

DATA & TRENDS

Education, fertility postponement and parity progression: Exploring variation by migration background using a joint modelling approach

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ABSTRACT Educational expansion has been a key driver of fertility postponement in Europe. Given the growing share of individuals with a migration background, understanding how education shapes fertility across these population subgroups is becoming increasingly important. To date, the intersection between education, migration background and fertility has received limited attention. Using Belgian register data (2000–2011) and shared frailty models for recurrent events, we examine the association between education and first, second and third births among 1.5 (migrated before age 18) and second (children of immigrants) generation women from six origin groups alongside native Belgian women (women without a migration background). We investigate (i) how educational gradients vary across origin groups and generations and (ii) how fertility varies within educational levels across origin groups, while also considering (iii) the role of selective entry into parenthood. Results reveal striking differences in how education shapes fertility across origin groups and birth orders. For first births, patterns by level of education are similar across origin groups, particularly among the second generation. For second births, variation by level of education is highly group-specific: positive gradients emerge among certain European origin groups, while remaining absent among Turkish, Maghrebi and other non-European groups. For third births, educational gradients are neutral for all groups. Substantial variation across origin groups and generations persists after controlling for educational levels, indicating that factors beyond education continue to differentiate childbearing behaviour. Finally, groups with a migration background show larger unobserved heterogeneity in fertility hazards, highlighting that minority groups cannot be considered homogenous in terms of fertility, and underscoring the need to control for selection when comparing the education-fertility nexus across origin groups and generations.

KEYWORDS Education • Parity progression • Migration background • Joint model • Belgium

Introduction

In recent decades, educational expansion has been a main driver of fertility postponement in countries across Europe (Neels and De Wachter, 2010; Neels et al., 2017;

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Ní Bhrolcháin and Beaujouan, 2012). At the same time, educational expansion has proceeded unevenly across population subgroups, particularly among the growing and heterogeneous group of individuals with a migration background. Hence, the impact of education on future trends in the timing and quantum of order-specific fertility will increasingly be shaped by the education-fertility nexus among individuals with a migration background, who are often still characterised by lower educational attainment and patterns of early family formation. To date, the education-fertility link on the one hand, and the fertility of the descendants of migrants on the other, have been studied largely in isolation from each other. However, understanding their intersection is becoming increasingly important.

The differentiating role of education in both the tempo and quantum of fertility in (western) European countries has been well established in previous research (Lappegard and Ronsen, 2005; Neels and De Wachter, 2010; Ní Bhrolcháin and Beaujouan, 2012; Vasireddy et al., 2023). Higher educational attainment has consistently been associated with postponement of the transition to parenthood and higher levels of childlessness (Gustafsson et al., 2002; Martin, 2000; Mills et al., 2011; Rendall et al., 2005; Wood et al., 2014), although recent studies report decreasing educational gradients in childlessness among more recent cohorts (Jalovaara et al., 2019; Köppen et al., 2017; Rybinska, 2020). After entry into parenthood, higher educated women have often been found to transition more rapidly – and sometimes more frequently – to second and higher order births than their lower educated peers. This pattern has been repeatedly described as reflecting selective entry into parenthood, whereby only the most fertility-motivated among the highly educated individuals become parents in the first place (Klesment et al., 2014; Köppen, 2006; Kravdal, 2001; Neels and De Wachter, 2010; Wood et al., 2020, 2025). Largely separate from research on the association between education and fertility, a growing literature has documented substantial variation in fertility patterns across origin groups and migrant generations. While first generation migrants generally exhibit higher fertility than natives (Guarin Rojas et al., 2018; Sobotka, 2008), findings on the fertility of descendants of immigrants are mixed. Fertility among 1.5 and second generation women depends strongly on the origin group, parity and the national context considered (Andersson et al., 2017; Baek et al., 2025; Guarin Rojas et al., 2018; Höhn et al., 2024; Krapf and Wolf, 2015; Kulu and Hannemann, 2016; Kulu et al., 2017, 2019; Pailhé, 2017; Wilson, 2019).

To date, these two dimensions of social differentiation in family formation have not been systematically combined (Krapf et al., 2024; Marynissen et al., 2025). In the expanding literature on the fertility of migrants and their descendants, education is often included as a covariate in order to examine whether their fertility patterns become more (or less) similar to those of natives after controlling for educational differentials (Baek et al., 2025; Kulu et al., 2017; Pailhé, 2017). However, the intersection between education, origin group and migrant generation is rarely examined, leaving potential variation by migration background in the association between education and both entry into parenthood and parity progression largely unexplored (Krapf and Wolf, 2015). Similarly, research on educational gradients in the tempo and quantum of fertility has focused primarily on majority (or general) populations, while paying only limited attention to the question of whether

similar associations hold across diverse origin groups and migrant generations (Krapf et al., 2024; Marynissen et al., 2025). Without examining how educational gradients vary across origin groups and migrant generations, we cannot assess whether education has an equalising effect on fertility behaviour across groups, or whether group-specific cultural and structural or contextual factors continue to shape childbearing even among individuals with similar educational levels.

Both the literature on migrant fertility and the literature on educational gradients in fertility face the challenge of how to account for selective entry into parenthood and subsequent selective progression to higher parities (Kravdal, 2001, 2007; Kreyenfeld, 2002; Wood et al., 2014). Unobserved characteristics that make some women more “prone to childbearing” than others may vary significantly across educational levels, as well as across origin groups and migrant generations. Accounting for such (differential) selection effects is therefore essential to avoid bias in the estimated relationship between education and fertility, and to enable meaningful comparisons across origin groups and migrant generations.

Building on our previous work that focused on entry into parenthood (Marynissen et al., 2025), this paper addresses these research gaps by examining the association between educational attainment, entry into parenthood and progression to second and third births among women of the 1.5 generation (who migrated before the age of 18) and the second generation in Belgium during the 2000–2011 period. Using population-wide register data, we distinguish six origin groups: women originating from (i) southern Europe, (ii) eastern Europe, (iii) northern and western Europe, (iv) Turkey, (v) Maghreb countries and (vi) other non-European countries, alongside native Belgian women (women without a migration background) as a reference group. We make three substantial contributions to the literature by answering the following three research questions: (1) To what degree do educational gradients in the timing and intensity of first, second and third births differ across origin groups and migrant generations? The extent to which educational gradients are similar across groups indicates whether education “transcends” other factors (e.g. cultural values, family networks) or is modified by specific cultural/structural contexts. (2) Conversely, to what degree do the timing and intensity of childbearing still vary across origin groups and migrant generations when considering women with the same level of education? The extent to which variation across origin groups and migrant generations persists when controlling for level of education indicates whether fertility differences are shaped primarily by factors beyond education (e.g. cultural values, family networks, economic conditions) or are mainly due to educational/socioeconomic factors. (3) Finally, to what degree do selective entry into parenthood and subsequent parities shape the education-fertility nexus across origin groups and migrant generations? In line with research on educational gradients in higher order births among majority populations, we address the issue of selectivity by modelling all three parity transitions jointly and including a time-constant shared frailty for recurrent events (i.e. random effect) at the level of individual women (Hougaard, 2000; Kravdal, 2001; Kreyenfeld, 2002; Wood et al., 2014). Building on our earlier work on the education-fertility nexus in migrant populations (Marynissen et al., 2025), the joint modelling of all three parity transitions now allows us to explore educational differences in entry into

parenthood and progression to second and third births across origin groups and migrant generations simultaneously, net of (differential) selection over subsequent parities by comparing women with average frailties across groups. Furthermore, the variance estimates of the shared frailty term indicate whether and to what extent heterogeneity – for instance regarding fertility motivations, opportunities or restrictions – differs across origin groups and migrant generations. Answering these research questions can shed light on the larger issue of whether ongoing educational expansion will lead to a convergence of fertility patterns across diverse populations, or whether fertility differentials will persist due to structural and cultural differences, regardless of a convergence of educational attainment. Moreover, these insights can help to answer the question of whether continued educational expansion among migrant groups will contribute to further fertility postponement – as previously observed in majority populations – or whether other factors will counteract postponement trends, potentially stalling or reversing current patterns of delayed childbearing.

Background: Migrant origin groups, education and fertility in Belgium

Belgium has a long history of immigration, with different ethnic minorities typically being rooted in different types of migration, which can, in turn, be linked to differential opportunity structures in terms of education and the labour market. Migrants from neighbouring northern and western European countries have often migrated to Belgium for reasons of education or employment. This has also been the case for more recent migrants from eastern Europe following EU enlargements (Myria, 2021). The fact that these migration channels are intrinsically connected to education and labour is often put forward as an explanation for the recurring finding that these migrants and their descendants have opportunity structures and labour market outcomes approximating those of the Belgian majority population.

In contrast, migrants and descendants of migrants originating from southern Europe, Turkey and Maghreb countries are more strongly rooted in the post-WWII labour migration of predominantly male and low educated workers. For southern European groups, this period of labour migration was followed by substantial levels of return migration due to economic growth in their origin countries and free movement within Europe since the 1960s. Thus, those southern European migrants who remained in Belgium or arrived later represent a more economically established and diverse population. More recent southern European migrants and later generations are now characterised by a more diverse profile in terms of their socioeconomic position and gender (Myria, 2016). In contrast, Turkish and Maghrebi labour migration was, in response to the migration stop in the early 1970s, followed by flows of family reunification and marriage migration that were largely unrelated to education or employment opportunities (Reniers, 1999). The concentration of Turkish and Maghrebi communities in urban industrial areas that experienced subsequent deindustrialisation has contributed to their persistent exposure to poverty

Table 1 Number of women and distribution of level of education (in 2011, row percentages) by origin group and migrant generation, Belgium

	1.5 Generation (and Belgian origin)				2nd Generation			
	<i>N</i>	Low	Medium	High	<i>N</i>	Low	Medium	High
Belgium	2 233 513	20.09	34.09	45.82				
Southern Europe	5 529	31.98	38.89	29.14	125 389	22.74	41.25	36.01
Eastern Europe	16 374	33.59	37.55	28.86	16 202	21.83	37.82	40.35
Northern and western Europe	16 067	22.80	38.76	38.45	84 254	20.20	36.88	42.92
Turkey	8 059	53.38	33.95	12.67	28 792	24.75	49.11	26.14
Maghreb countries	11 859	43.47	40.69	15.84	61 858	22.93	46.46	30.60
Other non-European	30 449	24.64	41.73	33.63	18 581	12.77	36.39	50.84

Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

and socioeconomic disadvantage (Costa and de Valk, 2018; Van der Bracht et al., 2014). Today, Turkish and Maghrebi migrants and their descendants, and particularly women, continue to be characterised by substantial disadvantages in terms of labour market participation (FOD WASO and Unia, 2022), which reflect both structural factors such as lower educational attainment and discrimination that creates additional barriers to economic integration (Van der Bracht et al., 2014; Wildan and Husein, 2021).

Finally, the group of migrants and their descendants from other non-European countries is highly diverse. This subgroup includes a substantial number of post-colonial migrants from Congo, as well as individuals originating from other (high-income) OECD countries, Asia, the US or South America. The origin countries have further diversified in recent migration flows, which often involve refugees and asylum seekers from, for example, Syria, Iraq, Afghanistan and Ukraine. The numbers of 1.5 and second generation migrants originating from single non-European origin countries are still small (making a further differentiation of the “other non-European” origin group in the analyses impossible), and these groups are highly diverse in terms of the ideational contexts and opportunity structures their members have experienced.

Whereas the 1.5 generation migrated during childhood or adolescence, and thus experienced partial socialisation in Belgian institutions, the second generation was born and entirely educated in Belgium. Nevertheless, as Table 1 shows, educational attainment varies substantially across origin groups for both generations. Educational expansion is evident across generations, with second generation women generally achieving higher educational levels than 1.5 generation women within most origin groups. However, the Turkish and Maghrebi groups continue to have lower educational attainment. In addition, educational credentials do not translate uniformly into economic opportunities across groups (Liebig et al., 2010). As a result, levels of labour market integration vary considerably, with discrimination and spatial concentration in deindustrialised areas creating additional barriers for some groups despite their educational gains (Costa and de Valk, 2018; Van der Bracht et al., 2014; Wildan and Husein, 2021). These differential opportunity structures suggest

that the association between education and fertility – through mechanisms such as opportunity costs, economic resources or cultural adaptation – is likely to play out differently across origin groups and generations.

Educational gradients and selective entry into parenthood

The mechanisms that link education to the timing and intensity of first, second and third births are complex and multifaceted, involving enrolment in education, labour market positions and opportunity costs, normative considerations, gender equality, attitudes and behaviour associated with higher levels of education and access to work-family reconciliation policies (Gustafsson et al., 2002; Robert-Bobée and Mazuy, 2005; Vasireddy et al., 2023; Wood, 2019). These mechanisms may operate differently across origin groups and migrant generations due to variation in cultural norms, migration histories, institutional contexts and structural constraints. Given the descriptive nature of this article, we do not explicitly examine these specific mechanisms or attempt to explain variation across origin groups and migrant generations through detailed causal pathways. Instead, we focus on a fundamental methodological challenge that affects any analysis of education-fertility associations, regardless of the underlying mechanisms: namely, how unobserved heterogeneity and selective entry into parenthood shape the observed associations between education, entry into parenthood and parity progression. Understanding and addressing this issue is essential for producing valid estimates of educational gradients in fertility, and for making meaningful comparisons across origin groups and migrant generations.

Unobserved characteristics of individual women – such as family orientation, aspirations, preferences or compliance with social norms, as well as more structural opportunities or constraints – have been shown to influence both the timing and intensity of entry into parenthood, as well as subsequent parity progression. Controlling for such selection mechanisms is essential when comparing groups since women entering parenthood at younger ages tend to have a specific profile (reflected in a higher risk or frailty of having a child), which, in turn, leads to a selective group of women entering the risk set for second and higher order births (Kravdal, 2001). Likewise, the group of women still at risk of having a first child will become increasingly selective with age (characterised by a lower individual risk or frailty), leading to deflated conditional first birth probabilities at these ages (Kravdal, 2001; Vaupel et al., 1979; Vaupel and Missov, 2014). This pattern holds for women across all educational levels. However, higher educated women generally start childbearing at later ages due to, among other factors, their longer enrolment in education and higher employment probabilities and wage potential compared to lower educated women. This implies that, for example, low educated women with high frailty may enter parenthood at around age 22 and those with low frailty may enter parenthood at around age 28, while higher educated women with high frailty may enter parenthood at around age 28 and those with low frailty may enter parenthood at around age 34. Comparing conditional first birth probabilities between low and higher educated women at age 28 without controlling for this unobserved heterogeneity would effectively

compare low educated women with low frailty to higher educated women with high frailty. This would result in an underestimation of the conditional first birth probabilities of low educated women, an overestimation of the conditional first birth probabilities of higher educated women and an overestimation of the difference between the two (at age 28).

Furthermore, selective entry into parenthood shapes the composition of the risk set for second and higher order births (Kravdal, 2001). Since women with higher frailties are more likely to have had a first birth, the risk set for second births becomes positively selected (i.e. it consists disproportionately of women with higher frailties), inflating conditional second birth probabilities. This selection strengthens with parity, making the estimation of second and third birth probabilities increasingly prone to bias if unobserved heterogeneity is ignored. Moreover, as the strength and structure of this selection process have been shown to differ by level of education, estimates of the association between education and fertility may be substantially biased. Incorporating a shared frailty for recurrent events thus avoids conflating the effect of education on transitions to higher parities with selective entry into parenthood or earlier parities.

Controlling for selection is particularly important when comparing fertility patterns across origin groups and migrant generations, as the influence of unobserved factors on childbearing decisions may vary substantially across groups, resulting in different variance estimates for the individual-level random effects or frailties, and different selection processes across parities. Such unobserved factors may range from cultural norms regarding ideal family size and timing to religiosity, gender role attitudes, intergenerational expectations and constraints related to discrimination or access to resources – many of which are difficult or impossible to measure directly. If these unobserved characteristics are systematically related to fertility behaviour, and their distribution differs by origin group and generation, failing to account for them will not only induce bias in the estimated educational gradients of entry into parenthood and parity progression, but will also affect the comparison of fertility patterns across origin groups and migrant generations.

Data and methods

Data

This paper uses population-wide longitudinal microdata from the Belgian census of 2011 and population registers. The data provide information on citizenship at birth, country at birth, level of education and, most importantly, descent, which allows us to determine women's migration background and reconstruct their maternity histories. We follow all women either of Belgian origin or with a 1.5 or second generation migration background; with parity 0, 1 and 2; aged between 15 and 50 years in the 2000–2011 period, up to and including the year in which their third child is born or censoring occurs when they reach age 50 or the end of the observation period on 31 December 2011. There is no censoring due to emigration or death because of the retrospective design.

Altogether, 24,085,710 person-years of exposure contribute to the construction of synthetic life tables of entry into parenthood and progression to second and third births (Feeney and Yu, 1987; Ní Bhrolcháin, 1987, 2011).¹

Origin group and migrant generation

Origin is determined based on women's citizenship at birth and that of their parents (giving priority to the mother's citizenship at birth), and distinguishes the following groups: (i) Belgium (BE), (ii) southern Europe (SEU), (iii) eastern Europe (EEU), (iv) northern and western Europe (NWEU), (v) Turkey (TKY), (vi) Maghreb countries (MGB) and (vii) other non-European countries (otNEU). Generation is based on country of birth and age at migration: women of the 1.5 generation were not born in Belgium and migrated to the country before age 18, while women of the second generation were born in Belgium to parents of foreign origin.

Education

Women's highest level of education is determined using their information in the 2011 census, complemented with follow-up register data on level of education up to 2021.² The use of a time-constant indicator for education is an important limitation since it does not allow us to disentangle the sequence of events – i.e. whether education was completed before childbearing or the other way around. Hence, the estimated effects reflect both how women's level of education influences birth rates and how births influence women's later educational attainment (Kravdal, 2001). Therefore, as suggested by previous research (Kravdal, 2001), it may be helpful to think of educational level as it is operationalised here as a proxy for an educational goal that women are pursuing throughout their reproductive life span, which influences their probability of having a birth at any age. While time-varying information on enrolment and educational level would allow us to document more precisely the sequence of events (completion of education and childbearing), such information would still be insufficient for a causal interpretation of the observed associations. Even with time-varying information on education, we would not adequately account for causally antecedent factors and anticipation effects that influence both

1 We adopt a synthetic (period) life table approach rather than relying on conventional indicators of period fertility, such as the period total fertility rate (TFR), which can be severely inflated (deflated) when fertility is advanced to younger ages (postponed to older ages), partially as a result of inadequately controlling for women's parity and previous maternity history (Bongaarts and Feeney, 1998). A cohort approach also seems less appropriate as it requires full observation of women's reproductive lifespans between ages 15 and 50. Given the 2011 Belgian census data, this would limit the analysis to women born in or before 1961 (or at most 1971). For the 1.5 and second generations, these cohorts are often small and their experiences are unlikely to reflect more recent patterns in the education-fertility link. The synthetic approach thus offers a more suitable and meaningful strategy for capturing recent parity-specific dynamics in the education-fertility nexus across origin groups and migrant generations.

2 These follow-up data on education allow us to make a relatively accurate assessment of the highest level of education, including for women who were still in education during the final years of the observation period (e.g. a 15-year-old in 2011), since the majority of these women most likely completed their education by 2021 (e.g. a 15-year-old was 25 years old by then).

educational trajectories and fertility trajectories – such as women adjusting childbearing in anticipation of future educational plans, or both education and fertility being influenced by common factors like family background or life goals. In the absence of a robust identification strategy that addresses these issues, the associations documented in this paper cannot be interpreted causally, regardless of whether education is measured as time-constant or time-varying. As such, this paper examines subgroup variation in the association between highest level of education and childbearing, without any intent or attempt to provide causal interpretations.

The education variable distinguishes three educational groups based on the ISCED 1997 typology: (i) the low education group includes women with no education, primary education or lower secondary education (ISCED 0, 1 and 2); (ii) the medium education group includes women with higher secondary education and post-secondary non-tertiary education (ISCED 3, 3A, 3C and 4); and (iii) the high education group includes women with short and long forms of tertiary education (ISCED 5, 5A, 5B and 6). [Table 1](#) shows the number of women and the distribution of level of education across these women in 2011 by origin group and migrant generation.

Modelling first, second and third birth hazards

We model birth histories as a progressive multistate process whereby nulliparous women enter the risk set at age 15 and move to a subsequent state (higher parity) with every birth ([Hougaard, 2000](#)). As the fertility histories derived from the population register provide the year of birth of children rather than the exact date, the data are interval censored and discrete-time hazard models are estimated using a complementary log-log link so that the model parameters are insensitive to interval length and refer to the underlying continuous-time hazard function ([Allison, 1982](#)). As successive spells for the same individual cannot be considered independent, the hazard functions for first, second and third births are estimated simultaneously including a shared frailty μ_i for recurrent events that is assumed to be normally distributed, $N(0, \sigma_\mu^2)$:

$$\left\{ \begin{array}{l} \text{P0: } [-\ln(1 - q1(a)_i^t)] = \int_{a-0.5}^{a+0.5} h(u) du = e^{\hat{\alpha}} \cdot e^{\hat{F}(P0_{it} \cdot A_{it})} \cdot e^{\hat{F}(P0_{it} \cdot E_i)} \cdot e^{\hat{F}(P0_{it} \cdot A_{it} \cdot E_i)} \cdot e^{\mu_i} \\ \text{P1: } [-\ln(1 - q2(a)_i^t)] = \int_{a-0.5}^{a+0.5} h(u) du = e^{\hat{\alpha}} \cdot e^{\hat{F}(P1_{it})} \cdot e^{\hat{F}(P1_{it} \cdot D_{it})} \cdot e^{\hat{F}(P1_{it} \cdot A_{it})} \cdot e^{\hat{F}(P1_{it} \cdot E_i)} \\ \quad e^{\hat{F}(P1_{it} \cdot D_{it} \cdot A_{it})} \cdot e^{\hat{F}(P1_{it} \cdot D_{it} \cdot E_i)} \cdot e^{\hat{F}(P1_{it} \cdot A_{it} \cdot E_i)} \cdot e^{\mu_i} \\ \text{P2: } [-\ln(1 - q3(a)_i^t)] = \int_{a-0.5}^{a+0.5} h(u) du = e^{\hat{\alpha}} \cdot e^{\hat{F}(P2_{it})} \cdot e^{\hat{F}(P2_{it} \cdot D_{it})} \cdot e^{\hat{F}(P2_{it} \cdot A_{it})} \cdot e^{\hat{F}(P2_{it} \cdot E_i)} \\ \quad e^{\hat{F}(P2_{it} \cdot D_{it} \cdot A_{it})} \cdot e^{\hat{F}(P2_{it} \cdot D_{it} \cdot E_i)} \cdot e^{\hat{F}(P2_{it} \cdot A_{it} \cdot E_i)} \cdot e^{\mu_i} \end{array} \right. \quad (1)$$

where $q1(a)_i^t$, $q2(a)_i^t$, $q3(a)_i^t$ reflect the conditional probabilities of having a first, second or third birth at age a in year t for any woman i with parity 0 (P0), 1 (P1) or 2 (P2) on 1 January of year t , respectively. First births are modelled as a function of age (A_{it}) in

years (centred at age 15, and using second, fourth or eighth order polynomials depending on the origin group and migrant generation considered),³ education (E_i), as well as the interaction between age and education ($A_{ii} \cdot E_i$) to allow different baselines by level of education. Second and third births are modelled as a function of duration since index birth (D_{ii}) (stepwise specification combining point estimates for the first four years with a linear term to model the tail of the hazard functions that are typically positively skewed for higher order births), age at index birth (AI_i) (quadratic specification), education (E_i), the interaction between duration since index birth and age at index birth ($D_{ii} \cdot AI_i$), the interaction between duration since index birth and education ($D_{ii} \cdot E_i$) and the interaction between age at index birth and education ($AI_{ii} \cdot E_i$). In addition, interactions with the dummy variables for parity (P1 and P2) allow covariate effects to differ by parity. The multistate model is estimated separately for all origin groups and generations and includes a time-constant random effect (μ_i) at the level of individual women (shared frailty) to control for unobserved characteristics of individual women that influence both the timing and intensity of entry into parenthood and progression to second and third births.

Model-based fertility indicators and coefficients of variation

The predicted probabilities of having a first, second or third birth are calculated for a woman with an average frailty ($\mu_i = 0$) by age (or age at index birth and years since index birth), level of education, origin group and migrant generation, thereby controlling for selection-induced deflation or inflation of birth probabilities (Figures 1–3). These probabilities are used to calculate synthetic parity progression ratios to first (SPPR1), second (SPPR2) and third (SPPR3) births, as well as synthetic mean ages at first birth (SMAC1) and synthetic mean birth intervals for second (SMBI2) and third (SMBI3) births, by level of education, origin and generation (Tables 2–4).

Based on these indicators, coefficients of variation (standard deviation divided by the mean) are calculated to measure variation in SPPR1-3, SMAC1 and SMBI2-3 across (i) educational levels within origin groups (CVar(education)), and (ii) across origin groups, both overall and within educational levels (CVar(origin)) (Tables 2–4). To illustrate the implications of selective entry into parenthood, three estimates are calculated for each coefficient of variation, based on estimates from (i) models including a random effect or shared frailty (sf) at the level of individual women (CVar, sf), (ii) models without a random effect or frailty term included (CVar, nof) and (iii) observed values (CVar, obs), which reflect the raw empirical patterns in the data without any model-based adjustment. Finally, Table 5 shows the standard deviation of

3 We use an eighth order polynomial for women of Belgian origin and second generation women of southern, northern and western European origin. We use a fourth order polynomial for second generation women of eastern European, Turkish, Maghrebi or other non-European origin and for 1.5 generation women of Maghrebi origin. The baseline has a quadratic specification for 1.5 generation women of all other origin groups. Model comparisons point out that these specifications yield the best fit for these respective origin groups and generations.

the frailty term and the estimated intra-class correlation coefficient (ρ) for each origin group and generation.

The educational gradient in the timing and intensity of first, second and third births: Variation across origin groups and migrant generations

In what follows, we examine variation in the education-fertility link across origin groups and migrant generations, separately for each parity. In line with our research questions, for each parity, we first explore educational gradients within origin groups and migrant generations to examine whether the effect of education is similar across groups or is moderated by cultural and/or structural factors specific to each group (RQ1). We then turn to variation in the timing and intensity of childbearing across origin groups (and migrant generations) within educational levels to study to what extent fertility differences across origin groups can be attributed to educational/socio-economic factors (RQ2). Finally, we compare the three variants of the coefficients of variation to assess the role of selective entry into parenthood in shaping the observed associations (RQ3).

First births

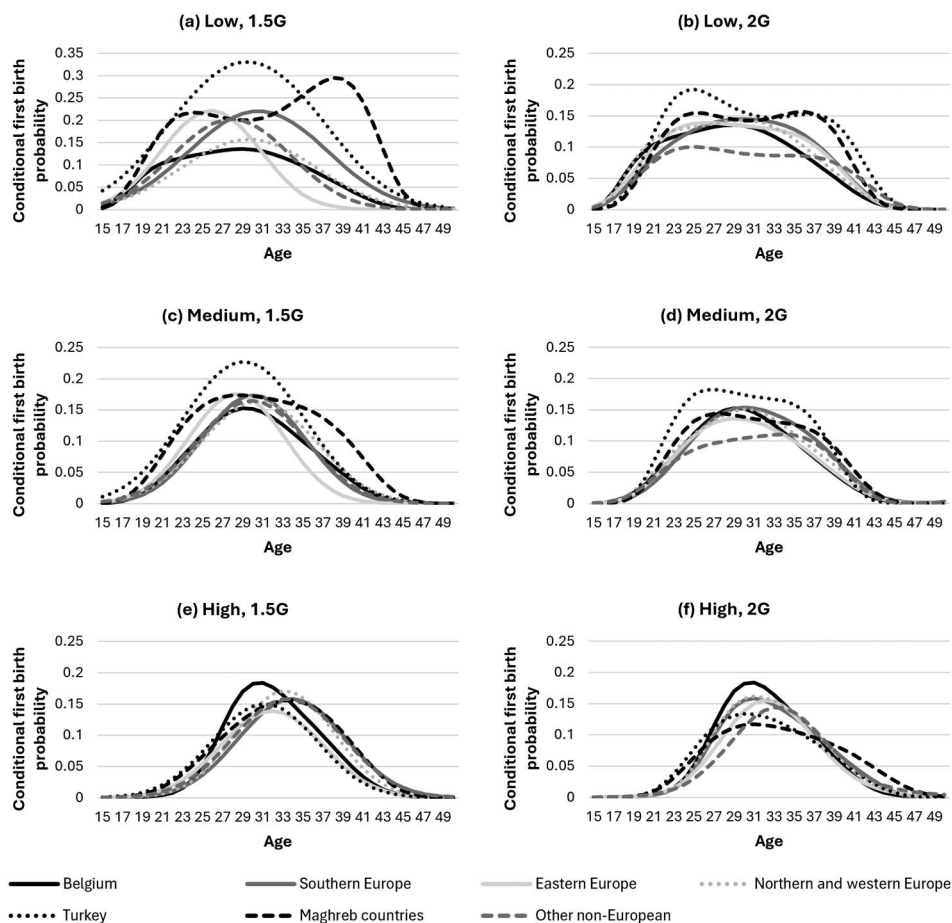
Educational gradients in first births by origin group and migrant generation

Comparing the *SPPR1* and *SMAC1* across levels of education within origin groups and migrant generations (i.e. rows in Table 2) reveals clear educational gradients. Across all groups, the life table proportion of women having a first birth (*SPPR1*) tends to decrease with higher levels of education, while mean ages at first birth (*SMAC1*) increase with higher education. These patterns are reflected in the coefficients of variation across levels of education (Table 2, $CVar(education)$, sf). For *SPPR1*, educational differences are minimal among women of Belgian origin ($CVar(education)$, sf = 0.019) and among women of northern and western European and other non-European origin. In contrast, variation in *SPPR1* across levels of education is more pronounced among women of southern European, eastern European, Turkish and Maghrebi origin. The $CVar$ for *SMAC1* hovers around 0.10 across all groups, indicating fairly consistent variation by education in mean ages at first birth. Notably, for both *SPPR1* and *SMAC1*, educational variation is consistently smaller among second generation women than among women of the 1.5 generation.

Variation across origin groups within educational levels

In line with previous literature, Figures 1(a)–1(f) show that the *schedules* of conditional first birth probabilities shift to higher ages with increasing levels of education across all origin

Figure 1 Estimated conditional first birth probabilities by age, origin group, migrant generation (1.5G/2G) and level of education, for women with average frailty ($\mu_i = 0$), Belgium 2000–2011



Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

groups and both migrant generations.⁴ At low and medium levels of education, the schedules are more dispersed and display substantial variation across origin groups. Among 1.5 generation women with low education, this variation is particularly pronounced (partly due to small sample sizes), while among medium-educated women, the largest deviations from the pattern of women of Belgian origin are found among women of Turkish, Maghrebi and

4 The slightly unusual shape of the schedule of conditional first birth probabilities for women of Maghrebi origin in Figures 1(a) and 1(b) is an artefact of the relatively small numbers of low educated women still at risk of a first birth at higher ages in that origin group. Nevertheless, model comparison indicates that a fourth order polynomial yields the best fit for the 1.5 and second generation Maghrebi origin groups overall.

Table 2 Synthetic parity progression ratios to a first birth (SPPR1) and synthetic mean ages at first birth (SMAC1) by origin group, migrant generation and level of education, ($\mu_i = 0$), Belgium 2000–2011

	Synthetic parity progression ratio to a first birth (SPPR1)													
	1.5 Generation (vs Belgian origin)							2nd Generation (vs Belgian origin)						
	CVar(education)							CVar(education)						
	Total	Low	Med	High	sf	nof	obs	Total	Low	Med	High	sf	nof	obs
BE	0.892	0.927	0.897	0.895	0.019	0.025	0.025	0.892	0.927	0.897	0.895	0.019	0.025	0.025
SEU	0.931	0.981	0.903	0.889	0.054	0.081	0.076	0.905	0.942	0.917	0.881	0.034	0.043	0.043
EEU	0.893	0.944	0.890	0.842	0.057	0.069	0.086	0.879	0.943	0.885	0.854	0.050	0.062	0.063
NWEU	0.905	0.933	0.915	0.891	0.023	0.038	0.040	0.902	0.943	0.912	0.888	0.031	0.039	0.039
TKY	0.992	0.999	0.974	0.871	0.071	0.118	0.055	0.951	0.980	0.961	0.869	0.063	0.075	0.073
MGB	0.990	0.998	0.969	0.915	0.044	0.062	0.066	0.922	0.964	0.929	0.872	0.050	0.059	0.062
otNEU	0.914	0.956	0.907	0.898	0.034	0.055	0.053	0.857	0.889	0.865	0.848	0.024	0.031	0.032
CVar(origin), sf	0.046	0.031	0.037	0.026				0.033	0.031	0.034	0.020			
CVar(origin), nof	0.072	0.054	0.058	0.049				0.040	0.036	0.041	0.025			
CVar(origin), obs	0.061	0.044	0.048	0.038				0.040	0.036	0.042	0.025			

(table continues)

Table 2 (continued)

	Synthetic mean age at first birth (SMACI)												
	1.5 Generation (vs Belgian origin)						2nd Generation (vs Belgian origin)						
	CVar(education)						CVar(education)						
	Total	Low	Med	High	sf	obs	Total	Low	Med	High	sf	nof	obs
BE	28.23	24.69	27.35	30.14	0.100	0.092	28.23	24.69	27.35	30.14	0.100	0.092	0.092
SEU	27.60	25.12	27.72	32.21	0.126	0.098	28.28	25.70	28.10	30.87	0.092	0.082	0.082
EEU	25.74	22.61	26.18	30.26	0.145	0.107	28.18	25.06	27.79	31.27	0.111	0.097	0.097
NWUEU	28.13	26.04	27.67	31.76	0.103	0.085	27.86	24.59	27.32	30.55	0.109	0.098	0.098
TKY	23.60	21.54	24.53	28.14	0.134	0.093	26.43	24.69	26.13	29.67	0.095	0.083	0.085
MGB	25.19	22.81	25.87	30.15	0.140	0.123	27.56	25.67	27.43	30.86	0.094	0.085	0.081
otNEU	27.25	24.22	27.34	31.66	0.135	0.114	29.51	26.51	28.48	32.08	0.097	0.089	0.089
CVar(origin), sf	0.066	0.067	0.045	0.046			0.033	0.028	0.027	0.025			
CVar(origin), nof	0.062	0.062	0.040	0.047			0.025	0.025	0.023	0.023			
CVar(origin), obs	0.054	0.048	0.034	0.019			0.032	0.025	0.023	0.022			

Notes: [1] Origin groups: BE (Belgium), SEU (southern Europe), EEU (eastern Europe), WNEU (western and northern Europe), TKY (Turkey), MGB (Maghreb countries), otNEU (other non-European countries). [2] CVar(education): coefficient of variation (st.dev./mean) across ISCED levels within origin groups, sf (shared frailty model), nof (model without shared frailty), obs (observed). [3] CVar(origin): coefficient of variation (st.dev./mean) across origin groups, both overall and within ISCED levels, sf (shared frailty model), nof (model without shared frailty), obs (observed).

Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

other non-European origin. At higher levels of education, the schedules converge noticeably across origin groups in both migrant generations.

This finding is substantiated by the *SPPR1* and *SMAC1*, as well as the coefficients of variation within educational levels across origin groups (Table 2, CVar(origin), sf). Both the *SPPR1* and *SMAC1* show consistently higher CVar values among low and medium educated women than among highly educated women. Variation across origin groups is also smaller among second generation women than among 1.5 generation women, reflecting a greater alignment in first birth timing and intensity between native women and women of the second generation. These findings suggest that higher education is associated with a convergence of fertility behaviours across origin groups, particularly among the second generation.

Selective entry into parenthood

The variance estimates for the shared frailty term indicate that unobserved individual-level heterogeneity significantly affects women's birth hazard across parities in all groups. The unobserved heterogeneity is typically more important, however, among women with a migration background than among Belgian women, particularly among women of the 1.5 generation, which gives rise to a larger heterogeneity in fertility outcomes in these groups. Conversely, when conditioning on average frailty, we effectively examine a more homogenous subpopulation, which naturally exhibits less variation in fertility patterns.

This mechanism is visible when comparing the three *variants of the coefficient of variation*, highlighting the impact of accounting for selective entry into parenthood (Table 2). In many cases – particularly among the second generation – the observed CVar(obs) and the CVar based on models without a random effect (nof) are quite similar, which suggests that the model specification accurately captures the observed schedules. The CVars from the shared frailty model (sf) are consistently smaller than the other two variants. Hence, adjusting for unobserved heterogeneity – by including a random effect at the level of individual women – substantially reduces variation both across origin groups and across levels of education, revealing more homogenous fertility patterns than those that are apparent in the observed data.

Second births

Educational gradients in second births by origin group and migrant generation

A comparison of *SPPR2* and *SMBI2* across levels of education within origin groups and migrant generations reveals mixed patterns (Table 3). Among women of Belgian origin, the life table proportion of women progressing to a second birth (*SPPR2*) increases clearly with higher education, while the mean birth interval (*SMBI2*) decreases – suggesting shorter intervals between first and second births among the more educated. These clear educational gradients are reflected in relatively high CVars: 0.199 for *SPPR2* and 0.108 for *SMBI2* (Table 3, CVar(education), sf). Similar decreases in *SMBI2* with higher levels of education

are observed in both generations of most origin groups, although the mean birth intervals of these women are generally longer than those of women of Belgian origin. Positive educational gradients in SPPR2 and high(er) CVar are also observed among second generation women of southern, eastern, northern and western European origin and among 1.5 generation women of northern and western European origin. In contrast, among second generation women of Turkish, Maghrebi and other non-European origin and among 1.5 generation women of all origin groups except northern and western Europe, no clear educational gradient in SPPR2 emerges. While there is still some variation in SPPR2 across educational levels, this variation does not follow a consistent directional pattern and is also reflected in notably lower CVars.

Variation across origin groups within educational levels

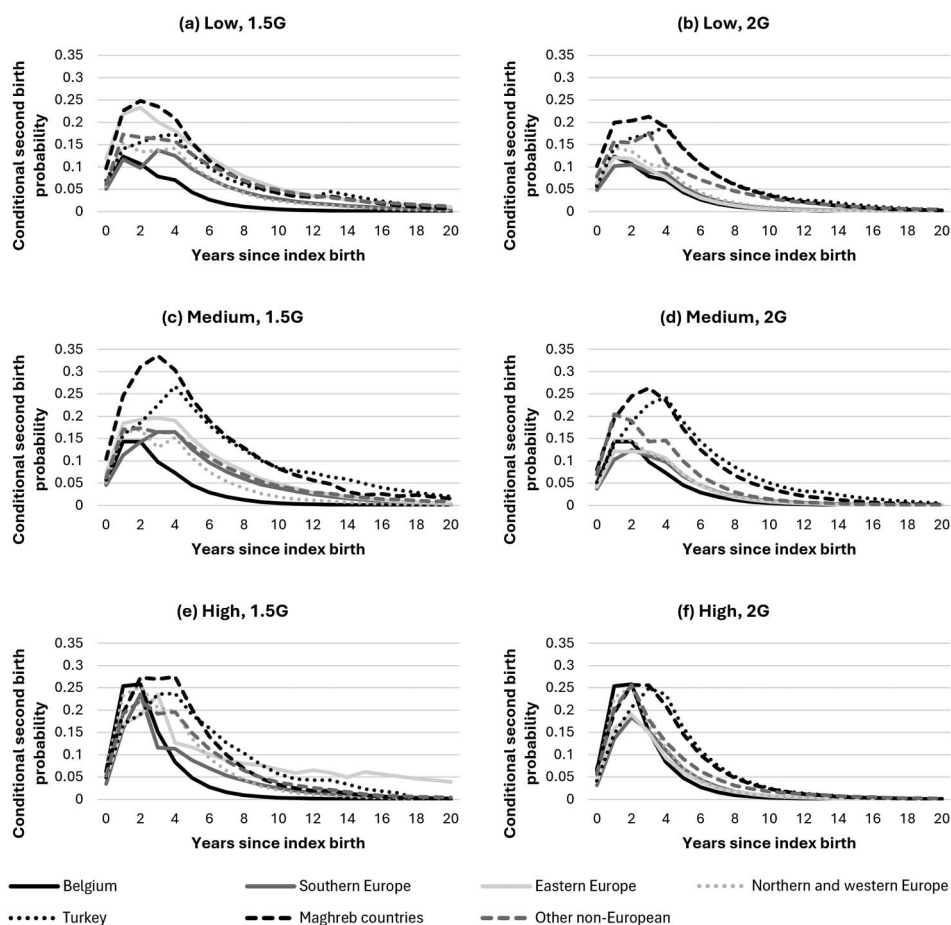
Figures 2(a)–2(f) show the typical *schedules* of conditional second birth probabilities for women with average frailty by origin group, migrant generation and level of education: conditional probabilities are high in the years immediately after the birth of the first child but decline sharply with increasing duration since the first birth. Among higher educated women, the onset of this decrease starts earlier due to their higher (mean) ages at first birth and the resulting shorter window for continued childbearing. Figures 2(a)–2(f) also reveal notable differences across origin groups within educational levels. Among low and medium educated women, the conditional second birth probabilities of women of the 1.5 generation, as well as of second generation women of Turkish, Maghrebi and other non-European origin, are substantially higher than those of women of Belgian origin. In contrast, among highly educated women, the schedules converge to a notable extent across origin groups in both generations – although Belgian women’s schedules show a particularly early peak.

This variation between origin groups is also reflected in the *SPPR2* and *SMBI2*, as well as in the coefficients of variation across origin groups within educational levels (Table 3. CVar(origin), sf). The CVars for second births are generally much higher than those observed for first births, sometimes reaching values as high as 0.254. For SPPR2, variation across origin groups is consistently lowest among highly educated women, but there is no consistent pattern of lower variation among the second generation compared to the 1.5 generation. Indeed, for SPPR2, variation is higher in the second generation across all educational groups, while the pattern for SMBI2 is reversed (Table 3. CVar(origin) 1.5 generation vs Cvar(origin)) second generation). This suggests that while higher education is associated with a convergence in second birth schedules, this convergence remains more limited than it is for first births.

Selective entry into parenthood and parity progression

Finally, comparing the three *variants of the coefficient of variation* yields conclusions that may initially seem counterintuitive. In particular, the Cvar(origin) from the shared frailty model (sf) is higher than both the observed CVar(origin) and the Cvar(origin) from models without a random effect (nof). This implies that variation across origin groups increases

Figure 2 Estimated conditional second birth probabilities by age, origin group, migrant generation (1.5G/2G) and level of education, for women with average frailty ($\mu_i = 0$), Belgium 2000–2011



Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

when controlling for selective entry into parenthood. The variance estimates of the individual-level random effect indicate that unobserved heterogeneity is more important in several origin groups than it is among native women, which gives rise to selection mechanisms in parity progression that play out differently across origin groups and migrant generations. The results suggest that such differential selection conceals, at least to some extent, structural differences in conditional second birth probabilities that exist between groups, and more detailed microsimulations would be required to reconstruct how unobserved heterogeneity differentially shapes entry into the risk set and subsequent transitions to second births.

Table 3 Synthetic parity progression ratios to a second birth (SPPR2) and synthetic mean birth intervals to a second birth (SMBI2) by origin group, migrant generation and level of education, ($\mu_i = 0$), Belgium 2000–2011

Synthetic parity progression ratio to a second birth (SPPR2)														
1.5 Generation (vs Belgian origin)								2nd Generation (vs Belgian origin)						
CVar(education)								CVar(education)						
	Total	Low	Med	High	sf	nof	obs	Total	Low	Med	High	sf	nof	obs
BE	0.557	0.442	0.489	0.642	0.199	0.182	0.181	0.557	0.442	0.489	0.642	0.199	0.182	0.181
SEU	0.675	0.639	0.724	0.675	0.063	0.063	0.066	0.521	0.463	0.512	0.578	0.112	0.107	0.107
EEU	0.839	0.855	0.814	0.851	0.027	0.019	0.017	0.535	0.476	0.526	0.580	0.098	0.087	0.086
NWEU	0.702	0.667	0.671	0.784	0.094	0.082	0.086	0.600	0.554	0.564	0.667	0.105	0.098	0.098
TKY	0.819	0.782	0.916	0.860	0.079	0.089	0.102	0.810	0.767	0.841	0.784	0.048	0.044	0.047
MGB	0.883	0.853	0.944	0.861	0.057	0.056	0.058	0.822	0.801	0.842	0.801	0.029	0.026	0.027
otNEU	0.795	0.794	0.782	0.804	0.013	0.017	0.025	0.703	0.700	0.681	0.718	0.026	0.024	0.022
CVar(origin), sf	0.151	0.206	0.203	0.115				0.198	0.254	0.240	0.132			
CVar(origin), nof	0.132	0.185	0.181	0.101				0.179	0.229	0.217	0.123			
CVar(origin), obs	0.128	0.180	0.177	0.100				0.174	0.222	0.213	0.122			

(table continues)

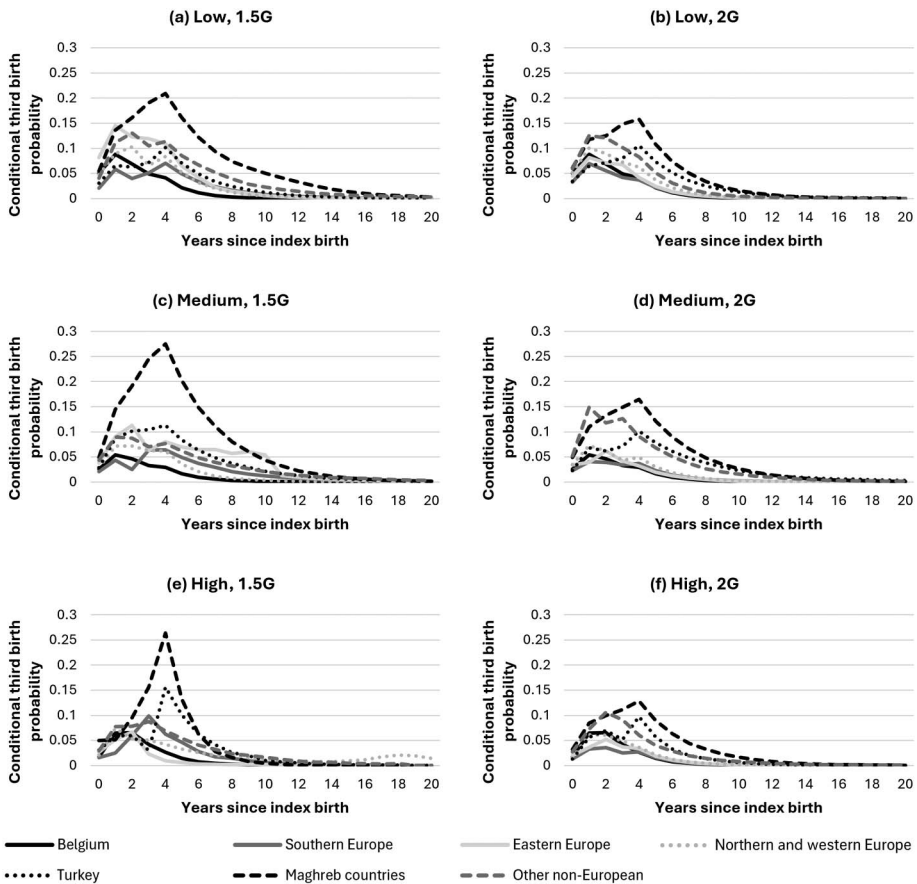
Table 3 (continued)

	Synthetic mean birth interval to a second birth (SMBI2)													
	1.5 Generation (vs Belgian origin)							2nd Generation (vs Belgian origin)						
	CVar(education)							CVar(education)						
	Total	Low	Med	High	sf	nof	obs	Total	Low	Med	High	sf	nof	obs
BE	2.754	3.023	3.002	2.482	0.108	0.123	0.123	2.754	3.023	3.002	2.482	0.108	0.123	0.123
SEU	4.509	4.786	4.662	3.871	0.112	0.102	0.081	3.619	3.529	3.752	3.290	0.066	0.067	0.057
EEU	4.042	4.028	4.173	5.298	0.154	0.134	0.107	3.375	3.150	3.486	3.152	0.059	0.063	0.070
NWEU	3.716	4.109	3.762	3.261	0.115	0.126	0.108	3.208	3.297	3.483	2.803	0.110	0.114	0.105
TKY	4.686	5.377	5.002	4.295	0.112	0.086	0.015	4.204	4.511	4.436	3.730	0.102	0.087	0.050
MGB	3.494	3.826	3.510	3.514	0.050	0.041	0.031	3.480	3.656	3.575	3.347	0.045	0.042	0.027
otNEU	4.451	5.045	4.581	4.042	0.110	0.099	0.053	3.528	4.204	3.218	3.343	0.150	0.139	0.117
CVar(origin), sf	0.173	0.187	0.174	0.230				0.127	0.152	0.128	0.129			
CVar(origin), nof	0.143	0.136	0.127	0.188				0.125	0.128	0.112	0.126			
CVar(origin), obs	0.116	0.095	0.104	0.152				0.109	0.091	0.092	0.119			

Notes: [1] Origin groups: BE (Belgium), SEU (southern Europe), EEU (eastern Europe), WNEU (western and northern Europe), TKY (Turkey), MGB (Maghreb countries), otNEU (other non-European countries). [2] CVar(education): coefficient of variation (st.dev./mean) across ISCED levels within origin groups, sf (shared frailty model), nof (model without shared frailty), obs (observed). [3] CVar(origin): coefficient of variation (st.dev./mean) across origin groups, both overall and within ISCED levels, sf (shared frailty model), nof (model without shared frailty), obs (observed).

Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

Figure 3 Estimated conditional third birth probabilities by age, origin group, migrant generation (1.5G/2G) and level of education, for women with average frailty ($\mu_i = 0$), Belgium 2000–2011



Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

Third births

Educational gradients in third births by origin group and migrant generation

Comparing *SPPR3* and *SMBI3* across levels of education within origin groups and migrant generations reveals no clear or consistent educational gradients in third births. Nonetheless, substantial variation exists. For the life table proportion of women progressing to a third birth (*SPPR3*), the $CVar(education)$ ranges from 0.104 to as high as 0.501 across origin groups, with one notable outlier of 0.019 among 1.5 generation women of southern European origin (Table 4, $CVar(education)$, sf). Variation in mean birth intervals (*SMBI3*) is more limited, typically ranging between 0.030 and 0.169, with one notable outlier of

Table 4 Synthetic parity progression ratios to a third birth (SPPR3) and synthetic mean birth intervals to a third birth (SMBI3) by origin group, migrant generation and level of education, ($\mu_i = 0$) Belgium 2000–2011

Synthetic parity progression ratio to a third birth (SPPR3)														
1.5 Generation (vs Belgian origin)								2nd Generation (vs Belgian origin)						
CVar(education)								CVar(education)						
	Total	Low	Med	High	sf	nof	obs	Total	Low	Med	High	sf	nof	obs
BE	0.226	0.298	0.205	0.222	0.204	0.195	0.195	0.226	0.298	0.205	0.222	0.204	0.195	0.195
SEU	0.336	0.336	0.346	0.335	0.019	0.025	0.015	0.205	0.258	0.210	0.159	0.238	0.218	0.219
EEU	0.503	0.544	0.565	0.182	0.501	0.421	0.430	0.239	0.315	0.233	0.203	0.231	0.213	0.211
NWEU	0.360	0.423	0.328	0.401	0.131	0.089	0.116	0.294	0.384	0.295	0.244	0.231	0.212	0.213
TKY	0.472	0.442	0.558	0.473	0.122	0.108	0.108	0.471	0.462	0.504	0.360	0.167	0.133	0.133
MGB	0.807	0.795	0.839	0.610	0.163	0.125	0.118	0.638	0.632	0.674	0.548	0.104	0.087	0.089
otNEU	0.528	0.602	0.507	0.445	0.153	0.115	0.123	0.477	0.479	0.571	0.405	0.172	0.151	0.153
CVar(origin), sf	0.403	0.348	0.435	0.390				0.454	0.323	0.505	0.452			
CVar(origin), nof	0.330	0.284	0.358	0.334				0.393	0.270	0.440	0.396			
CVar(origin), obs	0.319	0.273	0.352	0.336				0.387	0.268	0.433	0.388			

(table continues)

Table 4 (continued)

	Synthetic mean birth interval to a third birth (SMBI3)													
	1.5 Generation (vs Belgian origin)							2nd Generation (vs Belgian origin)						
	CVar(education)							CVar(education)						
	Total	Low	Med	High	sf	nof	obs	Total	Low	Med	High	sf	nof	obs
BE	2.926	2.314	2.583	2.459	0.055	0.070	0.069	2.926	2.314	2.583	2.459	0.055	0.070	0.069
SEU	4.671	3.666	4.267	3.514	0.104	0.071	0.083	3.482	2.593	2.981	2.820	0.070	0.087	0.082
EEU	3.613	2.668	4.251	1.866	0.414	0.303	0.368	3.320	2.520	2.636	2.669	0.030	0.065	0.067
NWEU	3.871	3.032	2.750	6.910	0.549	0.407	0.143	3.291	2.668	2.871	2.784	0.037	0.058	0.052
TKY	4.480	3.949	4.212	3.958	0.037	0.040	0.019	4.846	4.168	5.194	3.756	0.169	0.126	0.099
MGB	4.209	4.450	4.015	3.566	0.110	0.068	0.037	4.065	3.642	4.131	4.070	0.068	0.069	0.046
otNEU	4.876	4.089	4.482	3.850	0.077	0.052	0.020	3.735	2.740	3.536	3.487	0.137	0.118	0.088
CVar(origin), sf	0.165	0.230	0.207	0.428				0.172	0.232	0.279	0.196			
CVar(origin), nof	0.145	0.198	0.158	0.299				0.172	0.190	0.215	0.142			
CVar(origin), obs	0.135	0.187	0.163	0.187				0.146	0.164	0.159	0.105			

Notes: [1] Origin groups: BE (Belgium), SEU (southern Europe), EEU (eastern Europe), WNEU (western and northern Europe), TKY (Turkey), MGB (Maghreb countries), otNEU (other non-European countries). [2] CVar(education): coefficient of variation (st.dev./mean) across ISCED levels within origin groups, sf (shared frailty model), nof (model without shared frailty), obs (observed). [3] CVar(origin): coefficient of variation (st.dev./mean) across origin groups, both overall and within ISCED levels, sf (shared frailty model), nof (model without shared frailty), obs (observed).

Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

0.549 among 1.5 generation women of northern and western European origin. These findings suggest that while education may shape the timing and intensity of third births within specific groups, it does not do so in a uniform or predictable way across all origin groups and generations. The extent of variation also underscores the heterogeneity of third birth transitions, particularly in contrast to first and second birth transitions.

Variation across origin groups within educational levels

Similar to second birth *schedules*, the conditional third birth probabilities (Figures 3(a)–3(f)) tend to be highest in the years immediately following the birth of a second child and decline with increasing duration. Differences in the timing of childbearing by educational level are less pronounced for third births than for first and second births. Variation across origin groups remains substantial, particularly among 1.5 generation women with all levels of education. Women of Maghrebi origin stand out with consistently higher conditional third birth probabilities across all educational levels. Among second generation women, those of Turkish, Maghrebi and other non-European origin exhibit notably higher third birth schedules compared to women of Belgian origin.

These differences are confirmed by the *SPPR3* and *SMBI3*, as well as by coefficients of variation across origin groups within educational levels (Table 4. $CVar(\text{origin}, sf)$), which are considerably larger than those for first and second births, with values ranging from 0.196 to 0.505. This suggests that higher education does not (yet) lead to a convergence in third birth behaviour across origin groups. Other mechanisms – such as family norms, cultural preferences or differential access to employment, childcare and work-family reconciliation policies – may play a larger role in shaping third birth transitions.

Selective entry into parenthood and parity progression

Finally, comparing the three *variants of the coefficient of variation* yields mixed results. With the exception of the $CVar$ across education for *SMBI3* in a few origin groups, the $CVar$ from the shared frailty model (*sf*) is typically higher than both the observed $CVar(\text{obs})$ and the $CVar$ from models without a random effect (*nof*). This suggests that for third births as well, selective entry into parenthood and progression to a second birth masks part of the heterogeneity that exists across groups in terms of conditional third birth probabilities. Once this differential unfolding of selection is accounted for, differences in educational gradients and origin group variation become more pronounced.

Unobserved heterogeneity across origin groups and migrant generations

Table 5 shows the standard deviation of the shared frailty term and the estimated intra-class correlation coefficient (ρ) for each origin group and migrant generation. The estimated standard deviations of the frailty term range between 0.469 and 0.731 across origin-generation groups, indicating moderate to substantial unobserved heterogeneity in

Table 5 Standard deviation of the frailty term and estimated intra-class correlation coefficient (ρ), models by origin group and generation, Belgium 2000–2011

	St.Dev frailty term			ρ		
	BE	1.5G	2G	BE	1.5G	2G
Belgium	0.519			0.141		
Southern Europe		0.647	0.550		0.203	0.155
Eastern Europe		0.656	0.602		0.207	0.180
Northern and western Europe		0.667	0.539		0.213	0.150
Turkey		0.717	0.468		0.238	0.117
Maghreb countries		0.479	0.478		0.122	0.122
Other non-European		0.731	0.531		0.245	0.146

Source: Longitudinal microdata from the 2011 Belgian census and population registers, calculations by authors.

childbearing propensities across all women. This indicates that after accounting for education, there remains considerable individual variation in the conditional probabilities of having a(nother) child across parities. This unobserved heterogeneity translates into intra-class correlations (ρ) ranging from 0.117 to 0.245, which means that 12–25% of the total variance in birth hazards is attributable to unobserved individual-level factors.

The magnitude of unobserved heterogeneity differs systematically between migrant generations. The standard deviations of the frailty term are consistently larger among 1.5 generation women than among their second generation counterparts, suggesting that selective entry into parenthood and subsequent parities in terms of unobservables plays a more prominent role in the childbearing trajectories of women of the 1.5 generation. Furthermore, with the exception of second generation women of Turkish origin and women of Maghrebi origin, all origin groups and generations show higher unobserved heterogeneity than women of Belgian origin. This suggests that migrant populations are characterised by greater diversity in unmeasured factors affecting fertility behaviour, such as preferences, compliance with cultural norms, economic constraints or partnership dynamics. It also indicates that the unfolding of selection in terms of these unobserved factors across subsequent transitions shapes parity progression ratios and birth intervals more strongly in these groups than it does among native women. These findings underscore the relevance of taking unobserved heterogeneity explicitly into account when comparing the education-fertility link between origin groups and migrant generations.

Conclusion

Fertility transitions in contemporary European societies are characterised by pronounced social differentiation along multiple dimensions. While research has documented variation by both migration background and education, these dimensions have not been systematically combined to investigate how they jointly shape the tempo and quantum of fertility.

This study addressed this gap by examining the intersection of educational attainment, origin group and migrant generation in shaping entry into parenthood and progression to second and third births among women in Belgium in the 2000–2011 period. Using population-wide register data and shared frailty models that account for selective entry into parenthood, we addressed three interconnected research questions that reveal the interplay between education and migration background in fertility transitions.

Our first research question investigated to what degree educational gradients in the timing and intensity of first, second and third births differ within origin groups and migrant generations. The results reveal striking differences in how education shapes fertility across groups and birth orders. For first births, clear educational gradients emerge across all origin groups and migrant generations: the life table proportion of women having a first birth (SPPR1) decreases with higher levels of education, while the mean ages at first birth (SMAC1) increase. However, the strength of this gradient varies considerably, with more pronounced variation being observed among women of southern European, eastern European, Turkish and Maghrebi origin than among women of Belgian, northern and western European and other non-European origin. For second births, educational gradients become highly group-specific. Among most origin groups and migrant generations, higher education is associated with shorter intervals between the first and the second birth (as reflected in lower mean birth intervals, SMBI2). In contrast, the life table proportion of women progressing to a second birth (SPPR2) increases with higher education only among women of Belgian origin, second generation women of southern, eastern, northern and western European origin and 1.5 generation women of northern and western European origin. In all other origin-generation groups, no such educational gradients in SPPR2 emerge, suggesting that other (structural or cultural factors) override educational influences on the decision to have a second child. This divergence likely reflects different mechanisms operating across groups. Among women of Belgian and European origin, higher education may facilitate the transition to a second birth by providing them with greater economic resources and access to work-family reconciliation policies (Biegel et al., 2021; Marynissen et al., 2021; Wood, 2025). In contrast, the more limited economic returns to education for non-European origin groups may, potentially in combination with cultural norms favouring multi-child families (Milewski and Mussino, 2018), result in a decoupling of education and higher order fertility (Kreyenfeld and Andersson, 2014; Wood and Neels, 2017). For third births, our findings show no clear or consistent educational gradients, despite substantial variation in the life table proportions of women progressing to a third birth (SPPR3) and in the mean birth intervals (SMBI3) across educational levels within origin groups and migrant generations. The patterns are diffuse and unpredictable. As such, higher education does not appear to contribute to a convergence across origin groups in the likelihood of transitioning to a third birth, indicating that at higher parities, factors beyond educational attainment become increasingly decisive in shaping fertility.

Our second research question examined to what degree the timing and intensity of childbearing vary across origin groups and migrant generations when educational attainment is held constant. Our findings reveal that substantial variation persists within educational levels, although the extent varies by birth order. For first births, variation in

synthetic parity progression ratios to a first birth (SPPR1) and synthetic mean ages at first birth (SMAC1) across origin groups is lowest among the highly educated and the second generation. This suggests that higher education is associated with a convergence in both the timing and intensity of first births across origin groups, particularly among the second generation. This finding is consistent with previous research on the education-parenthood link among 1.5 and second generation migrants (Krapf and Wolf, 2015; Marynissen et al., 2025; Pailhé, 2017), suggesting that education has an equalising effect on entry into parenthood – be it through more similar employment probabilities, access to work-family reconciliation policies, more egalitarian gender role attitudes and/or more similar socialising experiences and normative expectations associated with higher education. For second births, there is considerable variation across origin groups, but it again tends to be smaller among highly educated women, particularly for SPPR2. There is no consistent pattern of lower variation among the second generation than among the 1.5 generation. These findings suggest that while higher education fosters convergence in the timing and intensity of second births across origin groups, this convergence remains more limited than it is for first births. For third births, variation across origin groups within educational levels remains substantial among all educational groups, indicating that factors beyond educational attainment may play a more decisive role at higher parities.

Our third research question examined to what degree selective entry into parenthood and subsequent parities shapes the education-fertility link across origin groups and migrant generations. The shared frailty models reveal moderate to substantial unobserved heterogeneity in childbearing propensity across all origin groups and migrant generations. This heterogeneity is consistently higher among the 1.5 generation than among the second generation, and – with the exception of second generation women of Turkish origin and women of Maghrebi origin – is higher among all origin groups and migrant generations than among women of Belgian origin. These patterns suggest that migrant populations are characterised by greater diversity in unmeasured factors affecting fertility behaviour, which differentially affects the progression to first, second and third births across groups. These results underscore the necessity of taking unobserved heterogeneity explicitly into account in future work on the association between education and parity progression across diverse population groups.

Finally, this study has several limitations that point to fruitful paths for future research. First, despite the use of population-wide register data and a modelling strategy that addresses unobserved heterogeneity, several data limitations and analytical choices may affect our findings. Education is measured as a time-constant indicator, meaning that the estimated effects of education conflate how education influences fertility with how fertility may affect later educational attainment (Kravdal, 2001). In addition, the desire to make more detailed distinctions by origin group and generation is traded off against the need to obtain stable and interpretable results on variation across origin groups and generations in the association between education, entry into parenthood and parity progression (i.e. results that are not too erratic due to small cell counts when combining all these dimensions). As a consequence, intra-group differences may be obscured by aggregating origin groups into rather broad categories, and by not differentiating the group of child migrants (1.5 generation) further by age at migration – which is an essential factor in integration and exposure to host country institutions, including the educational system. Furthermore, while estimating the models over an

11-year window (2000–2011) enables better identification of unobserved heterogeneity, it limits the ability to detect changes over time, timing-sensitive developments (e.g. policy changes or economic shocks) as well as more recent changes in migration flows. In particular, the analyses do not consider the substantial immigration waves after 2011, including increasing numbers of refugees and asylum seekers, which primarily altered the compositional profile of the 1.5 generation in terms of origin, migration motives and socioeconomic background. To the extent that post-2011 migrant cohorts include a higher share of refugees and migrants originating from contexts characterised by disrupted schooling or constrained labour market opportunities, the association between educational attainment and fertility timing observed in this study may be weaker or operate through different mechanisms among these cohorts. At the same time, increased educational integration efforts and policy attention to migrant children in more recent periods may counteract some of these effects. Consequently, caution is warranted when extrapolating the observed associations between education, entry into parenthood and parity progression to more recent cohorts of migrants – particularly those of the 1.5 generation. While shared frailty models are often used to capture unobserved heterogeneity, the assumption of a time-constant and normally distributed random effect (with the same structure across origin groups and migrant generations) may oversimplify real-life variation. In sum, future research would benefit from the inclusion of data on more recent periods, time-varying information on educational enrolment, more detailed distinctions between origin groups and migrant generations (if cell counts allow) and more flexible modelling of unobserved heterogeneity. Second, as a result of the descriptive nature of the paper, the potential mechanisms that link education to entry into parenthood and parity progression have not been explicitly considered in the model or empirically tested. Future research could include information on partnership status, employment status, income, partner characteristics or access to work-family reconciliation policies to enhance the understanding of how structural and normative factors shape the association between education and fertility patterns across origin groups and migrant generations.

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