speculate that broader development forces, such as economic development and educational expansion, may be more effective at influencing marital timing relative to fertility dynamics.

Alongside these empirical regularities, our analysis also uncovered a new finding: Once both the gender gap in marital timing and the gender gap in educational attainment are considered, neat evidence of convergence disappears. In fact, we found that the gender gap in marital timing became increasingly dissimilar across countries as the gender difference in educational attainment widened. While this finding deserves additional unpacking, it underscores the importance of exploring convergence dynamics intersecting both an educational and a gender lens. Despite different methodological approaches, the finding is consistent with recent evidence from the Global South suggesting that men and women still follow strikingly different transitions to adulthood, with little evidence of diminishing gender inequalities (Clark and Agnant 2025).

From a theoretical standpoint, evidence of cross-country convergence in marital timing aligns with predictions of diffusion theories, which argue that ideological changes and cultural shifts, including those related to changing family behaviours and practices, may diffuse around the world by means of social interactions (Bongaarts and Watkins 1996; Montgomery and Casterline 1996), peer influence, spread of media, and broader globalisation forces (Caldwell 2001; Giuntella, Rotunno, and Stella 2022). According to world society perspectives, globalisation itself diffuses ideologies of gender revolution, feminism, the changing division of labour between genders, and egalitarian attitudes towards gender roles (Pandian 2019; Pierotti 2013), all of which may push women to further delay marriage. Convergence towards delayed marital timing is also consistent with second demographic transition (SDT) theories postulating increasing decoupling between marriage and childbearing alongside delays of marriage reflected into increasing ages at marriage (Lesthaeghe 2014).

All in all, our study is unique in documenting neat convergence patterns in marital timing across both genders, albeit at different speeds, as well as in uncovering that global convergence patterns do mask fundamental heterogeneity by education, hinting at the growing importance of secondary and tertiary education over primary education. Findings provide important insights for addressing key challenges in global development and demography (such as postponement of childbearing, changing family structures and kinship networks, increasing rates of childlessness, nuclearization of households, and persistently low rates of female labour force participation) and for informing policymakers as they evaluate the suitability of specific policies aimed at further narrowing inequalities between societies. In some countries – primarily those with early ages at marriage – some effective policies in the realm of education may include boosting higher education rates, promoting educational quality, and ensuring that students reach the completion of targeted educational cycles. As age at marriage is an important predictor of multiple other outcomes, including marital stability, bargaining between spouses, female empowerment, and child health and well-being, this study may also inform policymakers on how gender-sensitive policies can complement educational policies across all stages of the life course. Similarly, as delays in age at marriage entail changing household composition dynamics, which in turn affect kinship networks and patterns of intergenerational support, studying convergence in marital timing may inform scholars and policymakers concerned with old-age support.

This study has some limitations that pave the way for additional research on the topic. First, our estimates cannot and should not be interpreted as causal. No one should draw the conclusive implication that educational expansion causes convergence in marital timing, as growth convergence techniques were not designed to uncover causal relationships but to identify empirical regularities in macro-level variables. Second, while we rely on different measures of educational attainment, we acknowledge that these may still not be comprehensive enough to capture the whole array of educational systems that exist worldwide. Specifically, while we recognize the importance of complementing our study with better measures of educational quality on top of quantity (Lutz et al. 2021), our study is cross-country and comparative in scope, so it inevitably requires reliance on a set of summary measures that are well-known and broadly understandable. Third, the synthetic cohort nature of SMAM relies on the stationarity assumption, which may not hold when different cohorts undergo changes in family domains at different times and/or under different conditions. In other words, if young cohorts in a population behave differently from their elders in terms of the proportion ultimately marrying, SMAM ceases to be a reliable estimate of age at marriage in a period (National Academies of Sciences, Engineering and Medicine 1993). While there is no a priori ‘first best’ between period and cohort measures, this study could be similarly conducted using age-specific proportions, yet this would entail delving into micro-level data from cross-national surveys (such as Demographic and Health Surveys) – which would importantly limit the geographical scope of the analysis as well as the possibility of comparing both men and women. Relatedly, SMAM captures the mean age at first marriage among individuals who ever marry by a certain time limit, thus overshadowing the growing complexity and heterogeneity of current family forms and structures, especially in HICs, where increasing shares of individuals decide to forgo marriage altogether. We acknowledge that, conditional on data availability, a more comprehensive analysis should delve into variability within the never-married population and explore the prevalence and timing of cohabitation and leaving the parental home. Fourth, while geographical coverage is relatively even across different macro areas of the world, some countries present more complete time-series on SMAM than others, entailing varying degrees of matching and extrapolation, which may bias the results. Lastly, this study does not adequately incorporate the idea that countries are not independent entities but are part of a network that extends across international borders, which, by means of peer influence and diffusion processes, is likely to shape some family domains more than others (Cherlin 2012).

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Appendix

Table A-1: List of countries under study

Subregion	Countries
Europe & North America (N = 37)	Albania; Austria; Belgium; Bulgaria; Canada; Croatia; Czechia; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Norway; Poland; Portugal; Republic of Moldova; Romania; Russia; Serbia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Ukraine; United Kingdom; United States of America
Sub-Saharan Africa (N = 31)	Benin; Botswana; Burundi; Cameroon; Central African Republic; Congo; Côte d'Ivoire; Democratic Republic of the Congo; Eswatini; Gabon; Gambia; Ghana; Kenya; Lesotho; Liberia; Malawi; Mali; Mauritania; Mauritius; Mozambique; Namibia; Niger; Rwanda; Senegal; Sierra Leone; South Africa; Togo; Uganda; United Republic of Tanzania; Zambia; Zimbabwe
North Africa & West Asia (N = 19)	Algeria; Armenia; Bahrain; Cyprus; Egypt; Iraq; Israel; Jordan; Kuwait; Libya; Morocco; Qatar; Saudi Arabia; Sudan; Syrian Arab Republic; Tunisia; Türkiye; United Arab Emirates; Yemen
South & Central Asia (N = 11)	Afghanistan; Bangladesh; India; Iran; Kazakhstan; Kyrgyzstan; Maldives; Nepal; Pakistan; Sri Lanka; Tajikistan
East & Southeast Asia (N = 16)	Brunei Darussalam; Cambodia; China; China, Hong Kong SAR; China, Macao SAR; Indonesia; Japan; Lao People's Democratic Republic; Malaysia; Mongolia; Myanmar; Philippines; Republic of Korea; Singapore; Thailand; Vietnam
Latin America & the Caribbean (N = 25)	Argentina; Barbados; Belize; Bolivia; Brazil; Chile; Colombia; Costa Rica; Cuba; Dominican Republic; Ecuador; El Salvador; Guatemala; Guyana; Haiti; Honduras; Jamaica; Mexico; Nicaragua; Panama; Paraguay; Peru; Trinidad and Tobago; Uruguay; Venezuela
Other (N = 5)	Australia; Fiji; New Zealand; Papua New Guinea; Tonga

Table A-2: Share of outliers

	Female sample	Male sample	Gender difference
Years of schooling	8%	7%	10%
Primary education			
Attended	9%	9%	
Completed	11%	10%	
Secondary education			
Attended	10%	10%	
Completed	12%	10%	
Tertiary education			
Attended	17%	13%	
Completed	18%	15%	

Table A-3: β-convergence coefficients with 95% confidence intervals in brackets, robustness checks, inclusion of outliers

	Female	Male	Gender difference
Years of schooling	−0.016	−0.015	0.150
	[−0.047, 0.015]	[−0.123, 0.092]	[−0.007, 0.307]
Primary education			
Attended	−0.017	0.005	
	[−0.041, 0.007]	[−0.031, 0.040]	
Completed	−0.031	0.008	
	[−0.071, 0.008]	[−0.020, 0.037]	
Secondary education			
Attended	−0.009	−0.003	
	[−0.019, −0.000]	[−0.016, 0.009]	
Completed	−0.049	0.004	
	[−0.122, 0.024]	[−0.017, 0.024]	
Tertiary education			
Attended	−0.060	−0.032	
	[−0.098, −0.022]	[−0.082, 0.018]	
Completed	−0.084	−0.004	
	[−0.146, −0.022]	[−0.049, 0.042]	

Notes: Standard errors clustered at the country level. Estimates weighted by the number of data points available per country. All models controlled for country dummies. Gender difference = male – female.

Table A-4: β-convergence coefficients with 95% confidence intervals in brackets, robustness checks, exclusion of country dummies

	Female	Male	Gender difference
Years of schooling	−0.004	−0.000	0.009
	[−0.007, −0.001]	[−0.003, 0.002]	[−0.041, 0.059]
Primary education			
Attended	−0.001	−0.000	
	[−0.002, −0.001]	[−0.001, 0.000]	
Completed	−0.002	−0.001	
	[−0.003, −0.001]	[−0.002, −0.000]	
Secondary education			
Attended	−0.001	−0.001	
	[−0.002, −0.001]	[−0.001, −0.000]	
Completed	−0.002	−0.000	
	[−0.002, −0.001]	[−0.001, 0.002]	
Tertiary education			
Attended	−0.003	−0.000	
	[−0.004, −0.001]	[−0.002, 0.001]	
Completed	−0.004	−0.001	
	[−0.006, −0.002]	[−0.002, 0.001]	

Notes: Standard errors clustered at the country level. Estimates weighted by the number of data points available per country. All models excluded outliers. Gender difference = male – female

Table A-5: β-convergence coefficients with 95% confidence intervals in brackets, robustness checks, exclusion of matched observations

	Female		Male		Gender difference	
Years of schooling	−0.011	[−0.020, −0.002]	−0.010	[−0.022, 0.002]	0.192	[−0.021, 0.406]
N	266		251		235	
Primary education						
Attended	−0.000	[−0.002, 0.001]	0.001	[−0.000, 0.002]		
N	261		248			
Completed	−0.002	[−0.006, 0.003]	0.000	[−0.001, 0.002]		
N	260		240			
Secondary education						
Attended	−0.002	[−0.004, −0.001]	−0.002	[−0.004, −0.001]		
N	269		244			
Completed	−0.002	[−0.004, −0.001]	−0.002	[−0.003, −0.000]		
N	264		244			
Tertiary education						
Attended	−0.003	[−0.005, −0.001]	−0.003	[−0.006, −0.000]		
N	246		235			
Completed	−0.006	[−0.010, −0.002]	−0.005	[−0.009, −0.000]		
N	249		235			

Notes: Standard errors clustered at the country level. Estimates weighted by the number of data points available per country. All models excluded outliers. Gender difference = male – female.

Table A-6: β-convergence coefficients with 95% confidence intervals in brackets, share of women of reproductive ages who are married

	β-coefficient	
Years of schooling	−0.000	[−0.001, 0.001]
N	1,275	
Primary education		
Attended	−0.000	[−0.001, 0.000]
N	1,206	
Completed	−0.000	[−0.001, −0.000]
N	1,193	
Secondary education		
Attended	−0.000	[−0.000, −0.000]
N	1,237	
Completed	−0.000	[−0.001, −0.000]
N	1,198	
Tertiary education		
Attended	−0.001	[−0.001, −0.000]
N	1,155	
Completed	−0.001	[−0.002, −0.000]
N	1,148	