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Closing the Gap? A Comparative Analysis of Fertility Delay among Men and Women in Europe

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1 Introduction

European countries have experienced a continuous increase in the age of birth, particularly for first-time parents, since the 1970s. Woman's mean age at first birth since then has increased dramatically: For example, while women in Austria had their first child on average at the age of 23 in the 1970s, in 2019 they have it at age 30 (Bongaarts & Sobotka, 2012; Human Fertility Database 2023b). On the other side until 1970, the average age at birth reached a historic low, primarily driven by a decrease in higher-order births, typically happening in later ages, while the recent increase is attributed to delayed first births (Beaujouan, 2020; Prioux, 2005). While often in the academic literature fertility delay is associated with women, men also tend to have their children, particularly their first children, later in life (Beaujouan, 2020; Dudel & Klüsener, 2016). The few studies that look at both male and female fertility find that the delay in fertility between these two sexes almost moves in parallel or "in tandem" (Coleman, 2000; Dudel & Klüsener, 2016; Schoumaker, 2019), whereby women tend to catch up with men (Beaujouan, 2020; Dudel & Klüsener, 2016). This is visible in the increase in female mean age at birth and male mean age at fatherhood from the 1970s in Europe (Dudel & Klüsener, 2021) as well as the increase in mean age at first birth observed in studies on Northern European countries (Lappegård et al., 2011; Nordfalk et al., 2015; Paavilainen et al., 2016). For example, the mean age at first birth for men in Denmark increased from around 28 years in 1980 to 32 years in 2010, while for women it increased slightly more from around 25 to almost 30 years (Nordfalk et al., 2015).

To gain a comparative perspective between these sexes on the delay of childbearing, one can assess the gap between men and women in their age when having their children. In Europe, the average age of men is typically around 3 years higher than that of women, whereby the gap in mean age at birth slowly closes over time and has some variations across different European countries (Coleman, 2000; Dudel & Klüsener, 2016, 2021; Nordfalk et al., 2015). This pattern was observed almost all over the world, with the worldwide average age of men at the birth of their children in 2011 being 35 years, about 6 years higher than that of women (Schoumaker, 2019). This points out an important distinction between male and female fertility, namely that men tend to have children later. In addition, it is in line with the age gap in partnerships (marital or cohabiting unions) (Ausubel et al., 2022; Kolk, 2015). Although the observation of a gender gap in mean age at birth across countries and over time points to an anthropological constant and biological explanation, and certainly physiological age limits play a major role in reproduction, economic, social and cultural factors may be more important (Bledsoe et al., 2000; Dudel & Klüsener, 2021; Presser, 1975, 2001). Academic literature on the gender gap in mean age at birth and partnership formation explains higher paternal age at birth or in unions with males longer reproductive lifespan, different gendered cultural preferences for partners' age (e.g., Bozon, 1991; Presser, 1975), the structure of the partnership market and partnership patterns (e.g., Ni Bhrolchain & Sigle-Rushton, 2005), different gendered social status and better economic opportunities for older men (e.g., Berardo et al., 1993; Kenrick & Keefe, 1992; Presser, 1975) and country differences in "development" as well as gender equality (e,g., Ausubel et al., 2022; Bozon, 1991; Dudel & Klüsener, 2021; Kolk, 2015; Ortega, 2014; Van de Putte et al., 2009).

Since the 2000s the gender gap in mean age at birth slightly narrows in many European countries (Dudel & Klüsener, 2016). For instance, in Denmark, during the 1980s, men, on average, were three years older than women when having their first child (Nordfalk et al., 2015); however, by 2010, the gender gap in mean age at first birth reduced to approximately two years due to the stronger delay of fertility among women (Statistics Denmark, 2023). Denmark stands as an extreme example with a significant decline, while other Northern, Western and Southern

European countries show a smaller decrease, and Eastern European countries even have witnessed an increase in the gender gap in mean age at birth since 1990 (Dudel & Klüsener, 2021). The shrinking gap is often associated with higher gender equality (Dudel & Klüsener, 2021; Kolk, 2015; Van de Putte et al., 2009) and certainly men and women are experiencing a convergence in their life course, due to a decreasing prevalence of the male breadwinner system, increased female labour market participation and increasing educational attainment (e.g., Balbo et al., 2013; Schmidt et al., 2012). Since men and women are experiencing a more equal life course, the recent decline in the gap is likely due to women experiencing a more pronounced fertility delay compared to men. However, it is also possible that the gap lowers due to the structural decrease in higher-order births, which typically exhibit a larger gender gap. This is because the age gap in partnership increases by age, whereby older men tend to re-partner with younger women, increasing their likelihood of becoming a father at older ages (Beaujouan, 2009). Once women tend to delay birth, they are more likely to seek a more equal-aged partner.

Despite the notable increase in the mean age of birth in Europe, there remains a substantial research gap as the combination of fertility delay among women and men is seldom explored. This is partly due to the fact that high quality, register-based data on female fertility are more widely available than data on male fertility, especially in terms of data by birth order. The exception here are Northern European countries, like Denmark, Finland, Norway or Sweden, where data on mean age at firs births for men is regularly published (Statistic Finland, 2023; Statistics Denmark, 2023; Statistics Norway, 2023; Statistics Sweden, 2023). While this scarcity of data is often cited as the primary reason for limited studies on male fertility, it is noteworthy that data is often available but it rests “untapped” (Schoumaker, 2019, S. 461). In this regard survey data, from which aggregate demographic indicators on male fertility can be derived, often remain untouched (e.g., Vergauwen et al., 2015).

This master thesis tries to partially close the research gap by comparing men and women[1] and their fertility delay as well as the gender gap in mean age at birth by parity and educational attainment in different European countries from the 1970s onwards. An attempt was undertaken to examine whether the delay in fertility and the reduction of the gender gap in mean age at birth were a result of changes in the birth structure or primarily attributed to a delay of first births, particularly among females. To conduct this analysis various data sources were included: First, register-based data on period and cohort mean age at birth from Human Fertility Collection (HFC), the Human Fertility Database (HFD) and data on period and cohort mean age at birth by parity provided by national statistical agencies in Northern Europe as well as survey data from the Gender and Generation Programme I and II (GGP). The examination and comparison of both men and women are essential to analyse sex differences in the drivers influencing fertility delay and the gender gap in mean age at birth and to address varied social and medical challenges and opportunities for women and men arising from these trends.

The thesis first investigates the gender-specific implications of fertility delay, by starting to discuss physiological and social “limits” in reproduction in the second chapter and their implications and potential consequences for individuals and societies in the third chapter. The fourth chapter gives an overview of potential factors differently impacting fertility delay among men and women and on mechanisms that translate fertility delay into a closing or widening gender gap in mean age at birth over time. In this part, several assumptions were made, which were not

[1] Other sexes or/and genders were not included in the study, as the data sources examined here did not allow for an analysis of, for example, intersex or trans people. These should not be excluded and the categories in the questionnaires and documents by authorities should be adjusted.

explicitly formulated as hypotheses, but empirically explored. The fifth chapter on methods and data describes the data sources used in the analysis and highlights the validity of the indicators derived from GGP survey data, by comparing it with a more accurate data source. In addition, an attempt is made to give an overview of the demographic methods used, by describing how the mean age at birth or the gender gap in mean age at birth were calculated and decomposed. The results section of this thesis is structured into four key chapters. Firstly, chapter six provides insights into distinct partnership patterns by age, forming the foundation for understanding how differences in fertility delay among men and women might influence the gender gap in mean age at birth. Secondly in chapter seven, the gender gap in mean age at birth is presented, as well as variations among European countries. Chapter eight includes the most extensive part of the results showing how fertility delay, particularly for first-time births, is associated with the narrowing gender gap in mean age at birth. The analysis includes a decomposition of Sweden's increasing mean age at birth and the narrowing gender gap. The final chapter nine assesses the role of two drivers of the gender gap in mean age at birth: educational attainment and multiple reproductive partnerships. In chapter ten the results are then discussed, with a specific focus on the implications of a narrowing gender gap in mean age at birth on gender equality.

2 Gendered social norms and physiological age limits

The gender gap in mean age at birth is influenced by cultural norms and physiological constraints related to the "ideal" or "too late" age for becoming a parent. From a physiological point of view, fecundity depends on all reproductive partners, with men causing or contributing to couples' infertility in around 50% of all cases, but not all of it is linked to ageing (Agarwal et al., 2021). While fecundity declines exponentially in women from the age of 35 onwards (Balasch, 2010; Leridon, 2008), it declines less and more slowly in men from around age 40 (De La Rochebrochard et al., 2006; De La Rochebrochard & Thonneau, 2003; Kühnert & Nieschlag, 2004; Sartorius & Nieschlag, 2010). Even assisted reproductive technologies (ART) like in vitro fertilisation (IVF) cannot fully compensate for this age-related infertility (De La Rochebrochard et al., 2006). Infertility increases in men and women as they age not only "naturally", but also because people are more exposed to diseases, unhealthy lifestyle factors such as smoking and other medical conditions that affect their fecundity as they age (Schmidt et al., 2012). The physiological decline in fecundity with age is also reflected in the physiological "ideal" age for having a birth. Men's "best" years for reproduction are probably before age 45, while for women this is before 35 (Balasch, 2010; Hassan & Killick, 2003). The broader public is often not aware of these physiological age constraints and women and especially men have only limited knowledge about age-related infertility and the age-related success rates of ART (Daniluk & Koert, 2013).

On the other hand, besides physiological constraints, social "timing norms" determine at which age it is socially considered "ideal" or "too late" to have children (Martín-García et al., 2023, S. 18; Settersten & Mayer, 1997). In Europe the ideal age of childbearing for women is on average at age 25 and for men on average 27 years, whereby people in Eastern European countries perceive a lower age as ideal, than people from Northern, Western and Southern European countries (Paksi & Szalma, 2009). Regarding fertility delay, the upper limit or age deadlines perceived as "too late" to become parents play probably a more important role, since non-compliance with widely agreed social age deadlines can lead to social sanctions and stigmatisation (Lazzari et al., 2022; Paksi & Szalma, 2009). Social age limits, which indicate it is "too late" to have children, are associated with physiological age limits, health risks as well as the ability to care for a child at an older age (Billari et al., 2011). In Europe on average women are considered "too old" to have children from age 42, while men are considered "too old" from age 47

(Billari et al., 2011; Paksi & Szalma, 2009). There is a higher between-country variation in the age deadline for men than for women, ranging from age 45.3 in Denmark to age 51.2 in Estonia. Furthermore, since the mid-2000s to the late 2010s age deadlines as well as the ideal age of birth were increasing over time for both women and men, potentially favouring later birth (Lazzari et al., 2022).

3 Gendered medical and demographic implications of fertility delay

In Europe since the 1970s, people have postponed the age at which they become parents, whereby the differences between men and women probably increased over time, as women experienced a greater delay in fertility than men and potentially narrowing the gender gap in mean age at birth (Beaujouan, 2020; Dudel & Klüsener, 2021; Nordfalk et al., 2015). The process of rising mean age at birth, especially first births, has some medical and demographic implications (Schmidt et al., 2012). First, advanced age of men and women comes along with health risks for both the pregnant partner and the child (Balasch & Gratacós, 2012; De La Rochebrochard & Thonneau, 2002; Nilsen et al., 2013; Schimmel et al., 2015). In this regard, higher paternal age over 40 years is associated with increased pregnancy-associated complications e.g., very preterm birth, caesarean and high blood pressure, and offspring problems e.g., genetic abnormalities which can lead to conditions like schizophrenia or autism (Balasch & Gratacós, 2012; De La Rochebrochard et al., 2006; Kühnert & Nieschlag, 2004; Nybo Andersen & Urhoj, 2017; Sartorius & Nieschlag, 2010). Furthermore, if men are above age 40 in reproduction, this is associated with a higher risk of stillbirths and miscarriage (De La Rochebrochard et al., 2006; De La Rochebrochard & Thonneau, 2002). Higher maternal age on the other side is associated with a higher likelihood of experiencing difficulties during pregnancy, e.g., gestational diabetes, pregnancy-induced hypertension, high blood pressure, severe preeclampsia, spontaneous abortions, preterm delivery and ectopic pregnancy as well as risks for their offspring's like lower birth weight, chromosome abnormalities and neurocognitive and psychiatric disorders (Balasch, 2010; Balasch & Gratacós, 2012; Goisis et al., 2018; Schimmel et al., 2015).

Second, due to the increased infertility with age as well as restrictive social age limits, males and females delaying birth for 'too long', have a higher chance to become involuntarily childless and experiencing related social pressure and psychological distress (Balasch & Gratacós, 2012; Hadley & Hanley, 2011; Pohl, 2000; Schytt et al., 2014; Wischmann & Thorn, 2013). In this regard men, but especially women, of higher ages have a higher risk of not fulfilling their fertility intentions (Beaujouan, 2022). However, (involuntary or voluntary) childlessness, depends strongly on men's educational attainment, income, occupation and health conditions, meaning that men who put off having children to gain higher social status or better career opportunities may have more children and be less likely to remain childless (Lappegård et al., 2011; Schmitt, 2005; Weeden et al., 2006). Empirical studies in Europe show that men with lower social status have children relatively early, but at the end of their reproductive life are more likely childless, while men with higher socio-economic status are delaying fatherhood more as well as being less likely to remain childless (Compans, 2021; Jalovaara et al., 2019; Kneale & Joshi, 2008; Lappegård et al., 2011; Nisén et al., 2014). This contradicts the fact that women with higher education, who delay childbirth, are more likely to be childless. Theoretically, this can be explained, since younger men and those with lower socioeconomic status are excluded from the partnership market and a prevalent social hypogyny among women (Coleman, 2000; Qian, 2017; Toulemon, 2000). In addition, men are less restricted by age-related infertility and entering a new partnership with a younger woman, increases their likelihood to have their desired number of children (Beaujouan, 2022; Ortega, 2014; Van Bavel et al., 2012).

Last, fertility delay has implications both at the individual level and on a macro level in terms of the number of children. Again, there are differences between men and women. Because of the above-mentioned social-status compensation and re-partnering patterns the impact of fertility delay on the absolute number of children of men is ambiguous. In Nordic countries, men with higher economic status might postpone as well as have more children over their life course, while this is less clear in other European regions (Jalovaara et al., 2019; Nisén et al., 2014). On the other side for women, childbearing delay is associated with a lower number of children at the individual level (Balbo et al., 2013; Sobotka, 2010), while depending on the welfare regime not necessary on the state level (Beaujouan & Toulemon, 2021; Schmidt et al., 2012). Up to this point, ways were discussed in which women in particular were disadvantaged by the delay in fertility. However, probably the only social issue where older fathers are significantly more "constrained" than older mothers is that due to their shorter life expectancy men have a higher risk of dying before their children are grown up, or before their grandchildren are born (Schmidt et al., 2012). Apart from this, delaying birth for men and women carries a greater risk for women regarding their health risks during pregnancy, age-related infertility, the risk of not having the desired number of children and to remain involuntarily childless. It is therefore important to ask what factors led to a delay in fertility in the first place, and why women in particular have an even greater delay, even though they have greater disadvantages from it.

4 Gendered drivers of fertility delay

4.1 Drivers of fertility delay

Many literature reviews conducted on drivers of fertility delay are focusing largely on drivers for childbearing delay among women and only partially or not at all mention drivers potentially increasing men's age when having children (e.g., Balbo et al., 2013; Beaujouan, 2020; Billari, 2006; Mills et al., 2011; Schmidt et al., 2012; Sobotka, 2010). Literature reviews on fertility delay often discuss potential drivers such as higher female educational attainment, female labour market participation, increasing economic insecurity and unemployment during young adult years, union instability, the shift and diffusion of sociocultural attitudes, norms and values and increased healthy life expectancy (Balbo et al., 2013; Beaujouan, 2020; Billari, 2006; Mills et al., 2011; Schmidt et al., 2012; Sobotka, 2010). These studies address drivers of fertility delay on the micro- meso- and macro level (Balbo et al., 2013), some cause a withdrawal from having children in young adulthood, while others lead to a mechanical delay of fertility, and still, others facilitate having children in older age (Beaujouan, 2020). Although later birth can lead to freedom at a younger age, it comes with some costs of having children at older ages (Beaujouan, 2020; Sobotka, 2010). In this regard, most individuals unconsciously delay childbearing in their early adulthood to prioritize educational attainment and career opportunities, overlooking the potential adverse consequences like infertility and involuntary childlessness (Beaujouan, 2020; Daniluk & Koert, 2013; Mills et al., 2011; Sobotka, 2010). Furthermore, some people are forced to delay childbearing in their young adulthood by facing constraints imposed by their social, cultural, and economic environment (Miret-Gamundi, 2000; Pohl, 2000).

Based on the large body of literature on drivers of fertility delay, this section focuses on comparing drivers of fertility delay between men and women and assessing their implications on the gender gap in mean age at birth. Overall, the parallel increase in mean age at birth for men and women suggests that potential drivers of fertility delay, like for example increased educational attainment, may affect both sexes similarly. On the other side, this simultaneous increase in mean age at birth could also be attributed to drivers that significantly impact only one of these two sexes' fertility delay, causing an indirect delay for the other. In this case, assuming that decisions regarding fertility within partnerships involve both men and women (Pohl, 2000, S. 272), the delay of the fertility of one partner might lead to an involuntary delay for the other partner. In reality, however, re-partnering also plays an important role. Third, drivers might differently impact fertility delay among men and women, potentially declining or increasing the gender gap in mean age at birth. For example, if a driver predominantly delays fertility among women, it could lead to a closing gender gap as women at later age tend to partner and have children with more equal-aged men (Beaujouan, 2009; Beaujouan & Wiles-Portier, 2011; Berardo et al., 1993; Bozon, 1991; Coleman, 2000; Ni Bhrolchain & Sigle-Rushton, 2005). This third and final factor will be discussed here, as it may contribute to widening or narrowing the gender gap in mean age at birth.

4.2 Drivers of the gender gap

In Europe since the 1970s, people have postponed the age at which they become parents. This postponement transition is embedded in a broader change in values and behaviours (e.g., Lesthaeghe, 2010), as well as the development of the pill and other modern contraceptive methods in the 1960s, giving individuals and especially women more control and freedom in their reproductive decisions (Balbo et al., 2013; Goldin & Katz, 2002; Mills et al., 2011; Schmidt et al., 2012; Sobotka, 2010). The evolution of societal norms and values, emphasizing self-fulfilment, relationship fulfilment, and the freedom to choose rather than an obligation to have children, changes the "traditional" order and timing of events marking the transition to adulthood (Presser, 2001). Women partially achieved emancipation by liberating themselves from domestic and economic reliance and taking on the role of "breadwinners" (Mills et al., 2011; Sobotka, 2010). While women have succeeded in asserting themselves in “male-dominated” areas of society, men are emancipating themselves less in the direction of household and childcaring, which often leads to a double burden for the former. Women’s emancipation process since the 1970s, caused a convergence in age at events marking the transition towards starting a family, such as the timing of leaving the parental home, finishing education, having a partnership, starting cohabitation and having stable employment (Coleman, 2000; Lesnard et al., 2016). This convergence of life events and greater gender equality between men and women likely leads to a stronger fertility delay for women compared to men, potentially closing the gender gap in mean age at birth.

The primary factor behind fertility delay among men and women is the rise in educational enrolment. Empirically it has already been shown that those women with higher education more strongly delay fertility and are more likely to have children later in life indicating the importance of this driver on fertility delay (e.g, Nisén et al., 2014; Sobotka, 2010). Educational attainment is linked to fertility delay in various ways: First and most importantly, educational enrolment directly or “mechanically” leads to a delay in fertility (Ní Bhrolcháin & Beaujouan, 2012, S. 322). Educational enrolment has significantly increased for both men and women, with women showing a more substantial growth in Europe since the 1960s, surpassing men's average education duration in many European countries (e.g., Buchmann et al., 2008; Buchmann & DiPrete, 2006; van Hek et al., 2016). Second, educational attainment also indirectly contributes to fertility delay by changing values, attitudes and norms (Ní Bhrolcháin & Beaujouan, 2012). In this regard, women with higher education have different attitudes and values, which may involve greater social status causing a lower age difference with their partners (Dudel & Klüsener, 2021). Third, higher opportunity costs favour later birth since educated individuals often have greater earning potential in the labour market (Balbo et al., 2013; Toulemon, 2000). In this regard, women with higher education and thus higher social status, have compelling reasons to delay birth, as they seek to accumulate career experience and enhance their earnings (Balbo et al., 2013; Dudel & Klüsener, 2021). This decision is influenced by the higher opportunity cost associated with having children earlier, as women, in particular, face wage penalties due to their greater likelihood of taking paternal leave (Kleven et al., 2019). In conclusion, the stronger increase in educational years among women in comparison with men might contribute to a direct and indirect to stronger fertility delay among them, likely resulting in a closing gendered age gap over time.

In addition, female labour market participation is an important driver of fertility delay. Unlike women, men in Europe did not experience the same recent increase in labour market participation, as historically the prevalent male breadwinner model already involved men working while women were mostly excluded from the public sphere of life (e.g., Cipollone et al., 2014). This has significant implications for fertility delay, as establishing a stable career for one or both partners in a relationship is often necessary for starting a family, and achieving career stability typically requires considerable time. Paradoxically greater job opportunities for women probably lead to the delay of their and their partner’s fertility, while greater job opportunities for men advance having children (De Cooman et al., 1987). Therefore, an insecure employment situation, unemployment or the lack of economic security for men often goes along with the delay of having children, while the opposite is more likely to be true for women (Schmitt, 2005; Toulemon, 2000). This can be explained, since despite a diminishing influence of traditional social norms, many men still perceive themselves as breadwinners or in the provider role resulting in a delay of childbearing until men feel they can fulfil this normative responsibility (Martín-García et al., 2023; Miret-Gamundi, 2000; Schmitt, 2005). Therefore, higher female labour force participation could lead to greater fertility delay among women compared to men, which could narrow the gender gap in the mean age at birth.

During periods of economic stability, there was a consistent rise in female employment accompanied by fertility delay. However, economic downturns can have different effects. Results on the timing of fertility after an economic downturn indicate an involuntary delay of birth, due to the rise of socioeconomic uncertainty, high unemployment, higher housing costs and a week welfare state (Balbo et al., 2013; Beaujouan, 2020; Matysiak et al., 2021; Mills et al., 2011; Miret-Gamundi, 2000; Pohl, 2000). This is because, in times of economic downturn, people tend to prioritize enhancing their educational attainment or training to enhance their future job prospects (Matysiak et al., 2021; Miret-Gamundi, 2000). However, it´s difficult to assume if economic crises lead to different delays of childbearing for men and women, as the impact of the crisis can vary based on which of these two sexes is most affected. For example, as shown by several studies the transition from former communist Central and Eastern European countries to a market economy resulted in a fertility delay, with reasons varying between experiencing high economic insecurity, especially for women as well as a process of liberalisation regarding individual reproduction rights and more diverse family forms (Ferge, 1997; Kohler & Kohler, 2002; Pohl, 2000; Sobotka, 2023). Paradoxically within the former totalitarian regimes women and men experienced relatively high gender equality, since almost all women were employed and childcare facilities were common (e.g., Ferge, 1997). However, with the rise of the "male breadwinner system" and the growing economic insecurity faced by women after the fall of the iron carton, it's possible that in this case men delayed fertility stronger than women. This delay may be contributing to a widening gender gap in the average age of birth, which has been observed in Central and Eastern European countries since the 1990s (Dudel & Klüsener, 2021).

A key difference between men and women in their fertility delay and their gender gap in mean age at birth is that men are more likely to have children within multiple reproductive partnerships (Bledsoe et al., 2000). In Europe where “theoretically monogamy” is the prevailing norm, multiple reproductive partnerships are sequentially occurring one after another (Bledsoe et al., 2000; Coleman, 2000, S. 41). Hereby the term “theoretical monogamy” point out to the fact that after the onset of the postponement transition marriage and cohabitation were more frequently followed by divorce and re-partnering, potentially resulting in a greater amount of having children within multiple partnerships (Coleman, 2000, S. 41). In comparison to female fertility in a new union, male fertility tends to be less impacted by having children in a previous relationship, making it more likely for them to have a larger number of higher order births (Beaujouan & Ní Bhrolcháin, 2011; Bledsoe et al., 2000; Toulemon, 1995). An increase in repeated marriages and multiple reproductive partnerships can increase the gender gap in mean age at birth since men as they age tend to re-partner with younger women (Beaujouan, 2009; Beaujouan & Wiles-Portier, 2011; Berardo et al., 1993; Bozon, 1991; Coleman, 2000; Ni Bhrolchain & Sigle-Rushton, 2005). These younger women are more fertile and at the stage of life where they are more likely to desire to have another child (Coleman, 2000; Ní Bhrolcháin et al., 2010) and thus men at later ages who re-partnered are more likely to have children (Andersson, 2023). Because divorce and re-partnering as well as multiple reproductive partnerships have become more frequent since the onset of the postponement transition (Lesthaeghe, 2010; Van Bavel et al., 2012), it can be assumed that this could widen the gender gap in the mean age at birth, especially for second or higher births.

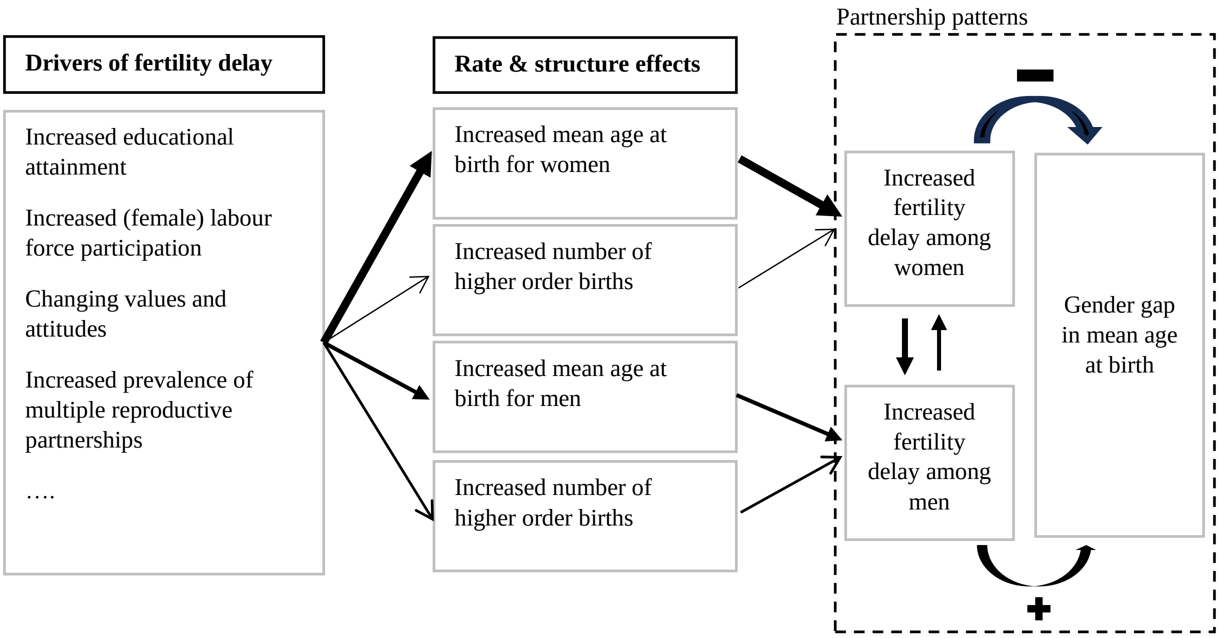

Figure 1: Theoretical mechanisms that increase the gender gap in mean age at birth

Figure 1 graphically illustrates the assumptions on how drivers of fertility delay impact the gender gap in mean age at birth. The thickness of the arrows indicates the presumed strength of the assumed relationship. On the far left, there are different factors that either increase the mean age at birth (rate effect) or lead to a higher number of higher-order births (structure effect). It can be assumed that above all the strong increase in the level of education among men and women, the strong increase in female labour market participation, changing cultural values, etc. have led to an increase in the average age at birth, especially among women. Secondly, more frequent multiple reproductive partners could increase the number of higher-order births for women and especially for men. These rate and structure effects lead to an increase in fertility delay for both men and probably even stronger for women. Taking into account the specific partnership patterns in European countries, namely that with age men tend to re-partner with younger women, while women with age prefer men of the same age, it can be assumed that an increase in the mean age at birth for women leads to a narrowing of the gender gap. Conversely, an increase in the mean age at birth for men leads to a widening gender gap. Moreover, the delay in fertility for men and women positively influences each other indirectly. Therefore, drivers of fertility delay always affect both of these sexes, but when they have a greater impact on one, it is likely that the gender gap in mean age at birth widens or closes.

5 Data and Methods

After the theoretical background, the methods section first describes how demographic indicators - the mean age at birth and the gender-specific difference in mean age at birth - are calculated in the first sub-chapter. The sub-chapter 5.2 discusses the various data sources and their quality. Furthermore, demographic indicators derived from survey data from the Generation and Gender Programme (GGP) was checked for validity by comparing it with higher-quality register-based data. The last sub-chapter 5.3 on demographic decomposition methods explains how the mean age at birth and the gender gap in mean age at birth are decomposed.

5.1 Calculation of the demographic indicators

5.1.1 Mean age at birth for men and women

To determine the mean age at birth for men and women, it is necessary to utilize age-specific fertility rates (ASFR). In this study, ASFR were only calculated from GGP survey data, since all other data sources already provided them. These rates are computed as follows: ASFR of age (i) are the number of births by men (B) of a specific age (i), divided by the men exposed to the risk of having a birth (P) of that age (i). Usually, age-specific fertility rates (ASFR) are presented per thousand people, thus here they are multiplied by a factor of one thousand. To account for the five-year cohorts in the case of GGP survey data, the person-years lived in the denominator are multiplied by five. The calculations are shown in the formula below:

$$ASFR_i = \frac{B_i}{P_i * 5} * 1.000 \qquad (a)$$

Based on ASFR, the mean age at birth for men and women can be computed. This has been done for GGP survey data as well as for HFC data, whereby the computation slightly differs depending on the data source. First, the male cohort means the age at birth ($MAB_{m,cohort}$) was calculated based on ASFR given by the Human Fertility Collection (2023a). The computation of mean age at birth for women and men is shown in formulas b and c. In this formula, the nominator includes the product of age-specific fertility rates (ASFR) in each age interval (i) by the midpoint of each age interval observed in a period or cohort. The midpoint of an age interval can be derived by summing up the start point of the age interval (a_i) plus the start point of the next interval (a_{i+1}) and divide this product by two. In the case of HFC data one-year age intervals were used here. In this case, the midpoint is the start point of the age interval plus 0.5. The denominator on the other side includes the sum of all ASFR observed in that period or cohort.

However, when calculating mean age at birth for men and women using GGP survey data., a slightly different formula has to be applied (not shown here): First, the age of the respondents was determined based on their birth year rather than their exact age at the time of the interview. Therefore, no adjustment of 0.5 was added to the age. Second, age-specific fertility rates were calculated using the weighted number of births for one age group in the numerator and the weighted number of total populations of the same age group multiplied by five in the denominator. This calculation considers the fact that the data are collected in five-year age cohorts. It is important to note that the total number of persons in the different age cohorts of the survey remains constant, as all persons included in the survey have survived to this age.

$$MAB_f = \frac{\sum_{i_{min}}^{i_{max}} ASFR_i * \left(\frac{a_i + a_{i+1}}{2}\right)}{\sum_{i_{min}}^{i_{max}} ASFR_i} \qquad (b)$$

$$MAB_m = \frac{\sum_{i_{min}}^{i_{max}} ASFR_i * \left(\frac{a_i + a_{i+1}}{2}\right)}{\sum_{i_{min}}^{i_{max}} ASFR_i} \qquad (c)$$

In addition, the GGP survey data as well as data provided by statistical agencies in Northern European countries includes variables on birth order specific average age at which people become parents. Unconditional age-specific fertility rates (ASFR) for each birth order as well as in the case of GGP data for educational level were calculated as shown in formula d below: In the nominator, these rates only included births within a specific period for each birth order (p) and age group (i). The denominator remained consistent, encompassing all person-years lived within an age group and period. Again, ASFR rates by birth order are presented per thousand individuals and are multiplied by that factor. Regarding the GGP data calculations on ASFR by parity, two important points are worth noting. Firstly, the age information is already accurate and doesn't require computing midpoints of age intervals. Secondly, the ASFRs by parity are calculated for five-year cohorts, which means that the person-years lived are multiplied by five to obtain the appropriate rate. By applying the MAB by parity formula, the mean age at which individuals experienced first, second, and subsequent fatherhood/births are calculated. Again, MAB for men and women by parity can be derived by multiplying ASFRs by parity with the midpoint of the age interval and dividing the product by the sum of ASFRs by parity. The formulas are provided separately for men and women below (see formula e and f).

$$ASFR_{i,p} = \frac{B_{i,p}}{P_i} * 1.000 \qquad (d)$$

$$MAB_{m,p} = \frac{\sum_{i_{min}}^{i_{max}} ASFR_{i,p} * \left(\frac{a_i + a_{i+1}}{2}\right)}{\sum_{i_{min}}^{i_{max}} ASFR_i} \qquad (e)$$

$$MAB_{f,p} = \frac{\sum_{i_{min}}^{i_{max}} ASFR_{i,p} * \left(\frac{a_i + a_{i+1}}{2}\right)}{\sum_{i_{min}}^{i_{max}} ASFR_i} \qquad (f)$$

The mean age at birth, from one specific cohort or period, can be derived from mean age at birth by parity. This is shown in formula g, in which the mean age at birth for men is decomposed into parities. Here the average age of first, second, and subsequent births is weighed by the relative number of births that occurred in that birth order.

The relative number of births is calculated by taking the number of births, that occurred in the birth order in the nominator, relative to the total number of births that occurred in all birth orders combined in the denominator (see formula g and h).

$$MAB_f = \left(\frac{B_{p1}}{B_{p1} + B_{p2} + B_{p3+}}\right) * MAB_{f,p1} + \left(\frac{B_{p2}}{B_{p1} + B_{p2} + B_{p3+}}\right) * MAB_{f,p2} + \left(\frac{B_{p3+}}{B_{p1} + B_{p2} + B_{p3+}}\right) * MAB_{f,p3+} \qquad (g)$$

$$MAB_f = \frac{B_{p1} * MAB_{f,p1} + B_{p2} * MAB_{f,p2} + B_{p3+} * MAB_{f,p3+}}{B_{p1} + B_{p2} + B_{p3+}} \qquad (h)$$

5.1.2 Gender gap in mean age at birth

When aggregated data on the mean age at birth is available for both women and men, the gender gap between the two can be calculated. The gender gap in mean age at birth is determined by comparing the mean age at birth for women and men for a specific period or cohort. It quantifies the age difference between men and women when they have children, indicating how much older men are on average relative to women. The gender gap in mean age at birth is calculated by subtracting the mean age at birth for women from the mean age at birth for men (see formula i). This can also be done by parties, for example for first-time parents, whereby in this case the mean age at first birth for women is subtracted from the mean age at first birth for men (see formula j).

$$Gap = MAB_m - MAB_f \qquad (i)$$

$$Gap_{p1} = MAB_{m,p1} - MAB_{f,p1} \qquad (j)$$

The overall gender gap in mean age at birth can be decomposed by analysing the gender gaps in mean age at birth for each parity. The formula g below shows how the gender gap in mean age at birth can be derived, when the mean age at birth for first births, second and third+ births are given in a cohort or period. To decompose the overall gender gap, the gender gap of each parity needs to be weighted by the number of births that occurred for women ($B_{f,p}$) plus the number of births occurred for men ($B_{m,p}$) within that birth order. In other words, each gender gap observed for one specific birth order (e.g., Gap_{p1}) has be weighted by the relative number of births. In this formula the relative number of births is calculated by taking the number births of one parity in the nominator, relative to the total number of births observed in that period or cohort.

$$Gap = \frac{(B_{p1,f} + B_{p1,m}) * \ Gap_{p1} + (B_{p2,f} + B_{p2,m}) * \ Gap_{p2} + (B_{p3+,f} + B_{p3+,m}) * \ Gap_{p3+}}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} \qquad (k)$$

5.2 Data sources and their quality

5.2.1 Register-based data

Different data sources were used to analyse the delay in fertility among men and women. First, aggregated birth-register-based data on age-specific fertility rates (ASFR), as well as summary indicators on mean age at birth for one-year age groups, have been taken for women from the Human Fertility Database (HFD 2023b) and for men from the Human Fertility Collection (HFC 2023a). Hereby, data for men's fertility provided by the HFC includes age-specific fertility rates as well as already calculated period mean age at birth (Dudel & Klüsener, 2021). Only the cohort mean age at birth for men had to be calculated from ASFR. Here and for all other cohort indicators it was assumed that men did not have any new children after a certain age threshold. This has been done to be able to study more cohorts. Otherwise, waiting until the last man in the cohort had had his last child would have been necessary. In this regard threshold of 45 years seems promising, since in reality, only a few men and women have children at a high reproductive age of over 45+ years (e.g., Beaujouan, 2020).

The register based HFC and HFD data includes 17 high-income countries from Europe, Northern America, Oceania, and East Asia. In this analysis, the focus lies exclusively on Europa, including three Northern European countries (Denmark, Finland, and Sweden), three Southern European countries (Italy, Spain, and PT), three Central and Eastern European countries (Hungary, Poland, Estonia) and three Western European countries (Germany, France, and Great Britain). Depending on the country the data covers the periods from around the 1980s to 2014. Men's fertility was included for the age range from <15 to 59+. On the other side data for women is available for a longer period in all countries. Female period data range from age <12 to 55+, while female cohort data include births in age intervals from age <15 to 55+. The register-based analysis of the data from HFC/HFD encompasses both periods and cohorts. A specific problem, that arises with birth records got mrn, is missing values, as the children are sometimes unrecognised or "forgotten" by the father, or not registered by the state authorities (Dudel & Klüsener, 2021; Toulemon, 1995, S. 324). In European countries, the percentage of missing fathers in official statistics is usually quite low (Nordfalk et al., 2015; Toulemon, 1995), and on average in the Human Fertility Collection, it makes up only a few per cent points (Dudel & Klüsener, 2021). Furthermore, missing fathers have been corrected in this database by using a conditional imputation approach, whereby missing births by men were imported in condition to the age at birth of the women (Dudel & Klüsener, 2019, 2021).

While only some register-based data is available for the mean age of birth for men over time for different European countries, the limitations are becoming much greater if the mean age by birth order is to be represented. The exceptions are northern European countries such as Norway (Statistics Norway, 2023), Sweden (Statistics Sweden, 2023), Denmark (Statistics Denmark, 2023) and Finland (Statistic Finland, 2023). The first three countries published already calculated period mean age at first birth for men and women, and for Sweden additionally, period mean age at birth for second and third and higher order births were available. For Finland, the average age at fatherhood by birth order was self-calculated using published male births by birth order as well as people exposed to the risk obtained from the human mortality database (HMD 2019). However, live births by parity and sex provided by Statistic Finland were not accurate enough, and therefore this country was excluded from the analysis. In addition, the databases of the statistical offices of some other European countries (Italy, Portugal, Spain, Hungary, Poland, Estonia, Belgium, Austria, Great Britain and Germany) were examined, but without being able to find data on fertility by parity for men. Therefore, the register-based data analysis of first birth among men and women as well as the gender gap in mean age at birth by parity is mainly limited to Northern European countries, with Norway, Sweden and Denmark being examined in more detail. However, even in these countries, the data do not go back very far, for Denmark data is available only from 1986 and for Norway and Sweden only from 2000 to 2022.

5.2.2 GGP survey data and variables

To be able to analyse further countries by birth order, the cohort mean age at birth by parity for men and women was calculated using survey data. Individual-level panel survey data was obtained from the Generations and Gender Programme (GGP 2019), both from the GGS-I (2004-2011) and GGS-II (2017-ongoing). Survey data was used to show changes in male and female cohort mean age at birth along different parities and education. The analysis includes five countries from the GGS-I Wave 1, namely Hungary, Poland, Estonia, France, and Belgium and six countries from GGS-II Wave 1, namely Norway, Sweden, Czech Republic, Estonia, Belarus, and Moldova. The country selection was based on several criteria: First, a considerable number of cohorts were included in the study. Second, countries that were consistent with the HFC data were selected to be able to analyse the validity of the data. Third, countries were selected to include several European regions.

Table 1: Sample Size of selected countries from GGP I and II

Countries	*GGP*	*Age-range*	*min. Cohort*	*max. Cohort*	*Sample size*
Estonia	GGP-I	45-81	1930-1934	1955-1959	3920
Hungary	GGP-I	45-79	1925-1929	1955-1959	7402
Poland	GGP-I	45-83	1930-1934	1960-1964	11552
France	GGP-I	45-79	1925-1929	1955-1959	5230
Belgium	GGP-I	45-82	1930-1934	1955-1959	3816
Sweden	GGP-II	45-59	1960-1964	1970-1974	3628
Estonia	GGP-II	45-59	1960-1964	1975-1979	3244
Moldova	GGP-II	45-79	1940-1944	1970-1974	6112
Czechia	GGP-II	45-69	1955-1959	1975-1979	2383
Belarus	GGP-II	45-79	1945-1949	1970-1974	4347
Estonia	GGP-II	18-59	1960-1964	1975-1979	3244
					n = 51,634

Table 1 shows all countries' age range, minimum and maximum cohorts, and sample size. Depending on the country, cohorts range from 1925-1929 to 1975-1979. The sample size, male and female combined, is lowest for Czechia (n = 2,383) and highest for Poland (n = 11,552), while for all countries combined the sample size is 51,634 individuals. All people over 45 years of age and their biological births/children that occurred from age 15 to age 45 were included in the analysis. It was assumed that there are no more births after age 45, which may lead to a marginal downward bias in cohort mean age at birth. To ensure a great enough sample size by cohorts the analysis of GGP data is based on five-year cohorts and only includes those cohorts where both men and women have a minimum sample size of n = 150. For the recently published GGP-II data, by looking at the age at birth by parity for each respondence, it was observed that some respondents misreported the year of birth of one or more children, whereby the children are reported to be older than their parents. Respondents with these inaccurate values are excluded from the analysis. The calculations of demographic indicators done with GGP data are weighted. However, for Sweden no survey weights were applied since they were not yet available in GGP-II and for Poland five observations were filtered out because of missing survey weights. One additional notable bias could be caused by missing births for men since they might not know of their biological children, while others "falsely" declare themselves as biological fathers (Coleman, 2000, S. 45). Second and more important there is a tendency of non-co-resident fathers to underreport their biological children in surveys (Juby & Le Bourdais, 1999).

Survey data from the Generations and Gender Programme includes various variables on fertility. To calculate the mean age at birth, the procedure conducted by Vergauwen et al. (2015) has been applied to GGP-I data. In this regard, resident and non-resident biological children were determined separately using distinct data items. These values were subsequently combined and ordered, and the age of first, second, third, and subsequent birth for each person was computed. In GGP-II, the year of birth for each child is already specified by a separate variable, so that the age at which individuals had their children can be calculated. In both survey data, the type of child is always indicated (e.g., adopted, stepchild or biological child), whereby here only children are included in the analysis who were identified by the respondents as biological children. Furthermore, the variables on sex and educational attainment were utilized. *Sex* is a dummy variable, with a value of 1 for men and 2 for women. *Educational attainment* was categorized into three broad groups ("high" "middle" and "low") based on the International Standard Classification of Education (ISCED) system: "High" educational attainment includes individuals who have achieved at least tertiary education or at least a bachelor's degree. Second, the category "middle" educational attainment represents individuals with upper secondary or post-secondary non-tertiary education levels. And third, the "low" category comprises individuals with educational attainment at the primary or lower secondary level.

5.2.3 Checking the quality of the data

To verify the validity of the data obtained by the statistical agencies and from the GGP survey, a comparison was conducted using more accurate data from HFD and HFC. Regarding data comparison between data from statistical agencies and HFD/HFC data, both sources rely on official register-based birth counts, and slight variations are expected. These discrepancies can arise due to three main reasons. First, HFD and HFC obtain person-years lived from the Human Mortality Database, which involves specific adjustment methods, while statistical agencies calculate person-years lived using their methods. Second, differences may emerge from the age intervals considered in mean age at birth calculations, with HFC/HFD using a relatively wide age range (age 12 to 55+), compared to the here unknown intervals applied by the statistical agencies. Third, varying data manipulation methods, such as splitting or merging age groups, could also contribute to differences between the data sources.

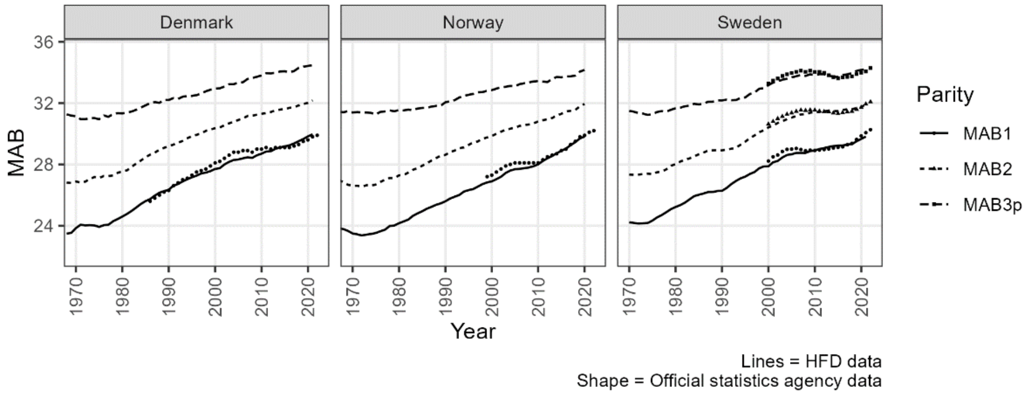

Figure 2: Checking similarities of female mean age at birth by parity, by comparing data from official statistical agencies and HFD data

Empirically, when comparing the overall mean age at birth for men and women, the two data sources show remarkable similarity, with disparities ranging from only -0.5 to 0.5 years at most. These differences by parity are shown in Figure 2, which illustrates the estimates of mean age at birth by parity among men and women, by comparing the official statistical agency's data with that of HFD. As expected, a close alignment is observed between the estimates for mean age at first birth from both sources, with a maximum difference of only between

0.5 and -0.2 years, indicating a good fit. Moreover, as shown in Sweden the estimates for second and higher-order births also exhibit a similar level of accuracy, with differences ranging from 0.2 to -0.3 years at most. On the other side, a direct comparison for mean age at birth by parity for men was not possible, as HFC only provides data for all birth orders combined. Nevertheless, this analysis confirms that the calculations of the two sources are aligned.

To assess the quality of demographic indicators derived from GGP data, again a comparison can be made with a more comprehensive data source, like the Human Fertility Collection (HFC) and the Human Fertility Database (HFD). To ensure comparability, HFD and HFC data were adjusted to include only ASFRs from age 15 to 45. A similar analysis has already shown that in the case of GGP-I data, the mean age at birth for women for cohorts before 1945 may not always reflect the values obtained from birth-register-based data, even after applying survey weights (Vergauwen et al., 2015). This discrepancy can be attributed to various factors, including the presence of missing values, measurement errors, and challenges related to the comparability of specific survey items (Vergauwen et al., 2015). However, this is not the case for countries selected in this analysis where the difference in cohort mean age at birth between survey data and register-based data estimates is relatively low.

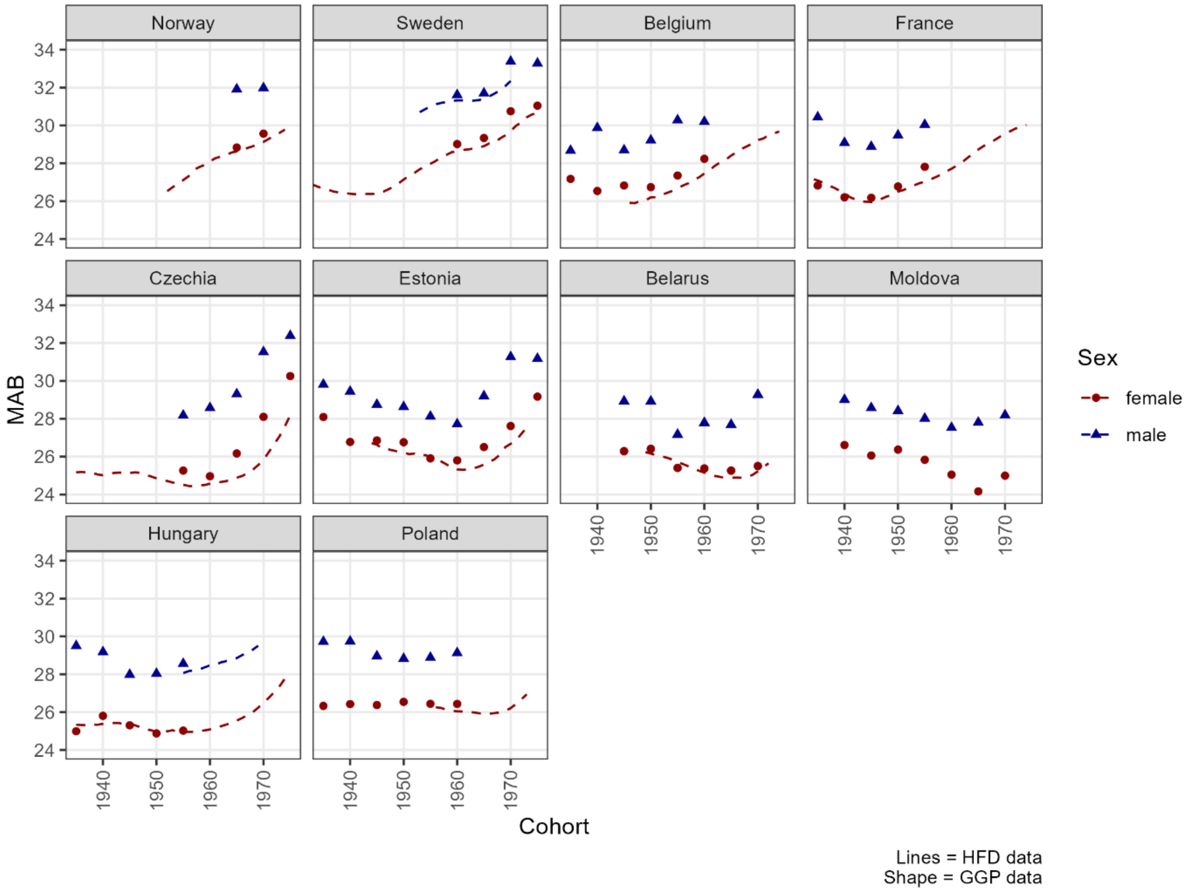

Figure 3: Checking the validity of male and female cohort mean age at birth, by comparing GGP and HFD/HFC data

Figure 3 illustrates this graphically, by showing the cohort mean age at birth for men and women for several countries over time. The dashed lines depict the more accurate HFC/HFD data, while the points and triangles represent survey data from GGP. As shown in the figure, overall GGP estimates are only slightly higher than HFC/HFD estimates, indicating a relatively good fit. However, estimates for men and women based on GGP data are usually about 0 to 0.5 year higher. In few other cases estimates derived from GGP data are slightly lower. Since HFC/HFD data was adjusted and includes the same age groups as GGP data, this points out a notable bias. The study on the validity of mean age at birth for men is limited, since only for two countries, namely Sweden and Hungary, male cohort data from the HFC could be compared with those from the GGP. In Hungary, estimates of the mean age at birth for men based on GGP data are around 0.35 years higher than the more accurate values from HFC, and in Sweden, it is about 0.1 years higher. Nevertheless, differences between the two data sources are marginal and trends over time in HFC/HFD data are mirrored by GPP data, indicating a relatively good fit.

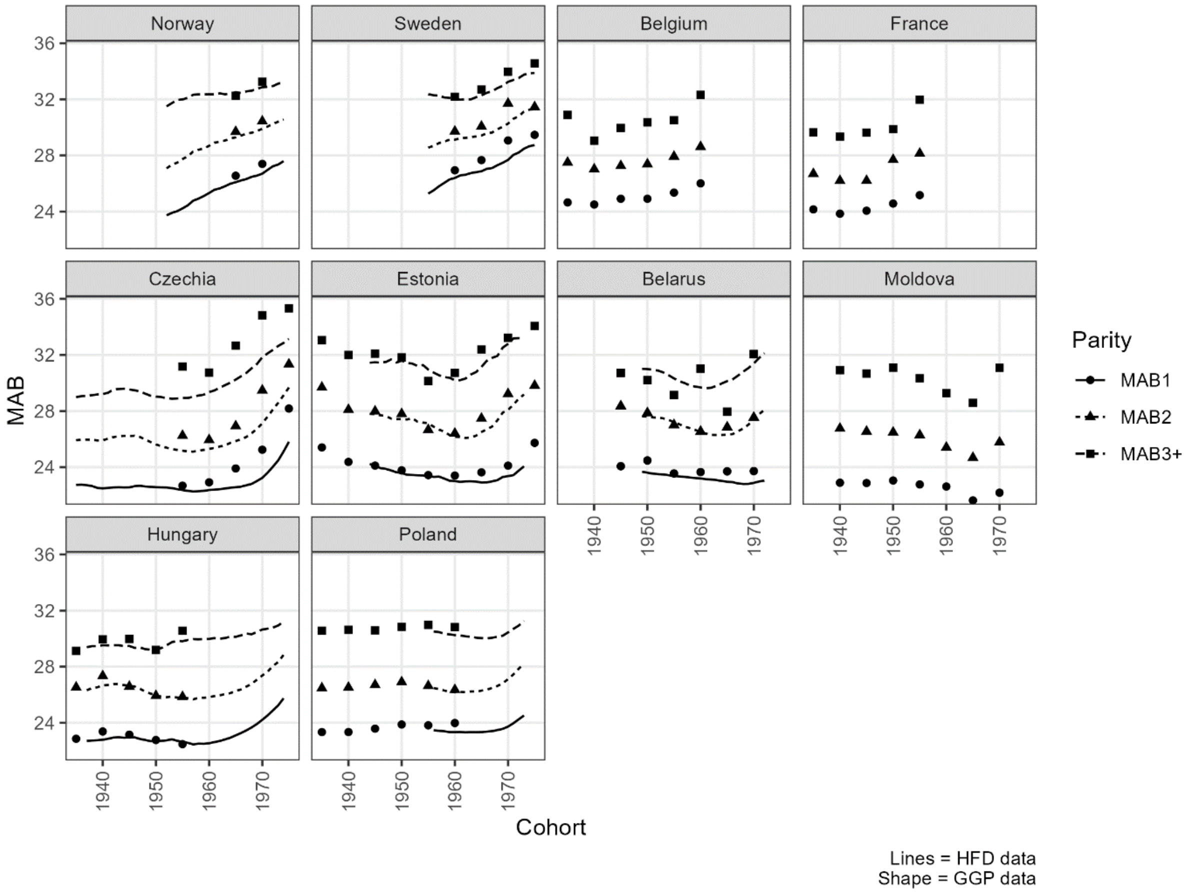

Figure 4: Checking the validity of female cohort mean age at birth by parity, by comparing GGP and HFD data

Secondly, the same process can be used to determine the correctness of indicators by parity derived from GGP data. Here, the HFD/HFC database only contains high-quality register-based estimates for women, which is why the analysis here is limited to them. Figure 4 contains estimates from both GGP and HFD on the parity-specific mean age of birth across cohorts. The figure clearly shows that both estimates of mean age at birth by parity follow the same trends over time. However, it is again observable that GGP estimates are somewhat higher than the register-based estimates. The differences are smallest, at around 0 to 1 years for the average age at first and second birth. In addition, the differences for third and higher births are usually between -0.5 and 1 years higher for GGP data, but stronger outliers were observed for this parity. In the Czech Republic, for example, the GGP estimates for third and higher-order births from 1955 to 1970 are about 2 years higher than the HFD estimates, while in Belarus GGP estimates even give a lower value for the average age of birth than HFD estimates. Still, it could be shown that survey data from the GGP-I and GGP-II are suitable for calculating cohort mean age at birth by parity. Just as for the overall mean age at birth, GGP estimates overestimate the mean age at birth by parity for women. This has to be considered when analysing aggregated GGP estimates. Unfortunately, the same procedure could not be carried out for men, as no register-based cohort data by parity was available. It can only be assumed with a high degree of probability that GGP data also overestimate the man age at birth by parity for men.

5.3 Decomposition methods

5.3.1 Kitagawa Decomposition

In the case of Sweden, register-based data on mean age at first, second, and higher-order birth were available for both men and women, enabling the decomposition of changes in the gender gap in mean age at birth as well as in mean age at birth over time into structure and rate effects. This is important in determining whether changes in a demographic indicator are due to changes in the birth structure or whether they are "real" changes in the sense that the rate itself has changed. For example, the average age at birth may have increased only because of a higher number of higher-order births, which typically occur at a later age, or because the first birth is also occurring later and later. To assess this a Kitagawa decomposition technique can be applied, whereby the difference in means between two rates over time can be decomposed into two parts, one being the differences in specific rates and the other in the composition of the population, or in this case the number of births by parity (Kitagawa, 1955). This decomposition technique is based on the calculation of rates, representing a hypothetical scenario in which one assumes a constant population composition or a constant rate between two points in time.

This Kitagawa decomposition can be applied to decompose the change in the gender gap over time. If the proportion of births by parity (pro_p) and the gender gap in mean age at birth by parity (Gap_p) are given the reduction of the gap can be decomposed into changes due to a reduction in the gap itself (rate effect), and changes due to the different structure in the number of births by parity (structure effect). Here, the rate effect (see formula l below) indicates the differences in mean age at birth over time, let's say from 2000 to 2022, assuming that the proportion of births by parity had remained constant between the two years. This can be calculated by subtracting the weighted observed gender gap in mean age at birth by parity in 2022 from the weighted observed gender gap in 2000. Both observations are weighted by the average proportion of births by parity from the two years analysed ($pro_p^{aver.} = \frac{pro_p^{2022}+pro_p^{2000}}{2}$). Second, it was assumed that the differences between the gap by parity remain constant over time to decompose the structure effect (see formula m below). Here, the proportion of births by parity observed in each year is weighted by the gap n mean age at birth by parity of these two years: $Gap_p^{aver.} = \frac{Gap_p^{2022}+Gap_p^{2000}}{2}$. The change in mean age at birth over time ($Gap_{Gap\ p\ 2022}^{pro\ 2022.} - Gap_{Gap\ p\ 2022}^{pro\ 2000}$) can be explained by a changing structure of births by parity (structure effect) and by changes in the gender gap itself by parity (rate effect). The impact of these two effects is shown in the last formula below:

$$Rate\ effect = \sum_{\mathrm{p}} (\mathrm{pro}_{\mathrm{p}}^{\mathrm{aver.}} * \mathrm{Gap}_{\mathrm{p}}^{2022}) - \sum_{\mathrm{p}} (\mathrm{pro}_{\mathrm{p}}^{aver.} * \mathrm{Gap}_{\mathrm{p}}^{2000}) = Gap_{Gap\ p\ 2022}^{pro\ aver.} - Gap_{Gap\ p\ 2000}^{pro\ aver.} \qquad (l)$$

$$Structure\ effect = \sum_{\mathrm{p}} (Gap_{\mathrm{p}}^{\mathrm{aver.}} * pro_{\mathrm{p}}^{2022}) - \sum_{\mathrm{p}} (\mathrm{Gap}_{\mathrm{p}}^{aver.} * \mathrm{pro}_{\mathrm{p}}^{2000}) = Gap_{Gap\ p\ avr.}^{pro\ 2022.} - Gap_{Gap\ p\ avr.}^{pro\ 2000.} \qquad (m)$$

$$Gap_{Gap\ p\ 2022}^{pro\ 2022.} - Gap_{Gap\ p\ 2000}^{pro\ 2000} = rate\ effect + structure\ effect \qquad (n)$$

The same decomposition technique has also been applied to examine the increase in mean age at birth. The formulas below depict the decomposition of the increase in mean age at birth for women into rate and structure effects. To calculate rate effects, the mean age at birth by parity is weighted by the average proportion of births by parity between the two time points. The sum of all weighted mean ages at birth for each parity in the year 2022 is subtracted by the sum of the weighted mean ages at birth for all parties in the year 2000 (see formula o). For structure effects, the average mean age at birth by parity is multiplied by the proportion of births by parity observed in the year. Here again, this calculation done for the year 2022, was subtracted from the year 2000 (see formula p). The contributions of rate and structure effects to the overall increase in mean age at birth for women and men can be decomposed that way (see formula q).

$$Rate\ effect = \sum_{\mathrm{p}} (\mathrm{pro}_{\mathrm{p}}^{\mathrm{aver.}} * \mathrm{MAB}_{\mathrm{p}}^{2022}) - \sum_{\mathrm{p}} (\mathrm{pro}_{\mathrm{p}}^{aver.} * \mathrm{MAB}_{\mathrm{p}}^{2000}) \qquad (o)$$

$$Structur\ effect = \textstyle\sum_{\mathrm{p}} (\mathrm{MAB}_{\mathrm{p}}^{\mathrm{aver.}} * pro_{\mathrm{p}}^{2022}) - \textstyle\sum_{\mathrm{p}} (\mathrm{MAB}_{\mathrm{p}}^{aver.} * \mathrm{pro}_{\mathrm{p}}^{2000}) \qquad (p)$$

$$\mathrm{MAB}_{MAB\ p\ 2022}^{pro\ 2022.} - \mathrm{MAB}_{MAB\ p\ 2000}^{pro\ 2000} = rate\ effect + structure\ effect \qquad (q)$$

5.3.2 Decomposition assuming no multiple reproductive partnerships

Second, the influence of various factors on the gender gap in mean age at birth can be subjected to decomposition analysis. By considering that the difference in mean age at birth can be calculated using birth order-specific gaps, it is possible to decompose the impact of each birth order (p) on the overall gap. The formula r below shows the impact of mean age at first (p1), second (p2) and higher order (p3+) birth on the overall gender gap in mean age at birth. It can determine how many years in the gap are due to different ages between men and women at their first birth. This is calculated by weighing the gender gap in mean age at birth for each birth order, by the relative frequency of births, both of men and women, occurring in that birth order. The formula can also be simplified by representing the effect of the individual parts by the variable I (see formula s).

$$Gap = \frac{(B_{p1,f} + B_{p1,m}) * Gap_{p1}}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} + \frac{(B_{p2,f} + B_{p2,m}) * Gap_{p2}}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} + \frac{(B_{p3+,f} + B_{p3+,m}) * Gap_{p3+}}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} \qquad (r)$$

$$Gap = I_{p1} + I_{p2} + I_{p3+} \qquad (s)$$

Breaking down the gender gap in mean age at birth by parity allows not only for an examination of the extent to which first, second or higher-order births contribute to it but additionally, this analysis can serve as an indicator to assess partially the impact of multiple reproduction partnerships on the gender gap in the mean age at birth. This can be done by using one simple assumption: In monogamous societies without any multiple reproductive partnerships, the difference in mean age at birth arises from the gender gap in mean age at the first reproductive union. However, this is only true if there are no structural changes in the birth distribution, the age difference is independent form the age when having a birth and if the number of children is independent of age differences with the partner. In this respect, it is likely that more traditional families (with more births in higher order) have a larger gender gap in mean age at birth, increasing the effect on the gender gap in mean age at birth. Nevertheless, these other effects are likely to be marginal, and therefore the above assumption still allows for a partial assessment of the impact of multiple reproductive partnerships. Based on the assumption in a scenario (S) assuming no reproduction in new partnerships, the gender gap in the mean age at first birth should be equivalent to the gender gap in the mean age at second or higher-order birth as well as the overall gender gap in mean age at birth (see formula t). By taking this assumption into account the gender gap in mean age at birth can be decomposed by parity, whereby each gap by parity is weighted by births for men and women occurred in that parity (see formula u). Again, the formula was simplified by representing the effect of the individual parts by the variable scenario impact (see formula v).

$$SGap_{p1} = SGap_{p2} = SGap_{p3+} = SGap \qquad (t)$$

$$SGap = \frac{(B_{p1,f} + B_{p1,m}) * SGap}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} + \frac{(B_{p2,f} + B_{p2,m}) * SGap}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} + \frac{(B_{p3+,f} + B_{p3+,m}) * SGap}{B_{1,f} + B_{1,m} + B_{2,f} + B_{2,m} + B_{3+,f} + B_{3+,m}} \qquad (u)$$

$$SGap = SI_{p1} + SI_{p2} + SI_{p3+} \qquad (v)$$

To analyse the partial impact of multiple reproductive partnerships on the gender gap two scenarios were made, one without re-partnering assuming a stable gender gap over birth orders (this has been described above) and one including observed data. Herby the impact of each birth order observed in reality is subtracted by the impact of each birth order assuming no multiple reproductive partnerships. For example, in order to calculate the difference in the impact of first birth orders on the gender gap if no multiple-reproductive partnerships occurred, the formula below can be applied (see formula w). As shown in the absence of multiple reproductive partnerships, the impact of first births on the gender gap in mean age at birth would be exactly 0 ($I_{p1} - SI_{p1} = 0$). This is logical since it was assumed that all birth orders experienced the same gender gap in mean age at birth as observed in the first birth. However, the differences for second and higher-order births in the impact observed in reality compared to the scenario without multiple reproductive partnerships, drive the gender gap in mean age at birth upwards or downwards. Hereby the gender gap in mean age at birth is driven by the differences in second ($I_{p2} - I'_{p2}$) and higher order births ($I_{p3+} - SI_{p3+}$). By summing up all differences by birth order between the real gender gap and the scenario without multiple reproductive partnerships, partially the impact of multiple reproductive partnerships (IMRP) on the mean age at birth can be examined (see formula w). This indicates how many years the gender gap in mean age at childbearing could be lower if no multiple reproductive partnerships within a population occurred. However, as discussed above, there are other effects that could explain a smaller part of this impact.

$$IMRP = (I_{p1} - SI_{p1}) + (I_{p2} - SI_{p2}) + (I_{p3+} - SI_{p3+}) \qquad (w)$$

6 Partnership patterns: Age difference by age starting cohabitation

The gender gap in the mean age of birth is based on an age difference observed at the formation of a cohabiting union since most births occur in married or unmarried cohabiting partnerships. Studies on the age difference in heterosexual cohabiting couples, which measure the age difference between men and women, conclude that men are usually already 2-3 years older (Ausubel et al., 2022; Kolk, 2015). However, the age difference of a cohabiting couple depends strongly on the age at which the partners came together. In this regard, men as they age tend to (re-)partner with younger women, while women, as they age, tend to (re-)partner with more equal-aged men (Beaujouan, 2009, S. 229–230; Beaujouan & Wiles-Portier, 2011; Berardo et al., 1993; Bozon, 1991; Coleman, 2000; Ni Bhrolchain & Sigle-Rushton, 2005). This partnership pattern forms the basis for how a delay in fertility might affect the mean age at birth differently for men and women and thus narrowing or widening the gender gap in mean age at parenthood. If women delay the age at which they start a cohabiting union, and thus possibly also the age of birth, then this leads to a smaller age difference with their partner, potentially narrowing the gender gap in mean age at birth. Vis a vis when men postpone having a cohabiting union, the age difference between them and their partner tends to be greater, potentially increasing the gender gap in mean age at birth.

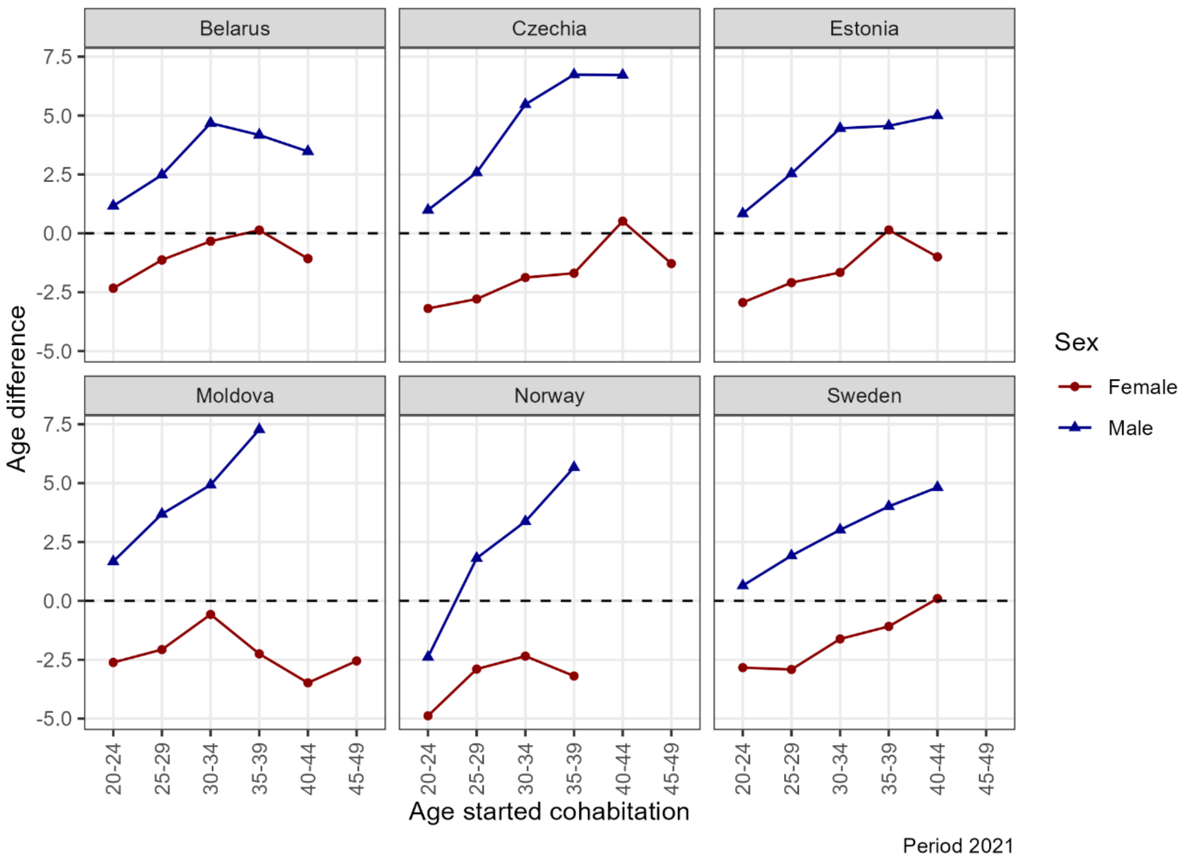

Figure 5: Age difference by age started cohabitation for men and women, based on GGP-II data

Figure 5 shows the age difference, at an individual level, between men and women with their partner, according to the age at which they started cohabitation, based on GGP-II data. Overall, it is evident that men are average older than their cohabiting partners, whereas women are more frequently younger than their partners. However, this pattern is strongly influenced by the age at which individuals initiate cohabitation. Younger women, between the ages of 20-24, tend to have a larger age difference, typically being 2 to 3 years younger than their partners. As women age, the age difference tends to narrow, with women in the 40-44 age group on average having partners of the same age. While the age difference decreased in all countries, it only increased again in Moldova from age 35 onwards, possibly due to a bias due to smaller sample sizes at higher ages or due to a cohort effect where older cohorts have a more traditional partnership and thus a larger age difference. In contrast, the age difference for men evolves differently. Younger men, aged 20-24, tend to have partners who are closer to their age, while older men tend to have younger partners. For instance, men in the 30-34 age group are typically 3 to 5 years older than their partners. This suggests a distinct partnership pattern: older women tend to prefer partners of a similar age, while older men tend to partner with younger women. Returning to the topic of fertility delay, this finding has interesting implications. Namely, when women delay their first birth much more compared to men, it can result in a reduction of the age difference in cohabitation and the end, since most births are born in cohabiting unions, also in the gender gap in mean age at birth.

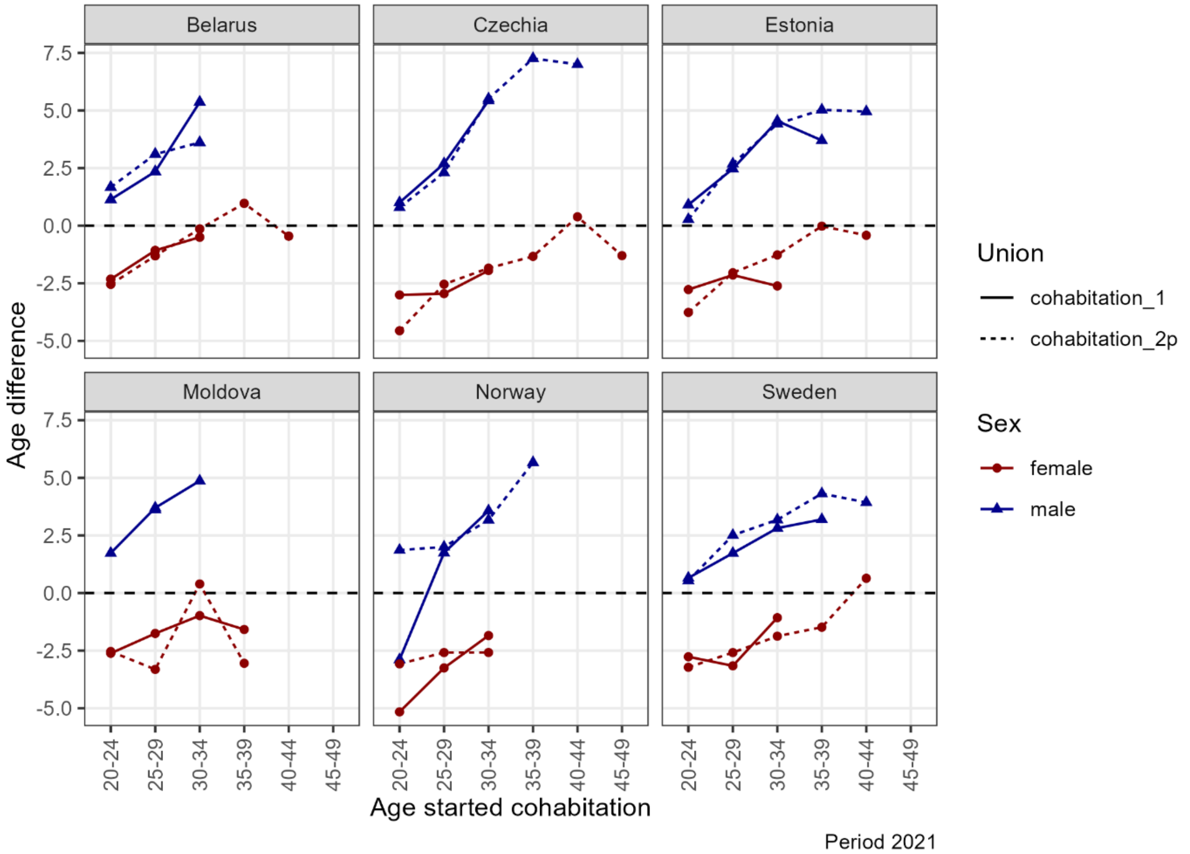

Figure 6: Age difference by age started cohabitation and number of cohabitation unions for men and women, based on GGP-II data

Second and subsequent birth within these partnership patterns may exhibit differences. Figure 6 provides insights into the age difference by age started cohabitation for first and higher-order cohabitations. For all countries, it is clear that the trends between the first cohabiting union and subsequent ones do not differ for individuals. However, in higher-order cohabitation, women tend to have partners who are closer in age, as these cohabitations tend to take place at an older age (age effect). In contrast, women may have a greater age difference with their partner in their first cohabitation because it takes place earlier in their lives. On the other hand, men who enter a second or further cohabitation are usually older than in their first cohabitation, which increases the age difference between them and their partner. These findings have implications for the gender gap in mean age at birth. The distinct re-partnering pattern has the potential to increase the gender gap, as men tend to form multiple reproductive partnerships with younger women. On the contrary, re-partnering is less likely to lead to childbirth for women at later ages, as they may already have children from previous relationships. This might explain partially how the potential increase in multiple reproductive partnerships over time, especially among men, might impact the gender gap in mean age at birth. Furthermore, this might also have some implications on the gender gap in mean age at birth by parity. Higher birth orders might have a larger gender gap in mean age at birth as a result of men having more multiple reproductive partnerships, while women might have their higher-order birth within the same partnership.

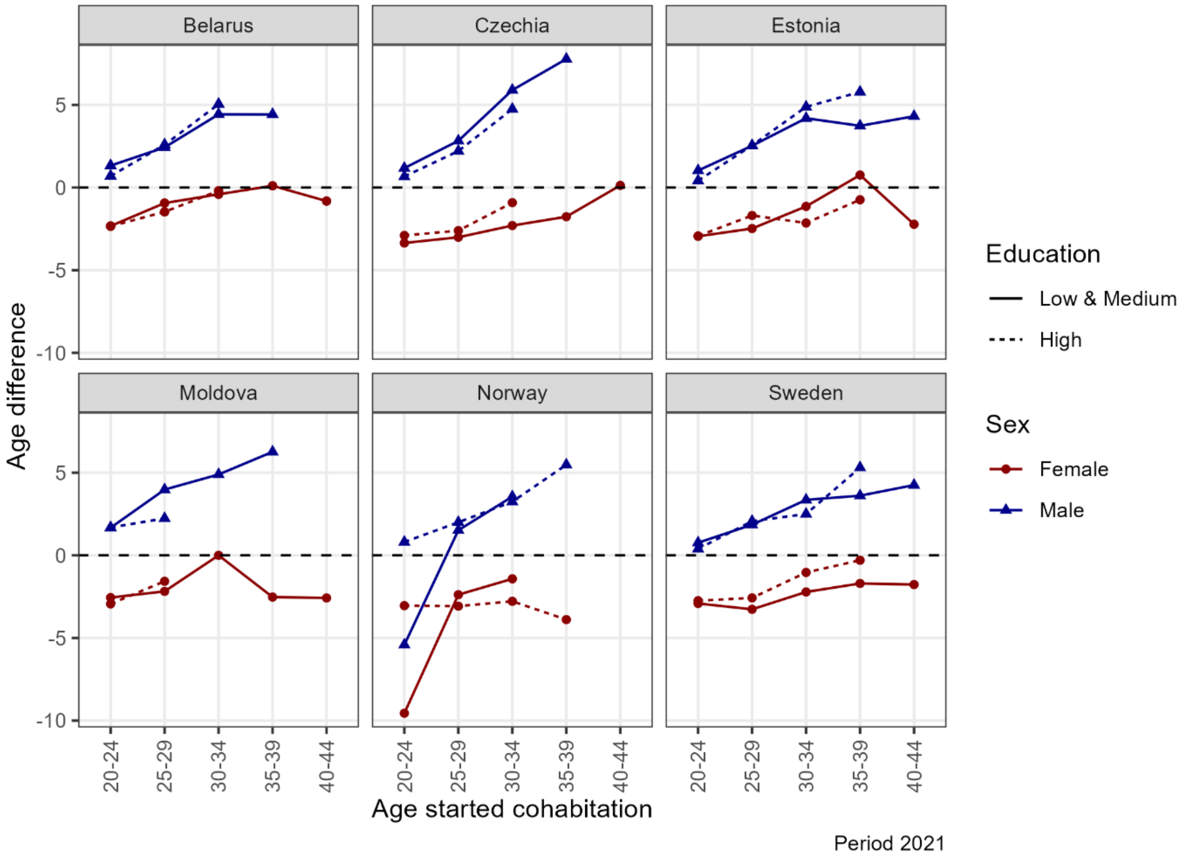

Figure 7: Age difference by age started cohabitation and educational attainment for men and women, based on GGP-II data

In addition, partnership patterns can also provide information about the influence of a higher education on the gender gap in mean age at birth. Figure 7 illustrates the age difference in cohabitation by age started cohabitation for women and men by their educational attainment. In most countries, there is only a marginal difference in the age differences with their partner between higher-educated and middle and low-educated. Only in Sweden and the Czech Republic do higher educated people have a smaller age difference with their partner, than lower or middle educated. However, as discussed in the theory section, people with higher education, especially women, on average delay their childbearing more, which leads them to enter into a reproductive partnership later. Herby women with higher education tend to have smaller age differences with their reproductive partners as they often delay having children. In contrast, lower-educated women tend to have children at a relatively early age, resulting in a larger age difference with their reproductive partner as well as potentially a larger gender gap in the mean age at birth. Higher-educated men are also delay birth and entering reproductive partnerships later in life, which probably results in a larger age difference with their reproductive partners. Frequently, they may form partnerships with lower-educated women, which could again contribute to a larger gender gap in age at birth among lower-educated. In summary the partnership patterns may have implications for gender gap in mean age at birth, which are discussed in the following chapters.

7 Men have children on average three years later

In European countries, men are on average three years older than women when their children are born (Coleman, 2000; Dudel & Klüsener, 2021). This gender gap in mean age at birth between the mean age of birth for men (MABm) and mean age of birth for women (MABf) can be shown using a simple linear Ordinary Least Squares (OLS) regression. In Figure 8, the mean age at birth for men is the dependent variable (on the y-axis), and the mean age at birth for women is the independent variable (on the x-axis). The regression includes all available observations for each European country and period from HFC and HFD data. All data points represent the mean age at birth for men and women in one year in one country. As indicated by the thick solid line, the results of the OLS regression show that MAB for men and women are almost perfectly related. One year increase in mean age at birth for women is associated with a 0.96 increase in mean age at birth for men (Intercept = 4.3; Slope = 0.96; $R^2 = 0.961$; $p < 0.01$). On the other hand, the dotted line at the bottom right corner of the graphic indicates the first median (MABm = MABf). This is the line that passes through the origin of the coordinates (0, 0) and has a slope of exactly 1. In this line, men would have the same age as women in having children. The other dashed lines indicate a shift of the MABm = MABf line by one year upwards. By looking at the observations (light dots in the background) it can be seen that they are between two and four years off the first median. Therefore, depending on the country and period, the mean age of birth for men is between 2 and 4 years higher than the mean age of birth for women. Whereby, as shown by the regression line (solid black line), on a country level men have their children on average 3 years later than women.

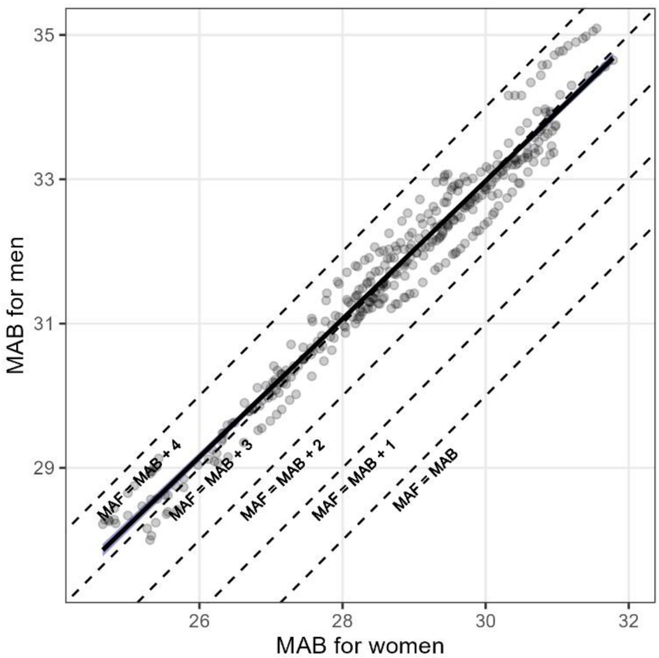

Figure 8: Association between mean age at birth for men and women, based on HFD and HFC data

Although men tend to have children 3 years later than females on average, there is some variation between countries. For instance, the largest gender gap in mean age at birth was observed in Italy in 1999, with men being, on average, 3.84 years older than women. As observable in Figure 13 (see sub-chapter 8.3), the gender gap in Italy remained consistently high over time, never falling below 3.5 years. Another country that has historically exhibited a high gender gap in mean age at birth is Germany, with a gap of 3.65 years observed in 1993. However, Germany has experienced a notable reduction over time and by 2013, the gender gap had decreased to 3.22 years. While Germany has witnessed a decreasing gender gap in mean age at birth, Hungary, another country with a high gender gap, experienced the opposite trend. In 1990, Hungary had a relatively average gender gap of 3.06 years, which increased to 3.61 years by 2013. While Italy, Hungary, and historically Germany have exhibited high values, Finland stands out with consistently low values around 2.45 in mean age at birth over time. Furthermore, Portugal (2.64) and Denmark (2.41), due to a sharp recent decline, demonstrate a low gender gap in 2013. Considering more recent trends in Northern European countries, it is noticeable that in the early 2020s, they showed a relatively small gender gap of 2-2.5 years (see Table 5, in the sub-chapter 8.6). This points to an important difference between these and other European countries, where the gender gap is on average closer to 3 years.

8 Fertility delay and the narrowing gender gap

In chapter eight, trends in the fertility delay for men and women are shown and linked to a decline or rise in the gender gap in mean age at birth. The first sub-chapter on the empirical results demonstrates the development of mean age at birth for men and women over time. It is shown that the mean age at birth for both men and women has increased since the 1970s periods and the 1945 cohorts, with the onset and extent of the shift in transition depending on the European region. The second and fourth sub-chapter explores the question of whether the delay in fertility and the narrowing gender gap is due to rate or structural effects by examining the increase in the mean age at birth from the 2000s onwards in Sweden. Rate effects have been shown to be the main cause of fertility delay. Building on this, it was shown in the third sub-chapter that the greater delay of fertility in women reduces the gender gap in mean age at birth. Sub-chapters 8.5 and 8.6 analyse fertility delay in men and women and show how greater delay of first birth in women reduces the gender gap in mean age at birth.

8.1 Men and women delay fertility almost parallel

It’s often argued that fertility among men and women is developing in tandem or parallel (Coleman, 2000; Dudel & Klüsener, 2021; Schoumaker, 2019). The almost parallel onset of postponement transition and trends in fertility delay in several European countries, based on HFD and HFC data, will be discussed here. Figure 9 shows the mean age of birth for men (blue triangled line) and women (red pointed line) from the period 1970s to 2014 for selected countries based on HFD and HFC data. In addition, Table 2 gives some information on the mean age at birth for men and women since 1980. All the countries depicted in Figure 9 have observed a rise in the mean age at which men and women are having children. However, these countries vary both in the timing of when this trend towards delay began and the extent to which it has occurred. Northern and Western European countries (first and second row in Figure 9) started delaying childbearing particularly early. In Sweden, for instance, men's and women's mean age at birth increases from the mid-1970s onward. In this country mean age at birth for men in 1975 was slightly below age 30 and increased to 33.67 years in 2013. In parallel, the mean age at birth of women increased from 26.7 years in 1975 to 30.96 years in 2013.

The three Southern European countries included in the analysis (third row in the graph) started the fertility delay somewhat later, namely Italy and Spain around 1980 and Portugal in the mid-1980s. In these countries, the average age at which men and women have children is already historically higher before the onset of the postponement transition. For example, the mean age at birth for men in Spain was about 31 years in 1980 and in Portugal, it was around 30.2 years. All southern European countries experienced fertility delay and in 2013 the mean age at birth for men increased in Spain to 34.56 years and in Portugal to 33.2 years. Furthermore, Italy, experienced the highest mean age at birth for men of all countries in 2013 at 35 years, while Spain had the highest mean age at birth of women in 2013 at 31.6 years. This clearly shows that both men and women in Southern European countries have children relatively late.

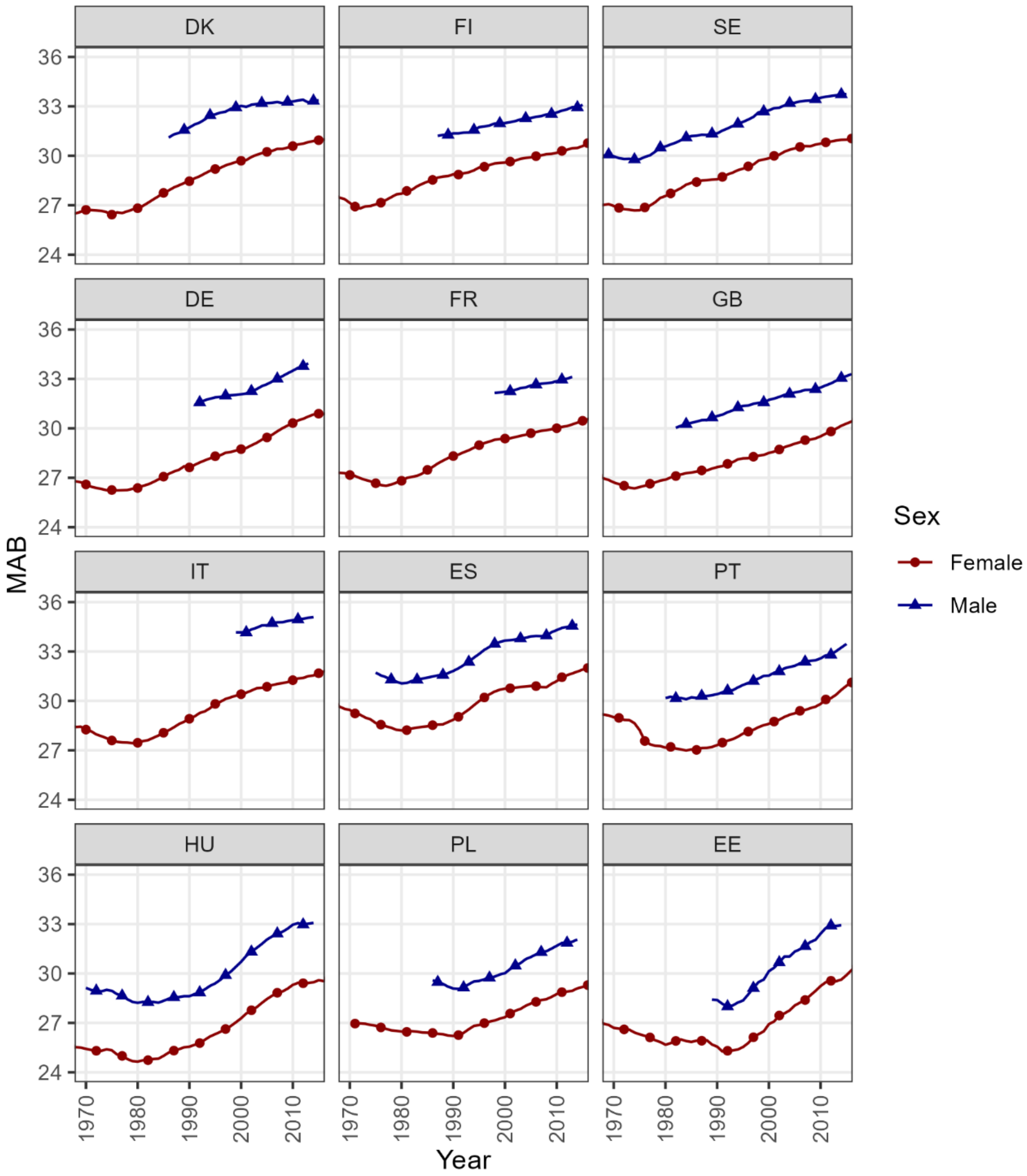

Figure 9: Mean age at birth for men and women from the 1970s to 2015 in several European countries, based on HFC and HFD data

In Eastern European countries (last row of Figure 9) it is noticeable that these countries began to delay having children rather late, namely only after 1991, after the collapse of the iron carton. However, the delay in fertility then occurred even faster than in other countries. This was particularly the case in Estonia, where from 1991 to

2013, men's mean age at birth increased from 28.2 to 32.4 years. In parallel, the mean age at birth for women also rose sharply from 25.3 to 29.2 years. Therefore, Eastern European countries started relatively late with the delay of fertility, but they quickly caught up with other European regions. T

So far, mean age at birth has been considered from a period perspective, assuming that individuals follow the fertility patterns observed in a given year. On the other hand, cohorts can also be studied by using HFD and HFC data. In order not to have to wait until the last child of a man in a cohort was born, here different age thresholds were applied. Only four out of the twelve countries in the Human Fertility Collection dataset on male fertility possessed sufficient data points to enable the analysis of cohort-specific trends in mean age at birth for men. These countries are Sweden, Spain, Portugal, and Hungary. Figure 10 provides a visual representation of the mean age at birth for men, including various maximum age thresholds for cohorts ranging from the early 1950s to the 1980s for Sweden and Hungary, since these two countries provide the longest time frame. The solid grey line at the bottom in Figure 10 indicates the mean age at birth for men, only including births that occurred before age 30. The subsequent lines assume that births only occurred up to the ages of 35, 40, 45 and 50. When births at higher ages are included, the mean age at birth for men moves upwards. In addition, the gap between the lines becomes smaller as the maximum age at which births are included increases. In the figure, it is visible that the difference between the mean age at birth for men at the age of 50 and the age of 45 is only marginal. As shown in the figure in Hungary, for the cohort born in 1960, the mean age at birth for men was 28.47 years when considering births up to the age of 45. Interestingly, the mean age at birth for men increased by just 0.27 years, reaching 28.74 years, when extending the analysis to births up to the age of 50. The difference between age 50 (31.85) and age 45 (31.32) in Sweden for birth cohorts 1960 is slightly higher at around 0.53 years.

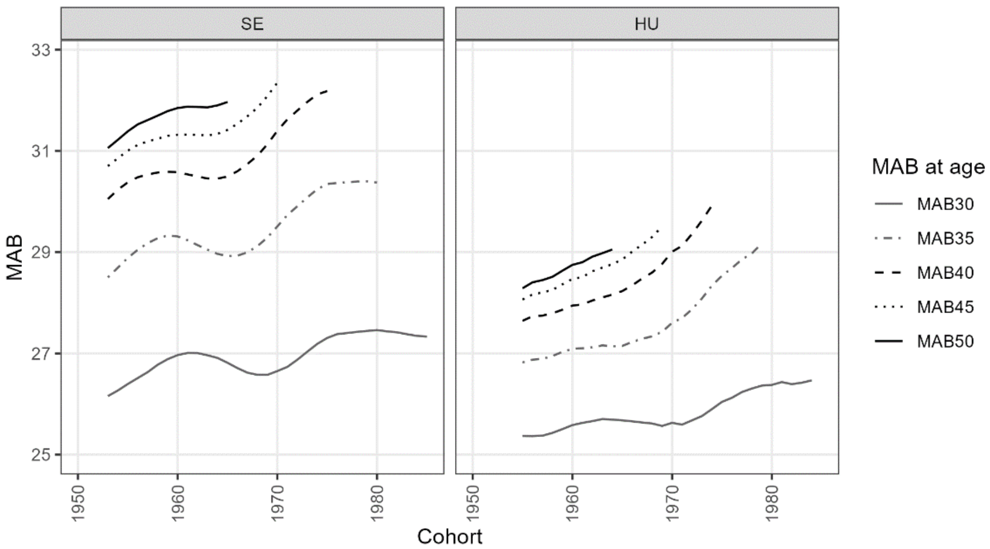

Figure 10: Cohort mean age at birth for men by different age thresholds for Sweden and Hungary, based on HFC data

Table 2: Period mean age at birth and the gender gap in mean age at birth in several European countries from 1980 to 2013

Region	*Country*	*Year*	*MAB for women*	*MAB for men*	*Gap*
Western Europe	*Germany*	1980	26.38		
		1990	27.63		
		2000	28.74	32.07	3.33
		2013	30.72	33.94	3.22
	France	1980	26.82		
		1990	28.32		
		2000	29.38	32.22	2.84
		2013	30.24	33.12	2.88
	Great Britain	1980	26.89		
		1990	27.65	30.75	3.1
		2000	28.51	31.73	3.22
		2013	29.98	32.89	2.91
Northern Europe	*Denmark*	1980	26.82		
		1990	28.46	31.72	3.26
		2000	29.7	33.03	3.33
		2013	30.83	33.24	2.41
	Finland	1980	27.7		
		1990	28.88	31.36	2.48
		2000	29.59	31.99	2.4
		2013	30.46	32.95	2.49
	Sweden	1980	27.56	30.57	3.01
		1990	28.58	31.36	2.78
		2000	29.85	32.76	2.91
		2013	30.93	33.67	2.74
Southern Europe	*Spain*	1980	28.21	31.06	2.85
		1990	28.86	31.82	2.96
		2000	30.75	33.66	2.91
		2013	31.67	34.56	2.89
	Italy	1980	27.46		
		1990	28.92		
		2000	30.41	34.16	3.75
		2013	31.5	35.05	3.55
	Portugal	1980	27.17	30.18	3.01
		1990	27.32	30.41	3.09
		2000	28.61	31.54	2.93
		2013	30.38	33.02	2.64
Central and Eastern Europe	*Estonia*	1980	25.68		
		1990	25.56	28.39	2,83
		2000	26.93	30.14	3,21
		2013	29.53	32.89	3,36
	Hungary	1980	24,65	28,22	3,57
		1990	25,56	28,62	3,06
		2000	27,28	30,71	3,43
		2013	29,42	33,03	3,61
	Poland	1980	26.48		
		1990	26.21	29.09	2.88
		2000	27.35	30.02	2.67
		2013	28.95	31.93	2.98

Secondly, cohort trends between men and women can be analysed. In this regard, Figure 11 illustrates the cohort mean age at birth for men and women by age 40 and age 50 in four European countries. By comparing men and women the figure shows that men are much more likely to have children between the age of 40 and 50. This is illustrated by the larger differences between the mean age at birth for men including by age 40 and age 50. On the other side, the difference between mean age at birth for women by age 40 and age 50 is much lower. In Spain for instance, for the cohort born in 1960, the mean age at birth for women by age 50 is 27.9 years, which is only 0.32 years higher compared to the mean age of 27.58 years by age 40. In contrast, there is a substantial difference in mean age at birth for men between age 50 (31.02) and age 40 (30.03) for the cohort being considered, with a difference of 0.99 years. In conclusion, all four countries indicate, that men tend to have much more births between age 40 and 50, but as shown in Figure 10 most of them are likely to occur by age 45, making it a good threshold when analysing cohort mean age at birth for men. This threshold, later on, was used to study cohort mean age at birth based on GGP data.

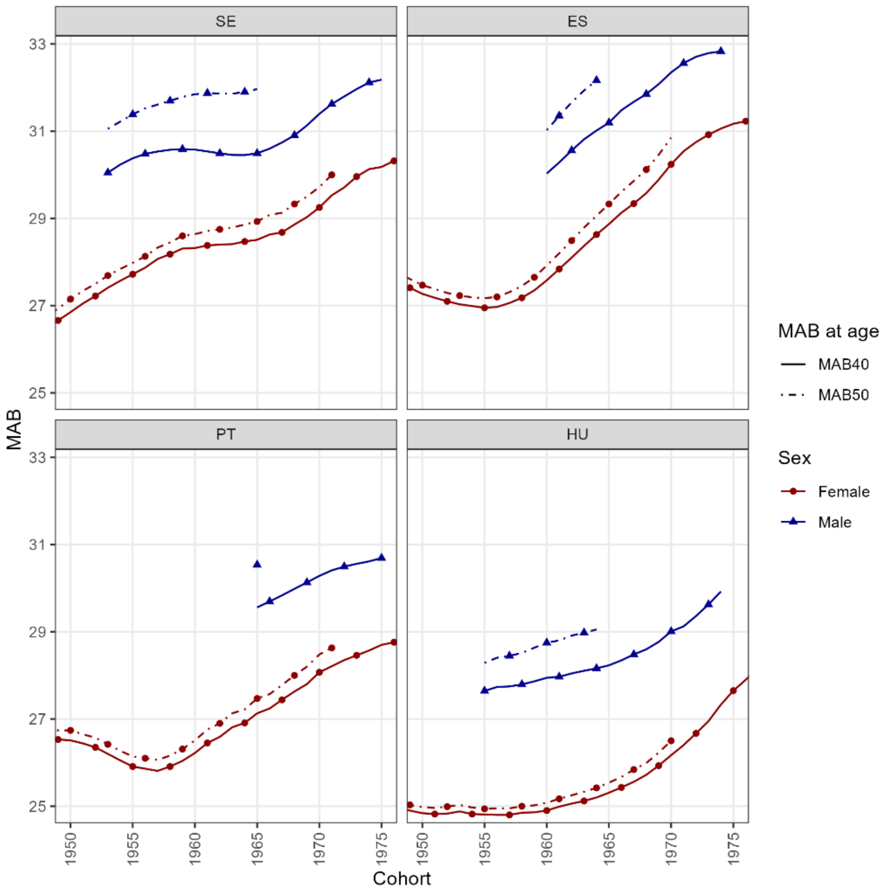

Figure 11: Cohort mean age at birth for men and women by age 40 and 50, based on HFC and HFD data

Thirdly, the onset of the postponement transition can be examined by cohorts. The first ones to experience an increase in mean age of birth are again Northern and Western European countries. The analysis conducted on mean age at birth for men and women with GGP data (shown in Figure 3 in sub-section 5.2.3) indicates, that in France and Belgium, men and women started delaying birth from cohorts 1945 onwards. In France, for example, cohort mean age at birth for men increased from 29.38 years in 1945-1949 to 30.54 years in the 1955-1959 cohorts. As depicted in Figure 11, in Sweden mean age at birth for men and women by age 40 and 50 increased from 1950 to mid-1970s cohorts relatively constantly. Only from 1960 to 1965 cohorts Sweden experienced a short slowdown in delaying fertility. While in Northern and Western European countries such as Sweden, births were delayed relatively early, Southern and Central and Eastern European countries started this process a bit later. In Spain and Portugal, there was a sharp increase in the mean age at birth from the 1955 cohorts. In Central and Eastern European countries, represented in Figure 11 by Hungary, the delay of birth started in later cohorts from around 1960 onwards. Furthermore, by studying cohort mean age at birth from GGP data it can be stated that Estonia, Czechia and partially Belarus experienced a similar trend to Hungary, with rising mean age at birth for men and women in cohorts 1960 onwards (shown in Figure 3 in sub-section 5.2.3).

In summary, men and women delay fertility almost in tandem. In Northern and Western Europe this process started earlier than in Southern and Central and Eastern Europe. However, the cause of the rising fertility delay for men and women is not yet clear. It remains uncertain whether it is primarily due to an increase in higher-order births, typically occurring at a later age, or a "real" increase in the mean age at birth. Therefore, this question will be explored in the next sub-chapter.

8.2 Rate effects increase fertility delay for men and women in Sweden

Understanding the changes in the mean age at birth over time requires consideration of multiple factors. Two distinct effects can potentially influence the observed increase in the mean age at birth for men and women: changes in the relative distribution of births by parity and changes in the mean age at birth within each birth order. On one hand, an increase in higher-order births can raise the mean age of birth since these births tend to occur later compared to first and second births. Here structure effects cause an increase in the mean age at birth. On the other hand, rate effects can also contribute to an increase in the mean age at birth for men and women. This occurs when, regardless of the birth structure, the mean age at birth decreases. To analyse the influence of rate and structure effects on the rise in mean age at birth for men and women, a Kitagawa decomposition can be employed. Due to the unavailability of register-based data on mean age at birth by parity for other European countries and the lack of precision in GGP data, this decomposition was conducted only for Sweden, where data by parity was obtained from Statistics Sweden (2023). Mean age at birth for men and women by parity was weighted by the absolute number of births obtained for women from the Human Fertility Database (2023b). Since births for men by parity were unavailable, it was assumed that men had the same number of births by parity as women. However, this assumption oversimplifies the real distribution of births by men, as there is typically greater within-gender variation among men in their number of births, in comparison to women (Coleman, 2000). This difference in birth distribution likely results in a higher proportion of higher-order births among males than females. By having this simplification in mind, the results of the Kitagawa decomposition can be examined.

Figure 12 shows the absolute increase in mean age at birth over time for women and men, decomposed by rate and structure effects. The figure indicates how much rate and structure effects increased mean age at birth from the year 2000 onward. First, it is worth noting that both men and women increased their mean age at birth since they experienced an increase in rate effects on mean age at birth by parity over time. In contrast, the analysis reveals that the impact of birth structure on the rise in mean age at birth over time was negligible. The structure effects were found to be negative, even indicating a declining mean age at birth. This was expected, since the relative proportion of higher-order births in Sweden since the 2000s, had even slightly increased. On the other side, due to rate effects, the mean age at birth rose in Sweden from 2000 to 2022 by 1.6 years for women and 1.28 years for men. Especially the increase in the mean age at having the first child led to an increase in the overall mean age at birth. Among women, the increase in mean age at first birth from 2000 to 2022 accounted for 0.89 years or 56%

out of the total increase of 1.6 years. Furthermore, the increase in female age at birth of the second child contributes 0.52 years or 33% and that of the third child 0.21 years or 13% to the overall increase. On the other hand, from 2000 to 2022 the structure effect resulted in a decrease of 0.02 years or 2% in mean age at birth for women.

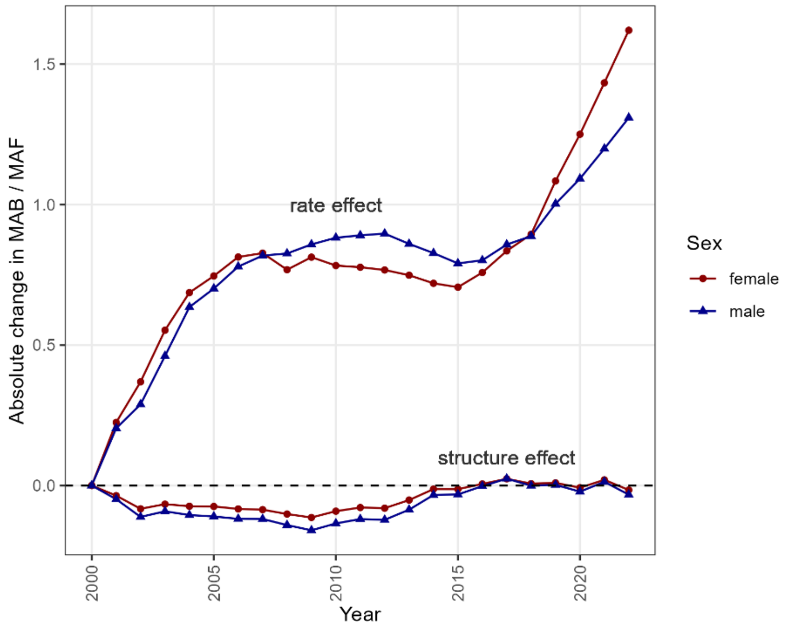

Figure 12: Decomposition of the increase in mean age at birth, based on data from Statistics Sweden

Men exhibit a similar trend, although this can be primarily attributed to the assumption that males had the same number of births by parity as women. However, if this assumption would not be made, the structure effect would probably play a slightly more important role in the increase of mean age at birth for men than for women. This could be attributed to the phenomenon that in Europe over time, men tend to have more multiple reproductive partnerships, resulting in a higher proportion of higher-order births among them. Nevertheless, both mean ages at birth for men and women in Sweden since the 2000s increased mainly due to rate effects, indicating a "real" increase. Although this analysis is limited to Sweden, it can be assumed that rate effects have also contributed to an increase in the mean age at birth in other countries. However, over time, the postponement transition has also led to a decline in higher-order births. Therefore, considering a longer period and examining other countries, structural effects may have also played a more important role.

8.3 Stronger fertility delay among women narrows the gap

Over time and across countries, the gender gap in mean age at birth has shown diverse trends. In some European countries, particularly from the 2000s onward, the gap narrowed, while in Central and Eastern European countries, it even widened. These trends can be observed by referring to Table 2, which displays the gap between mean age at birth for men and women in all countries between 1980 and 2013, based on HFC and HFD data. In addition, these trends are shown in Figure 13, where the gender gap in mean age at birth by three distinct groups of countries is depictured. First, some countries (Finland, Sweden, Spain and France) experienced a relatively constant gender gap from 1990 to 2014, while most other countries (Denmark, Italy, Portugal, Germany, and Great Britain) experienced a decline in the gender gap from the 2000s onward. The exception to this trend of a stronger delay in birth among women compared to men is observed in Central and Eastern European countries. This is also visible in Figure 13, where Hungary, Poland, and Estonia experienced a decline in the gender gap in mean age at birth until 1990, but after the fall of the iron carton, the gap started increasing again. This is attributed to men in these countries delaying birth to a greater extent than women. When examining cohorts, it is noticeable that all four countries with sufficient data (Sweden, Spain, Portugal and Hungary) experienced a decline in the gender gap in mean age at birth. This is primarily due to the inclusion of cohorts only up until the mid-1970s. Countries in the former Eastern Bloc like Hungary experienced a subsequent increase in the gap probably only in later cohorts.

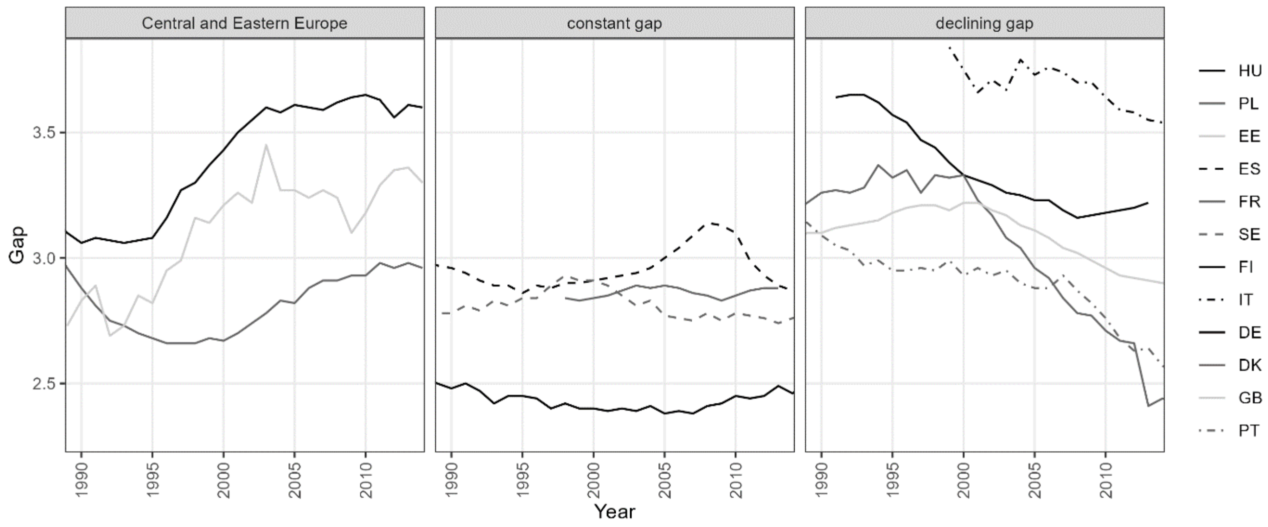

Figure 13: Gender gap in mean age at birth by countries over time, based on HFD and HFC data. The legend displays countries in the order from the top left of the first graph to the bottom right of the last graph.

To explain changes in the gender gap in mean age at birth over time, differences in the extent of fertility delay between men and women have to be considered. Figure 14 presents the extent of the delayed birth patterns among men and women in different European countries, by looking at the percentage change in the mean age at birth for men and women, relative to the base year of 1990. In the figure, distinct lines represent the percentage increase in mean age at birth for men (blue triangled line) and women (red pointed line). Notably, data for 1990 was unavailable for France, Italy, and Germany. Consequently, the first year of available data was used as a base year. The use of different base years for these countries limits direct comparisons between them and other countries included in the analysis. This is especially the case when the base year differs largely from those of other countries. The figure shows on the one hand that there was a particularly strong increase in the mean age at birth in Eastern European countries (first row in Figure 14). In Hungary and Estonia, for example, the mean age at birth increased by 15% between 1990 and 2015 for both men and women. On the other hand, Western and Southern European countries have experienced a smaller percentage increase in the mean age at birth since 1990. In these countries, the delay in fertility started earlier and experienced a constant increase also after 1990.

Although men and women in all countries experienced a percentage increase in the mean age at birth, in most Western, Northern and Southern European countries women are delaying childbearing faster. In these countries, the percentage change in the mean age of birth for women is higher than that for men. This can be seen in Figure 14 from the fact that the percentage change in mean age at birth for women (red pointed line) is slightly higher than for men (blue triangled line), especially in Northern-, Western- and Southern European countries. For instance, in Denmark from 1990 to 2014 women increased their mean age at birth by 8.6%, while men only increase their mean age at birth by 5.3%. Another example is Germany, where women's mean age at birth increased by

10.6% and men's by only 8% between 1991 and 2013. In these countries, women delay birth considerably more than men and thus catch up in mean age at birth, narrowing the gender gap in mean age at birth (see Figure 13 and 14). From this pattern, Central and Eastern European countries are the exception. In Hungary and Estonia, for example, men even delay birth a bit faster than women, increasing the gender gap in mean age at birth from the 1990s onwards.

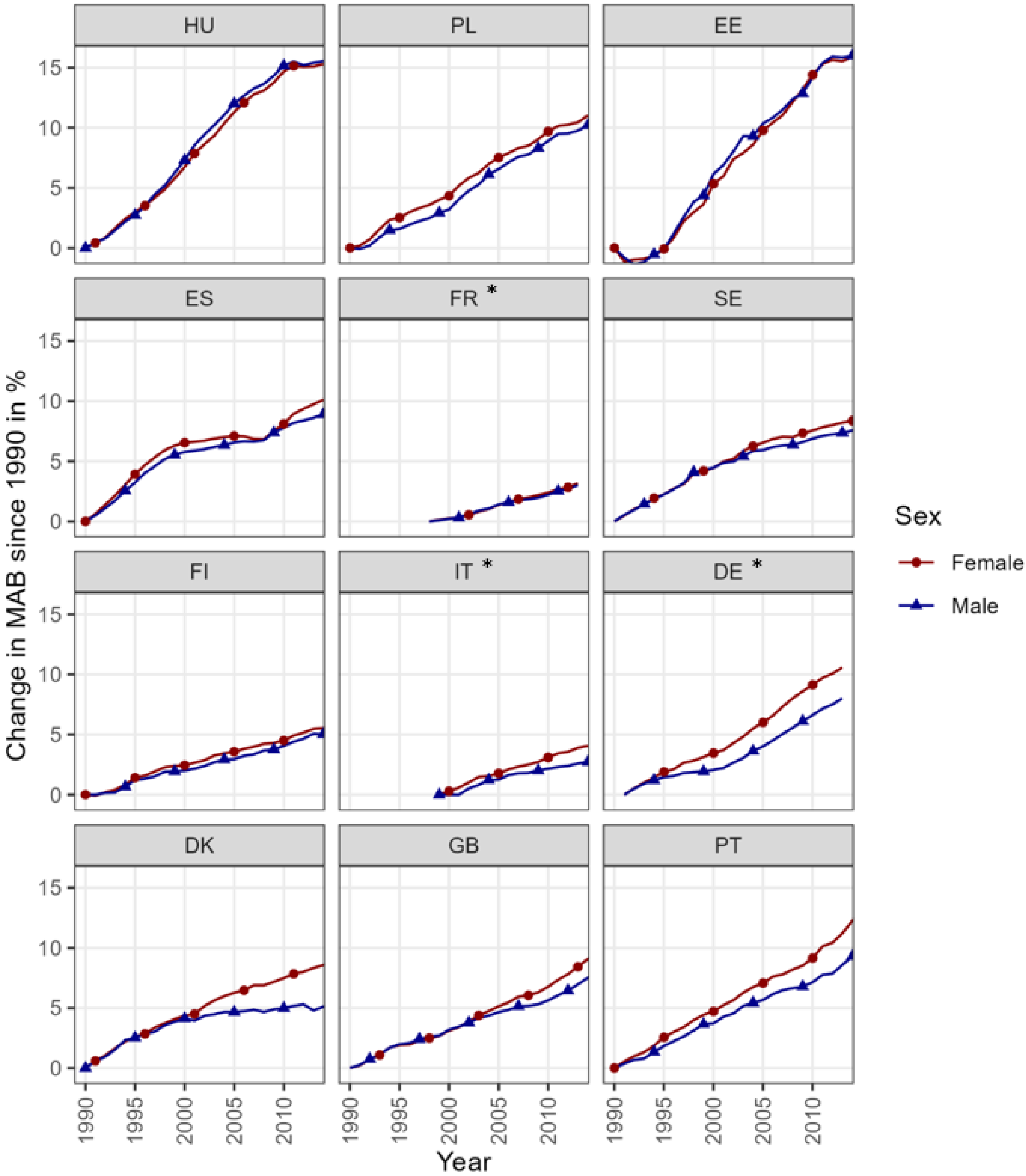

*Figure 14: Percentage change in mean age at birth and fatherhood from the base year 1990 until 2015 in several European countries, based on HFC and HFD data. *For France, the base year was set as 1998, for Italy as 1999 and for Germany as 1991.*

8.4 Rate effects narrow down the gap in Sweden

The gap over time in mean age at birth can be decomposed: Either structural changes in the number of births by parity can cause a reduction of the gap over time, e.g., if third or higher births, where the gap is much larger, become less frequent, or the narrowing of the gap can be due to the smaller gender gap in birth order over time, e.g., when independently from the distribution of births along birth orders the gender gap decreases. The decomposition analysis on the gender gap was again only done for Sweden since it was the only country included in this study providing accurate data on mean age at birth by second and higher-order births for men and women. Herby the differences in the gap from 2000 to 2022 and from 2010 to 2022 are examined in more detail. The process of how the Kitagawa decomposition was applied to the changes in the gender gap in mean age at birth over time is shown in Table 3.

Table 3: Decomposition of changes in the gender gap of mean age at birth over time

Decomposition of the reduction in the gap at mean age in birth from 2000 to 2022

		Gap		
Year	*Gap1*	*Gap2*	*Gap3*	*total*
2000	2,51	2,64	4,01	2,92
2022	1,99	2,36	4,08	2,60
		Births		
	B1	*B2*	*B3*	*total*
2000	39 796	32 014	19 503	91 313
2022	45 038	38 546	21 150	104 734
		Births pro		
	proB1	*proB2*	*proB3*	*total*
2000	0,44	0,35	0,21	1,00
2022	0,43	0,37	0,20	1,00
		*proB * Gap*		
2000	1,09	0,93	0,86	2,88
2022	0,86	0,87	0,82	2,55
Overall change:				0,3277
		Rate effect		
prop avar.	0,43	0,36	0,21	
prop. Avr * Gap2000	1,09	0,95	0,83	
prop. Avr * Gap2022	0,86	0,85	0,85	Sum rate:
	0,23	0,10	-0,01	0,3112
		Structure effect		
Gap avar.	2,25	2,50	4,05	
Gap. Avr * prop 2000	0,98	0,88	0,86	
Gap. Avr * prop 2022	0,97	0,92	0,82	Sum structure:
	0,01	-0,04	0,05	0,0165

rate effect + structure effect

0,3277

Decomposition of the reduction in the gap at mean age in birth from 2010 to 2022

		Gap		
Year	*Gap1*	*Gap2*	*Gap3*	*total*
2010	2,52	2,63	4,50	2,92
2022	1,99	2,36	4,08	2,60
		Births		
	B1	*B2*	*B3*	*total*
2010	51 558	42 515	21 689	115 762
2022	45 038	38 546	21 150	104 734
		Births proportion		
	proB1	*proB2*	*proB3*	*total*
2010	0,45	0,37	0,19	1,00
2022	0,43	0,37	0,20	1,00
		*proB * Gap*		
2010	1,12	0,97	0,84	2,93
2022	0,86	0,87	0,82	2,55
Overall change:				0,3831
		Rate effect		
prop avar.	0,44	0,37	0,19	
prop. Avr * Gap2010	1,10	0,97	0,88	
prop. Avr * Gap2022	0,87	0,87	0,79	Sum rate:
	0,23	0,10	0,08	0,4130
		Structure effect		
Gap avar.	2,26	2,50	4,29	
Gap. Avr * prop 2010	1,00	0,92	0,80	
Gap. Avr * prop 2022	0,97	0,92	0,87	Sum structure:
	0,03	0,00	-0,06	-0,0299

rate effect + structure effect

0,3831

However, the calculation procedure is not described here, as it was already included in the methods section. The table also shows the decomposition of the gap into rate effects (changes in the gap in mean age at birth over time) and structure effects (changes in the composition of the number of births by birth order over time), whereby the gender gap in mean age at birth by parity was weighted using data on births by women by parity only ($proB * Gap$), since births by men were not available and it was assumed that half of the births belonged to fathers and the other half to mothers.

The analysis reveals that between 2000 and 2022, the gender gap in mean age at birth decreased from 2.88 years to 2.55 years, indicating a reduction of 0.33 years. Moreover, from 2010 to 2022, the gender gap decreased even stronger, from 2.93 years to 2.55 years, demonstrating a decline of 0.38 years. This reduction in the gender gap in mean age at birth can be decomposed into rate and structure effects. As shown in Table 3, the majority of the decrease in the gender gap in the mean age at birth from 2000 to 2022, specifically 0.31 years or around 95% out of the total 0.33 years, can be attributed to rate effects. Notably, the decrease in the gender gap in mean age at first birth from 2.51 years in 2000 to 1.99 years in 2022 contributed to a reduction of 0.23 years or around 70% in the overall decline in the gender gap in mean age at birth. On the other side, the structure effect only contributes to 0.02 years or around a 5% reduction in the gender gap between 2000 and 2022. This is the result of a slightly lower relative share of third and higher-order births. In addition, as shown in the second column of Table 3, also the decomposition of the gender gap between 2010 and 2022 primarily reflects the impact of the decreasing gaps in mean age at birth by parity (rate effect). While the structural effects had a negative contribution of -0.03 years, the rate effect contributed 0.41 years, resulting in an overall reduction in the gender gap in mean age at birth by 0.38 years. The negative contribution of the structure effect can be explained by an increased relative share of third and higher-order births. Both decompositions from the 2000s to 2022 show that in Sweden the reduction in the gender gap in mean age at birth was primarily attributed to a decrease in the gender gap in mean age at first and second birth and not to a decline in the relative share of higher-order births.

8.5 Men and especially women delay their first births

The postponement transition is marked by a delay in the timing of birth, especially the first one (e.g., Billari, 2006). Therefore, it is important to examine the trends over time not only for all birth orders combined but at least separately for the first births. However, register-based data on the mean age at first birth for men are only available for Northern European countries. Figure 2 (see methods sub-section 5.2.3) as well as Table 4, illustrates the development over time of mean age at birth by parity for men and women in Denmark, Norway, and Sweden. Notably, Sweden provides data for second (MAB2) and third or higher-order births (MAB3+), while the other countries do not. In all three countries mean age at which men and women have their first child increased: In Denmark, for instance, the mean age at first birth for women increased from 25.6 years in 1986 to 29.9 years in 2022. Almost in tandem, the age at first birth for men increased from 28.4 years in 1986 to 31,6 years in 2022. Also, Sweden experienced a slight increase in mean age at first birth for men and women. Additionally in Norway, the age at first birth for women in comparison to the mean age at first birth for men experienced a huge increase. Women's mean age at birth increased by 3 years from age 27.2 in 1999 to age 30,2 in 2022, while the mean age at birth for men increased in the same period by 2.3 years from age 29.9 to 32.2. Analyses conducted with Finnish data came to the same conclusion, namely that the mean age at first birth for men increased from around 28.5 years in 1985 to 31.2 years in 2016 (Keski-Petäjä, 2022).

Sweden also allows for analysing second and third-higher-order births for men and women. As shown in Table 4, in Sweden mean age at first birth for women increased from 28.2 years in 2000 to 30.27 years in 2022, while it increased from 30.7 to 32.3 years for men. By looking at the third and higher births, the mean age at birth for men increased from 37.3 in 2000 to 38.4 in 2022. In this country, it is visible that the mean age at birth for men is delayed more for first-time fatherhood, than for higher-order paternities. To be precise in Sweden, men delayed their first birth by 1.5, while they only delayed their second by 1.2 years and higher-order births by 1.1 years from 2000 to 2022. In addition, also women seem to delay their first birth much more than their second and higher order births: While women increased their first birth by 2.05 years, their second births increased only by 1.5 years and their third+ by 1 year. To summarize, Northern European countries have significantly increased the mean age of first births for men and women, here observed from the 1980s until 2022 (but probably this process started already in the 1970s). Furthermore, in all three Northern European countries mean age at first birth for men and women was delayed almost in tandem.

Table 4: Mean age at birth by sex and parity

Country	*Year*	*MAB*	*MAB1*	*MAB2*	*MAB3+*	*MAF*	*MAF1*	*MAF2*	*MAF3+*
Denmark	2000	30	28,1			32,7	30,6		
	2010	30,9	29			33,5	31,3		
	2022	31,4	29,9			33,5	31,6		
Norway	2000	29,6	27,3			32,6	30,1		
	2010	30,3	28,1			33,4	30,8		
	2022	31,7	30,2			34,1	32,2		
Sweden	2000	30,1	28,2	30,6	33,3	33,1	30,7	33,3	37,3
	2010	30,8	28,9	31,5	34	33,9	31,4	34,2	38,5
	2022	31,8	30,3	32,1	34,3	34,4	32,3	34,4	38,4

The analysis of mean age at birth by parity for men and women beyond Northern European countries makes it necessary to include survey data from the Generations and Gender Programme (GGP) I and II as an additional data source. This is because other European countries do not publish the mean age at birth by parity for men. While the data source for Northern European countries presents mean age at birth over specific periods, the survey data show variations across five years cohorts, including different cohorts between 1925-1929 and 1975-1979, depending on the country. The cohort mean age at birth by parity, based on survey data, is shown in Figure 15 for countries that have already experienced a delay in fertility and for which data are available on at least some five-year cohorts. In this figure, the thick lines indicate smoothed trends, which facilitates analysis, while the much thinner lines in the background represent the actual observed values. The analysis of GGP data reveals that the cohort mean age at first birth for men, as well as for women, increased across countries. In Belgium for instance mean age at first birth for men increased from 27.3 years in cohort 1945-1949 to almost 29 years in 1955-1959. Again, men's and women's fertility behave almost in tandem, and the mean age at birth for women increases from 25.4 to 26.5 years across the same cohorts. In Belgium and particularly in France, it appears that both men and women have shown a greater increase in age for second births. This seems to contradict findings from Northern European countries, according to which first births, in particular, are delayed. However, it is important to consider the possibility that this observation could be influenced by potential issue resulting from the quality of survey data.

In addition, three Central and Eastern European countries are also shown in the figure. The Czech Republic has experienced the strongest increase in the mean age for first birth for men and women. There, women in the 1955-1959 cohorts had an average age of 23.2 years, which rose to 28.9 years in the 1975-1979 cohorts. This increase is slightly less pronounced for men. Estonia also experiences an increase in the average age at first birth. A slightly different picture can only be observed for Belarus, where it is mainly the third and higher births among men that are observed. In Figure 15 and Table 4, most countries included indicate a consistent trend of increasing mean age at first birth, especially for women. Based on this the next chapter will investigate the narrowing gender gap in first births in Northern Europe.

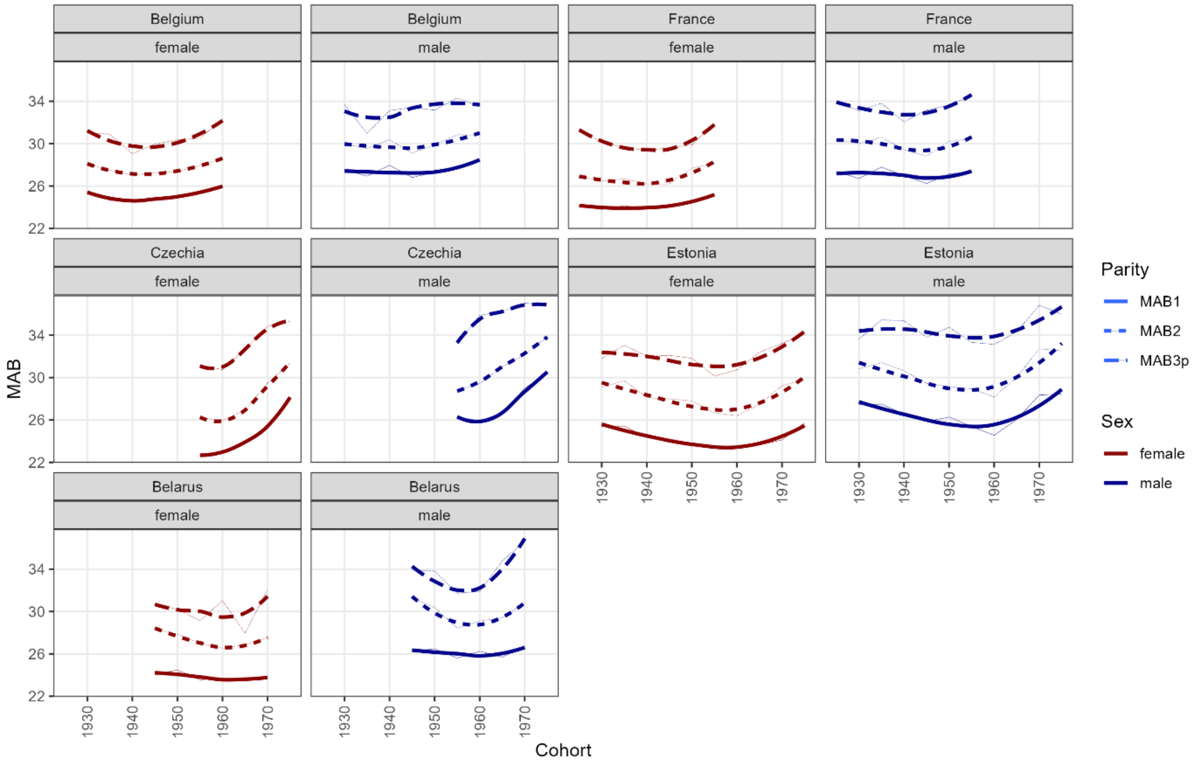

Figure 15: Mean age at birth by parity, based on GGP I and II data

8.6 Stronger delay in first births among women narrows the gap in Northern Europe

The variations in the gender gap in mean age at birth can be examined across different birth orders.[2] Table 5 illustrate the gender gap in mean age at birth by parity for some Northern European countries, namely Denmark, Norway and Sweden, based on register-based data. The gap for the first birth is particularly small. In Denmark, men are only 1.7 years older at first birth in 2022 and in Norway and Sweden only 2 years. In comparison, the gender gap is larger for second or higher-order births. In Sweden, for example, men are 2.4 years older than women at second birth in 2022. For third and higher births, the gap widens to 4.1 years. The wider gap observed in higher-order births is consistent with partnership patterns. This suggests that women with third and higher-order births

[2] The gender gap in mean age at birth remains relatively consistent when comparing data from national statistical agencies (presented here) and data from the Human Fertility Collection (referenced above). However, slight disparities arise in the magnitude and timing of the decline in the gender gap specifically observed in Denmark. These variations are likely attributed to distinct calculation methods employed by the two different data sources.

are more likely to have them with the same partner, while men, as they age, tend to have these births with younger women within multiple reproductive partnerships.

Table 5: Gender gap in mean age at birth by parity

Country	Year	MABm-MABf (Gap)	MABm1-MABf1 (Gap1)	MABm2-MABf2 (Gap2)	MABm3-MABf3 (Gap3)	Difference (Gap – Gap1)
Denmark	2000	2,7	2,5			0,2
	2010	2,6	2,3			0,3
	2022	2,1	1,7			0,4
Norway	2000	3	2,8			0,2
	2010	3,1	2,7			0,4
	2022	2,4	2			0,4
Sweden	2000	2,9	2,5	2,6	4,0	0,4
	2010	3,0	2,5	2,6	4,5	0,5
	2022	2,6	2,0	2,4	4,1	0,6

Examining the gender gap by partiy, beyond Northern Europe, provides more ambiguous insights. Figure 16 displays the gender gap in mean age at birth for cohorts 1960-1974 combined along different birth orders, based on GGP II data. It is evident that in most countries, the gender gap is smaller for first birth and appears to increase by higher birth orders. For example, in Sweden (cohort 1960-1974), men are approximately 3 years older at third and higher-order birth compared to a slightly above 2-year difference for first and second births. Belarus shows an even more remarkable trend, with men being nearly 5 years older for third and higher-order births, compared to just under 3 years older for first and second births. Czechia and Estonia exhibit a similar pattern with a slight increase in the gender gap by birth order. Thus, it is likely that the gender gap widens with higher birth orders. Therefore, increasing the number of higher-order births may lead to a widening gender gap over time. However, Norway and Moldova deviate from this pattern as they exhibit no substantial greater gender gap for higher-order births.

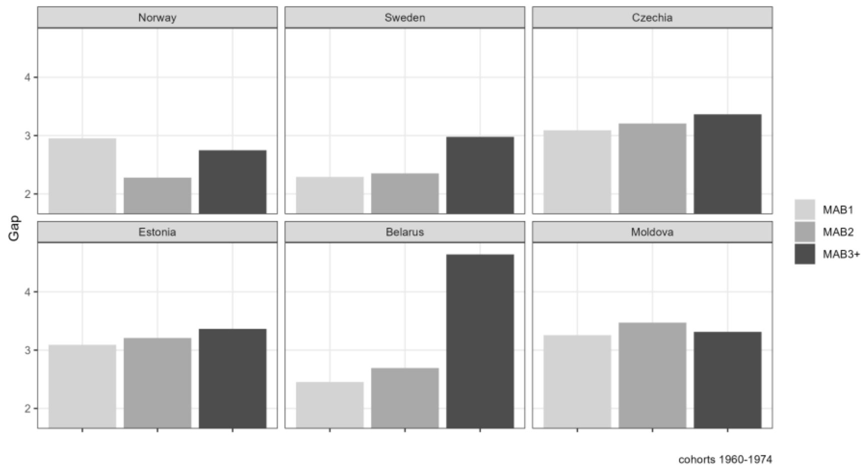

Figure 16: Cohort gender gap in mean age at birth by parity for 1960-1974 cohorts combined, based on GGP II data

Over time all three Northern European countries witnessed a significant reduction in the overall gender gap between mean age at birth for men and women (MABm – MABf). From 2000 to 2022, all three countries experienced a reduction in the gender gap in mean age at first birth: Denmark experienced a decline of 0.8 years, Norway by 0.8 and Sweden by 0.5 years from 2000 to 2022. By 2022, all three countries exhibited relatively low gender gaps compared to other European countries, with Denmark having the smallest at 2.1 years, followed by 2.4 years in Norway and 2.6 years in Sweden. Moreover, previous analyses have already shown that in Finland the gender gap in the mean age at first birth has narrowed as well and was about two years in 2016 (Keski-Petäjä, 2022). Importantly, in these countries the gender gap in mean age at birth decreased at a faster rate for first births compared to subsequent ones. In Sweden among the different birth orders, the gender gap in mean age at birth showed no decline for third and higher births. In 2000, men at the birth of their third+ children were, on average, 4 years older than women, and this slightly increased to 4.1 years by 2022. Thus, although the gender gap in mean age at first birth narrowed, the gender gap in third and higher-order births remained almost constant.

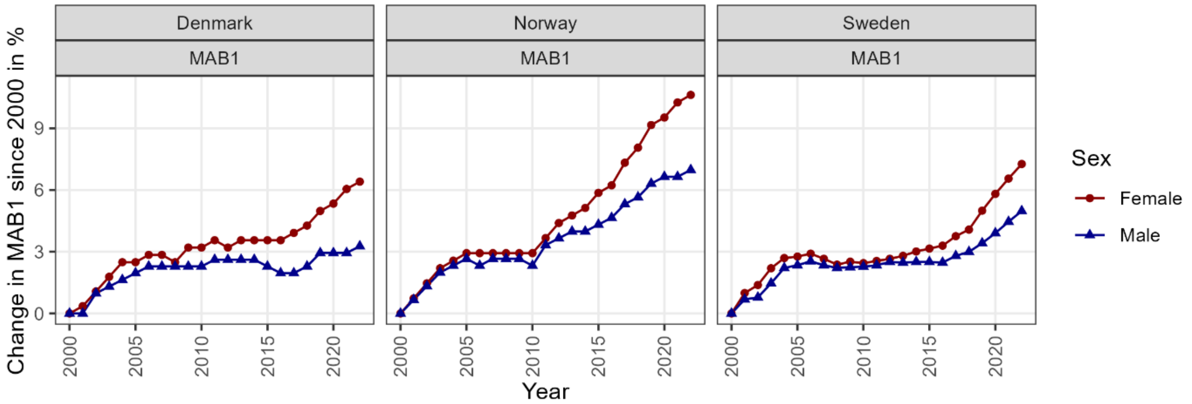

Figure 17: Percentage change in mean age at first birth for men and women from the base year 2000 until 2022 in several European countries, based on data from the official statistical agencies

The narrowing of the gender gap in mean age at birth in Northern European countries, therefore can be attributed to a stronger delay in women's first births, compared to men. Figure 17 shows the percentage change in mean age at first birth for men and women from 2000 to 2022. Here it is clear that women have delayed their first births more than men and are thus catching up in their mean age at birth. In Denmark, for example, women have increased their average age at first birth by 6% from 2000 to 2022, while men have only increased it by 3% over the same period. The declining gender gap since the 2000s in Northern European countries is therefore mainly due to a greater delay in first births among women, compared to men. Nevertheless, structural effects, that is, a reduction in higher-order births, could also have a marginal influence.

9 Assessing the role of multiple reproductive partnerships and educational attainment

This chapter examines the role of two possible drivers of the gender gap in mean age at parenthood: Multiple reproductive partnerships and educational attainment. The former may have contributed to a possible widening and the latter to a possible narrowing of the gap.

9.1 Increased number of multiple reproductive partnerships widens the gender gap

Findings on partnership patterns (see chapter 6) offer insights into the increase in the contribution of multiple reproductive partnerships to the gender gap in mean age at birth. Contrary to other drivers discussed, multiple reproductive partnerships could potentially widen the gap. Two possible explanations can be considered. Firstly, multiple reproductive partnerships may have become more prevalent, thereby contributing more years to the gender gap in mean age at birth. This is due to the larger age gap observed when entering higher-order cohabitation unions, combined with the fact that men in these age groups are more likely to re-partner and have children with a younger woman. A second and less likely explanation would be that not the amount but the age difference in multiple reproductive partnerships increased over time.

To assess the role of multiple reproductive partnerships, one can assume that in a population that experiences no multiple reproductive partnerships, the gender gap in mean age at birth observed within the first birth order would remain constant for all birth orders. Therefore, if the gap is higher overall than for first births, then this is an indication that multiple reproductive partnerships potentially contribute to the gender gap. By examining the difference between the gender gap in mean age at birth for first birth (MAF1-MAB1) and the overall gender gap in mean age at birth (MAF-MAB), this effect can be partially shown in Northern European countries. As shown in Table 5 (see above sub-chapter 8.6), in Denmark, Sweden and Norway the overall gender gap is higher than the gender gap for first births. For example, in Denmark and Norway, the differences between the overall gender gap and the gender gap for first birth were around 0.2 in 2000 and increased to 0.4 in 2022. Also, for Sweden, the difference increased from 0.4 in 2000 to 0.6 in 2022.

Furthermore, the extent to which multiple reproductive partnerships are linked to the gender gap in mean age at birth is assessed by partially decomposing it. Due to the availability of accurate data on second and higher-order births only for Sweden, the analysis is restricted to that specific country. Information on live births for women by parity were again obtained from the Human Fertility Database (HFD 2023b), and due to the unavailability of data for men it was assumed that they experienced the same number of births. To decompose the possible influence of multiple reproductive partnerships Table 6 shows the calculations applied step by step (described in more detail in sub-chapter 5.3.2). The calculations are done for a) observed data in Sweden as well as b) a scenario assuming no multiple reproductive partnerships. In this scenario, the gender gap in mean age at birth does not change by parity since all people only had children in one reproductive partnership. Therefore, by assuming an absence of multiple reproduction partnerships, men and women would have the same age at birth over birth orders. Important here is the last step of the calculations, comparing the impact by parity between the two scenarios. Here the parity-specific impact of the gap assuming no multiple reproductive partnerships was subtracted from the one observed in reality. The difference indicates how many years of multiple-reproductive partnerships would contribute to the overall gender gap in the mean age at birth. However, this result has some limitations, since it only holds if no structural changes in the birth distribution over time occurred, if the age difference is independent of the age when having birth and if the number of children is independent of age differences with the partner.

As shown in the last columns of Table 6 multiple reproductive partnerships probably drive the gender gap in mean age at birth upwards. Hereby, multiple reproductive partnerships occurring at second births, increase the gender gap in the mean age at birth by 0.05 years from 2000 to 2010 and by 0.14 years from 2000 to 2022. Third and higher-order reproductive partnerships increase the gender gap in mean age at birth to an even greater extent by 0.32 years from 2000 to 2010 and 0.56 years from 2000 to 2022. Overall multiple reproductive partnerships in

Sweden potentially explain 0.37 to 0.56 years of differences in the mean age at birth. Furthermore, the impact of multiple reproductive partnerships on the gap in mean age at birth appears to increase over time. This is because the gap in mean age at birth did not decrease over time for third and higher-order births. These findings match quite well with the calculation conducted above in Table 5, where the gap in first birth was subtracted by the overall gap.

In summary, as shown here multiple reproductive partnerships potentially play a role in determining the gender gap in mean age at partnerships, accounting for approximately 0.3 to 0.4 years in the overall gap in Northern European countries. However, they only explain 10-20% of the total gap in mean age at birth. Interestingly in this regard is that the impact of multiple reproductive partnerships potentially increased over time. Nevertheless, it can be concluded that already for first births, a noticeable gender gap in mean age at birth exists between men and women. This gender gap in mean age at birth in the first reproductive partnerships explains most of the overall gap in mean age at birth. Therefore, the role of multiple reproductive partnerships, in explaining the overall gender gap as well as the reduction of the gender gap over time is limited.

Table 6: The impact of re-partnering on the gender gap in mean age at birth in Sweden

a) Gender Gap in mean age at birth observed in Sweden in 2000, 2010 and 2022

The gap in mean age at birth by birth order

	GAP1	*GAP2*	*GAP3*	*total*
2000	2,51	2,64	4,01	2,92
2010	2,52	2,63	4,5	3,02
2022	1,99	2,36	4,08	2,6

Births by birth order and in total

	B1	*B2*	*B3*	*sum*
2000	39 796	32 014	19 503	91 313
2010	51 558	42 515	21 689	115 762
2022	45 038	38 546	21 150	104 734

The relative contribution of births (Bp/Bsum)

	relB1	*relB2*	*relB3*	*sum*
2000	0,44	0,35	0,21	1,00
2010	0,45	0,37	0,19	1,00
2022	0,43	0,37	0,20	1,00

*Impact on the gap (GAPp*relBp)*

	I1	*I2*	*I3*	*sum*
2000	1,09	0,93	0,86	2,88
2010	1,12	0,97	0,84	2,93
2022	0,86	0,87	0,82	2,55

b) Scenario without re-partnering, assuming the gender gaps stayed the same as for first births

The gap in mean age at birth by birth order

	SGAP1	*SGAP2*	*SGAP3*	*total*
2000	2,51	2,51	2,51	2,51
2010	2,52	2,52	2,52	2,52
2022	1,99	1,99	1,99	1,99

Births by birth order and in total

	B1	*B2*	*B3*	*total*
2000	39 796	32 014	19 503	91 313
2010	51 558	42 515	21 689	115 762
2022	45 038	38 546	21 150	104 734

The relative contribution of births (Bp/Bsum)

	relB1	*relB2*	*relB3*	*sum*
2000	0,44	0,35	0,21	1,00
2010	0,45	0,37	0,19	1,00
2022	0,43	0,37	0,20	1,00

*Impact on the gap (SGAPp*relBp)*

	SI1	*SI2*	*SI3*	*sum*
1,09	0,88	0,54	2,51	2,51
1,12	0,93	0,47	2,52	2,52
0,86	0,73	0,40	1,99	1,99

The difference in the impact of birth order on the gender gap assuming no multiple-reproductive partnerships (lp-Slp)

	lp1-Slp1	*Lp2-Slp2*	*Lp3-Slp3*	*Sum*
2000	0,00	0,05	0,32	0.37
2010	0,00	0,04	0,37	0.41
2022	0,00	0,14	0,42	0.56

9.2 Increased educational attainment narrows the gender gap

In multidimensional demography, it is crucial to extend the analysis beyond the two classical demographic characteristics, namely age and gender, but to consider at least also educational attainment (Lutz, 2021). Herby educational attainment plays a pivotal role in shaping individuals' decisions regarding birth, making it an essential factor to analyse at which age men and women have their children and how the gender gap in mean age at birth differs across countries. As explained in the theoretical background, a higher level of education could lead to people having children later. Moreover, it could lead directly (years of schooling) or indirectly (opportunity costs) to a narrowing of the gap in the mean age at birth, as education increases more for women than for men.

The mean age at birth for men and women greatly differs by educational attainment. Figure 18 shows the mean age at birth for men and women for the 1960-1974 cohorts combined, based on GGP II data. In the figure, it is visible that higher-educated men and women have children much later in life than lower-educated peers. For instance, in Norway, lower-educated men have children on average at age 31, while men with higher education have them later at the age of 33.6. For women, this age difference is even more pronounced. To show this, the difference in mean age at birth between lower-educated and higher-educated men and women can be examined. In Norway, for example, men born between 1960 and 1974 with a lower level of education have their children on average 2.5 years earlier than men having at least a university degree. Similarly, in Eastern European countries, the average age at birth is greater among those with higher levels of education. However, apart from Czechia, these differences are less pronounced. In Estonia, for example, men with higher levels of education are 1.6 years older than men with lower levels of education. The same is also true - for women, with those with higher education having an even greater tendency to have children later, compared to their lower-educated peers. In Norway for instance, for the 1960-1974 cohorts, the difference between women with higher and lower educational attainment in mean age at birth was 4.6 years, considerably larger than the 2.5 years difference for men.

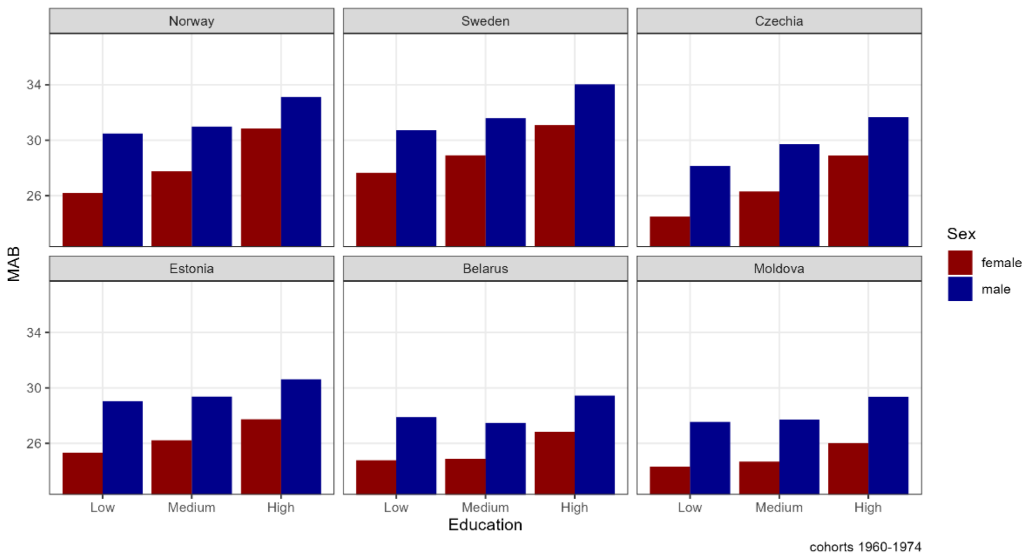

Figure 18: Mean age at birth across educational attainment for cohorts 1960-1974 combined, based on GGP II data

Furthermore, differences in the mean age at birth by educational attainment, reveal that those people with higher educational attainment on average have the lowest gender gap in mean age at birth. The gender gap in mean age at birth by educational level was only examined cross-sectionally and not over time since otherwise, the sample size would have been too small. Figure 19 shows the gender gap in mean age at birth by education level for the 1960-1974 cohorts combined, based on GGP-II data. As shown in the figure in most countries men and women with higher levels of education have a smaller gender gap than those with lower levels of education. This trend is particularly evident in Norway, where, on the one hand, men with lower educational attainment tend to be 4.2 years older at the birth of their child than women with the same education. On the other hand, men with higher educational attainment are on average only 2.2 years older at the birth of their children than women in the same education group. Czechia, Estonia and Belarus follow the same pattern, whereby the gap is lower among people with higher educational attainment than those with lower educational attainment. Sweden and Moldova are the exceptions to this general trend, as in these countries the gender gap in mean age at birth is almost constant among people with lower and higher educational attainment. Nevertheless, the general pattern analysed here suggests that individuals with higher levels of education tend to have the smallest gender gap in mean age at birth.

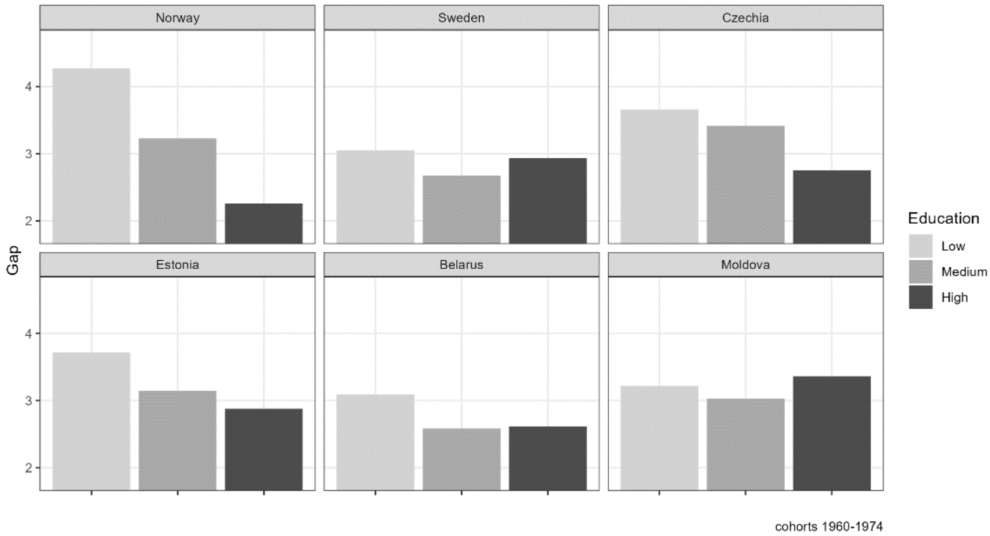

Figure 19: Cohort gender gap in mean age at birth by educational attainment for 1960-1974 cohorts combined, based on GGP II data

Furthermore, Figure 20 gives a slightly different insight into the difference in cohort mean age at birth by educational attainment, by including a time dimension. Additionally, this figure shows patterns in fertility delay by educational attainment. It is visible that in most countries people from each education group experienced an increase in mean age at birth. However, women and men with higher education tend to delay childbearing much more, compared to those with lower and medium education. For instance, in Belgium, women with higher education increased their mean age at birth by 1.2 years from age 28.9 in cohorts 1940-1944 to age 30.1 in cohorts 1960-1964, accompanied by a slower increase in mean age at fatherhood by 0.6 years from age 31.9 to 32.5 across the same cohorts. Similar patterns of fertility delay among higher-educated women and men can be observed in Czechia and Estonia but with a delayed onset of the postponement transition in both Eastern European countries. On the other hand, men and women with lower and medium education levels tend to exhibit less fertility delay, except for men in Sweden, Belarus, and France. For instance, in Belarus, lower-educated men postpone birth more than their higher-educated counterparts. However, it is important to note that the results across five years cohorts for the lower-educated group, may be less accurate due to the small sample sizes in all countries. This limitation is less of a concern for the medium and high educated groups. In this regard, the patterns for higher and medium educational attainment in Belarus are aligning with the overall trend. However, in contrast, the observation that men with medium education in France and Sweden delay childbearing more than those with higher educational attainment is surprising and deviates from the general trend. However, it is still evident that higher-educated men in France as well as in Sweden also experience a delay in fatherhood. Therefore, to sum up, it can be observed that both higher-educated men and women have experienced a notable increase in the mean age of birth, with the increase being more pronounced for higher-educated people.

In summary, both women and men with higher education tend to delay fertility the most. Furthermore, women with higher levels of education have a larger age gap with their peers with lower levels of education than men, suggesting that women with higher levels of education are likely experiencing a greater delay in fertility. Catching up in the higher mean age at childbirth due to an increase in women's educational attainment could also explain why people with higher educational attainment show a smaller gender gap in the mean age at birth. However, this could partly be due to a structural effect, as women with higher levels of education are less likely to have higher-order births. Nevertheless, it is likely that women with higher levels of education delayed fertility the most, potentially leading to a stronger narrowing of the gender gap in mean age at birth over time for this education group.

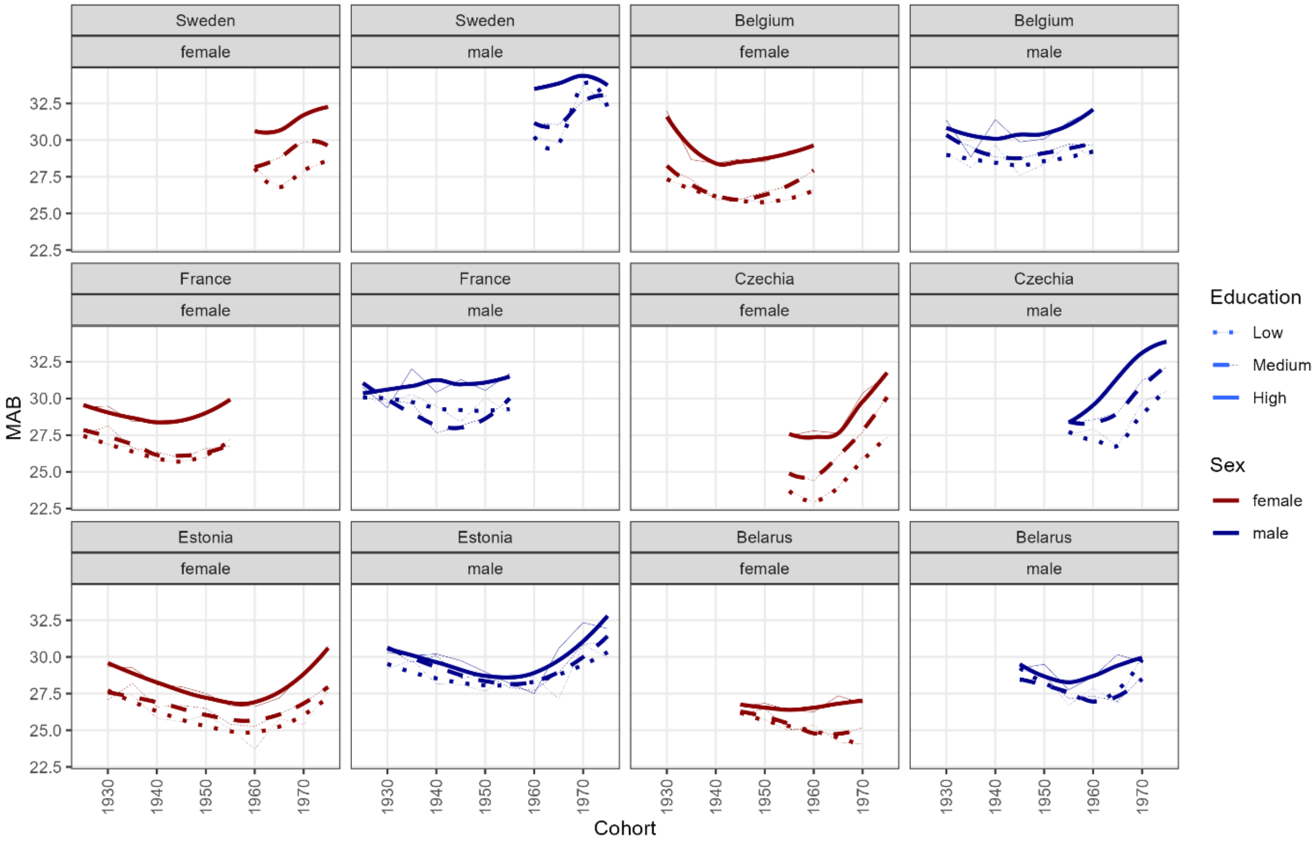

Figure 20: Cohort mean age at birth by educational attainment, based on GGP I and II data

10 Discussion

In the discussion, the results and the theory will be clarified by discussing the relationship between drivers of fertility delay and the gender gap in mean age at birth in the first sub-chapter. The second sub-chapter addresses the question of whether the narrowing gender gap in mean age at birth is possibly an indicator of greater gender equality.

10.1 Relationship between fertility delay and the gender gap in mean age at birth

Gender differences in the increase or decrease in mean age at birth between women and men, determine if the gender gap in mean age at birth narrows or widens. Two possible effects may influence the delay in fertility: First, structural changes in the number of births by parity, whereby an increase in higher-order births, which tend to occur at a later age, would increase the mean age at birth. Second, a "real" change in the rate of mean age at birth, particularly due to a delay in first births. The analysis of the impact of these rate and structure effects on the mean age at birth for men and women and the gender gap in mean age at birth is limited to Sweden, since for other countries register data for births by party were not available for men. For this country, it has been shown since the 2000s the mean age at birth for women is rising due to an increased rate effect. In particular, women, in comparison to men, experienced a stronger increase in the mean age at first births, which narrows the overall gender gap in the mean age at birth. Although the analysis of rates and structural effects is limited to Sweden, it can be assumed that other countries had also experienced an increase in the mean age at birth and a reduction in the gender gap mainly due to rate effects. Furthermore, it is likely that the stronger delay of first births among women, compared to men, caused a declining gender gap in mean age at birth in several countries.

Going one step back, in the first-place drivers of fertility delay differently impact men and women, potentially narrowing or widening the gender gap in mean age at birth. Changing cultural norms and values, higher levels of education especially among women, higher female labour force participation and economic stability are leading to a convergence between men and women in the events that shape their life course and therefore to greater gender equality. These factors influence the delay in fertility in women, especially in first births, more than in men, leading to a narrowing of the gender gap in the mean age at birth. In this work, the possible influence of educational attainment was presented in particular. It has been shown that higher-educated people have a smaller gender gap in the mean age at birth. Furthermore, individuals with at least a university degree tend to have children later in life compared to those with lower educational attainment, with women with higher education displaying the strongest delay in fertility. This could be an indication that the increase in educational attainment is reducing the gender gap. However, educational attainment and other factors might partially also affect the structure of births by parity, by increasing the number of higher-order births, where the age difference between men and women is much larger, thus reducing the gender gap. In this regard, an increased number of multiple reproductive partnerships since the beginning of the postponement transition (Lesthaeghe, 2010; Van Bavel et al., 2012), especially among older higher educated men, probably widens the gender gap in mean age at birth by increasing the number higher births. In this regard, it has been shown for Northern European countries from 2000 onwards, that the increasing influence of multiple reproductive partnerships on the gender gap in mean age at birth is potentially widening the gap over time, while at the same time, due to other factors, like increased educational attainment, the overall gender gap is decreasing.

One particularly important factor that could explain the decline in the gender gap was almost not mentioned in the results because it is very difficult to disentangle. Namely, the delay in fertility of men and women is not only determined by different driving factors but also influences each other. In such a scenario a stronger delay in women's mean age at birth may also lead to a stronger delay or acceleration of fertility for men. The impact of the delay of one of these two sexes on the other, however, is highly dependent on how a specific driver affects men and women differently and how the age difference between partners changes over age. Some factors that increase fertility delay among women, like for example higher female labour market participation, might indirectly also lead to a stronger delay of fertility among men. In this case, the gender gap in mean age at birth both narrows due to the effect of female labour market participation on women and widens due to the indirect effect on men.

The interaction between men's and women's fertility delay could explain the stagnating gender gap in certain countries over time, despite initial theoretical assumptions indicated a sharp decrease in the gender gap in mean age at birth across Northern, Western, and Southern Europe due to factors influencing fertility delay stronger for women. Nevertheless, in most of these countries there was a reduction in the gap. On the other side, in Central and Eastern Europe, the increase in the gender gap in mean age at birth can be largely attributed to economic insecurity after 1990. Men still often feel obliged to fulfil the provider role and therefore tend to delay fertility during such circumstances (Martín-García et al., 2023; Miret-Gamundi, 2000; Schmitt, 2005). Contrary women are less inclined to delay childbirth due to economic instability (Schmitt, 2005; Toulemon, 2000). Consequently, as men delay births, they are more likely to have children with younger women, leading to a wider gender gap in the average age at birth.

10.2 Is the gender gap in mean age at birth an indicator of gender equality?

The narrowing of the gender gap in the mean age at birth, which is due to a catching-up process in women's fertility delay, is often seen as the result of greater gender equality (e,g., Ausubel et al., 2022; Dudel & Klüsener, 2021; Kolk, 2015; Van de Putte et al., 2009). From this, it is sometimes concluded that a lower gender gap in mean age at birth is a good indicator of greater gender equality (Dudel & Klüsener, 2021). The analysis conducted here assumes that the greater gender equality and the narrowing of the gender gap in mean age at birth are the result of factors that delay fertility. Rather than arguing that gender equality is the reason for the narrowing of the gap, drivers of fertility delay could simply narrow the gender gap in mean age at birth, due to partnership patterns by age. In this respect, the gender gap closes, as women tend to partner with men of the same age at older ages. Therefore, a greater delay in partnering for women would lead to a more equal age difference with their cohabiting partner and ultimately to a narrow age difference in the mean age at childbirth.

Based on this the gender gap in mean age at birth may or may not be seen as an indicator of greater gender equality (Bozon, 1991). On the one hand, women are catch up with mean age at birth for men, which can lead to a stronger position of women within the partnership (Dudel & Klüsener, 2021). This is based on stronger fertility delay for women, which offers certain advantages, such as increased educational attainment and career opportunities, particularly for women at a young age (Mills et al., 2011; Sobotka, 2010). On the other hand, a stronger delay in fertility among women can reproduce gender inequalities. This is because, compared to men, women are much more affected by problems resulting from delaying fertility for too long, such as age-related infertility, a higher likelihood of involuntary childlessness and increased health risks for pregnant women (Balasch & Gratacós, 2012; De La Rochebrochard & Thonneau, 2002; Nilsen et al., 2013; Schimmel et al., 2015). Therefore, merely stating that a narrowing gender gap in mean age at birth implies increased gender equality within heterosexual relationships or society is insufficient. It is crucial to explore the factors driving fertility delay and leading to a decline in the gender gap in mean age at birth in the first place. Furthermore, while a lower gender gap in the mean age at birth might be an indicator of greater gender equality, it alone cannot address deeply rooted gendered structural inequalities.

11 Conclusion

In conclusion, this master's thesis aimed to address the research gap on fertility delay among men by comparing the mean age at birth for men and women in various European countries and examining the development of the gender gap in mean age at birth. The study revealed that both men and women have been delaying their fertility almost in tandem. The postponement transition for men and women began in the 1970s in Western and Northern Europe, in the 1980s in Southern Europe, and more recently in the 1990s in Central and Eastern European countries. While both men and women are delaying their fertility, there is one notable difference between these two sexes: men, on average, tend to be three years older at the birth of their children. However, over time, this gender gap in mean age at birth has been narrowing, particularly in Northern, Southern, and Western European countries. For instance, in 2022, men in Northern European countries were only 2-2.5 years older than women, compared to the 3-year difference at the birth of their child observed in the 1980s. Conversely, in Central and Eastern European countries, the gender gap in mean age at birth widens after the fall of the iron carton.

The narrowing gender gap in mean age at birth in many European countries is primarily attributed to a stronger increase in fertility delay among women compared to men, whereby women tend to increase, especially their mean age at first birth more than men. The reason why fertility delay among women has this impact on the gender gap can be understood by examining the age difference in partnerships when starting cohabitation. As men age, they often partner with younger women, leading to a larger age difference. In contrast, women, as they age, tend to partner with men closer to their age, resulting in a smaller age difference. It can be assumed that this holds for fertility as well. Namely, when women delay their births, they are more likely to have children with younger men. On the other hand, when men delay their births, they tend to have children with younger women. This partnership pattern contributes to the narrowing or widening of the gender gap in mean age at birth. Consistently countries which experienced a stronger rise in mean age at birth among women than men experienced a narrowing in the gender gap. For example, in Northern European countries, the gender gap has decreased from 2000 to 2022, primarily due to a strong increase in the mean age at first birth among women. Research conducted in Sweden indicates that this decline in the gender gap is mainly influenced by rate effects, while structural effects play a minor role. In other words, the decline is not solely due to a decrease in the prevalence of higher-order births, which typically have a larger gender gap, but rather due to a reduction in the gender gap in mean age at birth by parity.

The factors that influence fertility delay among men and women, potentially affecting the gender gap in mean age at birth were theoretically discussed, while the analysis particularly focused on educational attainment and multiple reproductive partnerships. Of all the factors, higher educational attainment among women emerged as a significant explanatory factor for the narrowing gender gap in mean age at birth. This is because the average number of years of schooling has increased more for women and has directly contributed to a greater delay in fertility for women than for men (Ní Bhrolcháin & Beaujouan, 2012). In addition, higher opportunity costs for women with higher levels of education could lead them to postpone fertility. On the other hand, the increase in multiple reproductive partnerships was found to be associated with an increase in higher-order births, especially among men. Thus, they might lead to a stronger fertility delay among men, potentially widening the gender gap in mean age at birth.

Previous research suggests that gender equality plays a role in shaping the gender gap in mean age at birth (Dudel & Klüsener, 2021). However, this study indicates that partnership patterns observed in Europe in combination with factors on fertility delay might give a more detailed insight. These patterns explain why gender gaps narrow when women postpone fertility, while they widen when men postpone fertility. The connection between a narrowing gender gap and gender equality can be understood through drivers of fertility delay, leading to a convergence in the life courses of men and women. In this regard a stronger prevalence of higher educational attainment among women, promotes both gender equality and stronger fertility delay for women, narrowing the gender gap in mean age at birth. Herby, it is essential to recognize that fertility delay may introduce new inequalities, since when women delay fertility for too long they are more affected by age-related infertility and are at a higher risk of not achieving their desired number of children. (Balasch & Gratacós, 2012; Beaujouan, 2022; De La Rochebrochard & Thonneau, 2002; Schimmel et al., 2015).

An obstacle faced in this thesis is the scarcity of data on fertility among men. To partially address this limitation, various data sources were analysed, including high-quality register-based data and GGP survey data. The analysis revealed that mean age at birth for women serves as the best predictor of fertility delay for men if no data on men is available at all. It is relatively straightforward to estimate men's mean age at birth from women’s mean age at birth in Europe by assuming a three-year gap (Coleman, 2000). Additionally, estimates derived from GGP survey data can be used, and this thesis demonstrated that comparing survey data estimates with register-based data shows only slight biases, allowing for reasonable approximations. When examining the exact gender gap in mean age at birth in European countries, which may not always be three years, survey data from GGP proves promising as it slightly overestimates the mean age at birth for both men and women in the same way, providing valuable insights into the overall gender gap in a specific country. However, survey data cannot precisely capture the widening or narrowing of the gender gap over time since the estimates lack the required precision to reveal the slight changes in the gender gap in mean age at birth.

In conclusion, numerous questions regarding the gender gap in mean age at birth remain unanswered. To address these gaps, it is crucial to have access to higher-quality data and conduct further academic investigations into men's fertility delay. This will lead to a deeper understanding of the dynamics of fertility delay and the gender gap in mean age at birth. In this regard, assuming that men's fertility develops in the same way as women's overlooks significant differences, such as the narrowing gender gap in mean age at birth over time. By analysing both fertility delay among women and men, it can better be understood how economic downturns and challenges arising from fertility delays affect each of these sexes. Moreover, this approach can unveil deep-rooted gender inequalities.

12 Literature

Agarwal, A., Baskaran, S., Parekh, N., Cho, C.-L., Henkel, R., Vij, S., Arafa, M., Panner Selvam, M. K., & Shah, R. (2021). Male infertility. *Lancet (London, England)*, *397*(10271), 319–333. https://doi.org/10.1016/S0140-6736(20)32667-2

Andersson, L. (2023). The Role of Gender Differences in Partnering and Re-partnering for Gender Differences in Completed Fertility. *Population Research and Policy Review*, *42*(2), 17. https://doi.org/10.1007/s11113-023-09767-1

Ausubel, J., Kramer, S., Shi, A. F., & Hackett, C. (2022). Measuring age differences among different-sex couples: Across religions and 130 countries, men are older than their female partners. *Population Studies*, *76*(3), 465–476. https://doi.org/10.1080/00324728.2022.2094452

Balasch, J. (2010). Ageing and infertility: An overview. *Gynecological Endocrinology*, *26*(12), 855–860. https://doi.org/10.3109/09513590.2010.501889

Balasch, J., & Gratacós, E. (2012). Delayed childbearing: Effects on fertility and the outcome of pregnancy. *Current Opinion in Obstetrics and Gynecology*, *24*(3), 187. https://doi.org/10.1097/GCO.0b013e3283517908

Balbo, N., Billari, F. C., & Mills, M. (2013). Fertility in Advanced Societies: A Review of Research: La fécondité dans les sociétés avancées: un examen des recherches. *European Journal of Population / Revue Européenne de Démographie*, *29*(1), 1–38. https://doi.org/10.1007/s10680-012-9277-y

Beaujouan, É. (2009). *Trajectoires conjugales et fécondes des hommes et des femmes après une rupture en France*. Université Paris I – Panthéon-Sorbonne.

Beaujouan, É. (2020). Latest-Late Fertility? Decline and Resurgence of Late Parenthood Across the Low-Fertility Countries. *Population and Development Review*, *46*(2), 219–247. https://doi.org/10.1111/padr.12334

Beaujouan, É. (2022). Late fertility intentions increase over time in Austria, but chances to have a child at later ages remain low. *Reproductive Biomedicine & Society Online*, *14*, 125–139. https://doi.org/10.1016/j.rbms.2021.10.002

Beaujouan, É., & Ní Bhrolcháin, M. (2011). Cohabitation and marriage in Britain since the 1970s. *Population Trends*, *145*(1), 35–59. https://doi.org/10.1057/pt.2011.16

Beaujouan, É., & Toulemon, L. (2021). European countries with delayed childbearing are not those with lower fertility. *Genus*, *77*(1), 2. https://doi.org/10.1186/s41118-020-00108-0

Beaujouan, É., & Wiles-Portier, E. (2011). Second-Union Fertility in France: Partners' Age and Other Factors. *Population (English Edition)*, *66*(2), 239. https://doi.org/10.3917/pope.1102.0239

Berardo, F. M., Appel, J., & Berardo, D. H. (1993). Age dissimilar marriages: Review and assessment. *Journal of Aging Studies*, *7*(1), 93–106. https://doi.org/10.1016/0890-4065(93)90026-G

Billari, F. C. (2006). The Postponement of Childbearing in Europe Driving Forces and Implications.pdf. *Austrian Academy of Sciences Press, Vienna Yearbook of Population Research*(4), 1–17.

Billari, F. C., Goisis, A., Liefbroer, A. C., Settersten, R. A., Aassve, A., Hagestad, G., & Spéder, Z. (2011). Social age deadlines for the childbearing of women and men. *Human Reproduction*, *26*(3), 616–622. https://doi.org/10.1093/humrep/deq360

Bledsoe, C., Lerner, S., & Guyer, J. (2000). Introduction. In *Fertility and the Male Life Cycle in the Era of Fertility Decline* (S. 1–26). Clarendon Press.

Bongaarts, J., & Sobotka, T. (2012). A Demographic Explanation for the Recent Rise in European Fertility. *Population and Development Review*, *38*(1), 83–120. https://doi.org/10.1111/j.1728-4457.2012.00473.x

Bozon, M. (1991). Women and the Age Gap Between Spouses: An Accepted Domination? *Population: An English Selection*, *3*, 113–148.

Buchmann, C., & DiPrete, T. A. (2006). The growing female advantage in college completion: The role of family background and academic achievement. *American sociological review*, *71*(4), 515–541.

Buchmann, C., DiPrete, T. A., & McDaniel, A. (2008). Gender Inequalities in Education. *Annual Review of Sociology*, *34*(1), 319–337. https://doi.org/10.1146/annurev.soc.34.040507.134719

Cipollone, A., Patacchini, E., & Vallanti, G. (2014). Female labour market participation in Europe: Novel evidence on trends and shaping factors. *IZA Journal of European Labor Studies*, *3*(1), 18. https://doi.org/10.1186/2193-9012-3-18

Coleman, D. A. (2000). Male Fertility Trends in Industrial Countries: Theories in search of Some Evidence. In C. Bledsoe, S. Lerner, & J. Guyer (Hrsg.), *Fertility and the Male Life Cycle in the Era of Fertility Decline* (S. 29–60). Clarendon Press.

Compans, M.-C. (2021). Late motherhood, late fatherhood, and permanent childlessness: Trends by educational level and cohorts (1950–1970) in France. *Demographic Research*, *45*, 329–344. https://doi.org/10.4054/DemRes.2021.45.10

Daniluk, J. C., & Koert, E. (2013). The other side of the fertility coin: A comparison of childless men's and women's knowledge of fertility and assisted reproductive technology. *Fertility and Sterility*, *99*(3), 839–846. https://doi.org/10.1016/j.fertnstert.2012.10.033

De Cooman, E., Ermisch, J., & Joshi, H. (1987). The Next Birth and the Labour Market: A Dynamic Model of Births in England and Wales. *Population Studies*, *41*(2), 237–268. https://doi.org/10.1080/0032472031000142786

De La Rochebrochard, E., de Mouzon, J., Thépot, F., Thonneau, P., & French National IVF Registry (FIVNAT) Association. (2006). Fathers over 40 and increased failure to conceive: The lessons of in vitro fertilization in France. *Fertility and Sterility*, *85*(5), 1420–1424. https://doi.org/10.1016/j.fertnstert.2005.11.040

De La Rochebrochard, E., & Thonneau, P. (2002). Paternal age and maternal age are risk factors for miscarriage; results of a multicentre European study. *Human Reproduction (Oxford, England)*, *17*(6), 1649–1656. https://doi.org/10.1093/humrep/17.6.1649

De La Rochebrochard, E., & Thonneau, P. (2003). Paternal age ≥40 years: An important risk factor for infertility. *American Journal of Obstetrics and Gynecology*, *189*(4), 901–905. https://doi.org/10.1067/S0002-9378(03)00753-1

Dudel, C., & Klüsener, S. (2016). Estimating male fertility in eastern and western Germany since 1991: A new lowest low? *Demographic Research*, *35*, 1549–1560. https://doi.org/10.4054/DemRes.2016.35.53

Dudel, C., & Klüsener, S. (2019). Estimating men’s fertility from vital registration data with missing values. *Population Studies*, *73*(3), 439–449. https://doi.org/10.1080/00324728.2018.1481992

Dudel, C., & Klüsener, S. (2021). Male–Female Fertility Differentials Across 17 High-Income Countries: Insights From A New Data Resource. *European Journal of Population*, *37*(2), 417–441. https://doi.org/10.1007/s10680-020-09575-9

Ferge, Z. (1997). Women and Social Transformation in Central-Eastern Europe: The „Old Left“ and the „New Right“. *Czech Sociological Review*, *5*(2), 159–178.

Generations And Gender Programme. (2019). *Generations and Gender Survey (GGS)—Wave 1* [dataset]. DANS Data Station Social Sciences and Humanities. https://doi.org/10.17026/DANS-Z5Z-XN8G

Goisis, A., Remes, H., Barclay, K., Martikainen, P., & Myrskylä, M. (2018). Paternal age and the risk of low birth weight and preterm delivery: A Finnish register-based study. *J Epidemiol Community Health*, *72*(12), 1104–1109. https://doi.org/10.1136/jech-2017-210170

Goldin, C., & Katz, L. F. (2002). The Power of the Pill: Oral Contraceptives and Women’s Career and Marriage Decisions. *Journal of Political Economy*, *110*(4), 730–770. https://doi.org/10.1086/340778

Hadley, R., & Hanley, T. (2011). Involuntarily childless men and the desire for fatherhood. *Journal of Reproductive and Infant Psychology*, *29*(1), 56–68. https://doi.org/10.1080/02646838.2010.544294

Hassan, M. A. M., & Killick, S. R. (2003). Effect of male age on fertility: Evidence for the decline in male fertility with increasing age. *Fertility and Sterility*, *79*, 1520–1527. https://doi.org/10.1016/S0015-0282(03)00366-2

Jalovaara, M., Neyer, G., Andersson, G., Dahlberg, J., Dommermuth, L., Fallesen, P., & Lappegård, T. (2019). Education, Gender, and Cohort Fertility in the Nordic Countries. *European Journal of Population*, *35*(3), 563–586. https://doi.org/10.1007/s10680-018-9492-2

Juby, H., & Le Bourdais, C. (1999). Where Have All The Children Gone? Comparing Mothers' and Fathers' Declarations in Retrospective Surveys. *Canadian Studies in Population*, *26*(1), 1. https://doi.org/10.25336/P6160C

Kenrick, D. T., & Keefe, R. C. (1992). Age preferences in mates reflect sex differences in human reproductive strategies. *Behavioral and Brain Sciences*, *15*(1), 75–91. https://doi.org/10.1017/S0140525X00067595

Keski-Petäjä, M. (2022, April 5). *Average age at first confinement rose in Finland to the top level of Nordic countries*. Statistics Finland. https://www.stat.fi/til/synt/2016/02/synt_2016_02_2017-12-04_tie_001_en.html

Kitagawa, E. M. (1955). *Components of a Difference Between Two Rates*.

Kleven, H., Landais, C., Posch, J., Steinhauer, A., & Zweimüller, J. (2019). Child Penalties across Countries: Evidence and Explanations. *AEA Papers and Proceedings*, *109*, 122–126. https://doi.org/10.1257/pandp.20191078

Kneale, D., & Joshi, H. (2008). Postponement and childlessness—Evidence from two British cohorts. *Demographic Research*, *19*, 1935–1968. https://doi.org/10.4054/DemRes.2008.19.58

Kohler, H.-P., & Kohler, I. (2002). Fertility Decline in Russia in the Early and Mid 1990s: The Role of Economic Uncertainty and Labour Market Crises. *European Journal of Population / Revue Européenne de Démographie*, *18*(3), 233–262. https://doi.org/10.1023/A:1019701812709

Kolk, M. (2015). Age Differences in Unions: Continuity and Divergence Among Swedish Couples Between 1932 and 2007. *European Journal of Population*, *31*(4), 365–382. https://doi.org/10.1007/s10680-015-9339-z

Kühnert, B., & Nieschlag, E. (2004). Reproductive functions of the ageing male. *Human Reproduction Update*, *10*(4), 327–339. https://doi.org/10.1093/humupd/dmh030

Lappegård, T., Rønsen, M., & Skrede, K. (2011). Fatherhood and Fertility. *Fathering: A Journal of Theory, Research & Practice about Men as Fathers*, *9*(1).

Lazzari, E., Compans, M.-C., & Beaujouan, E. (2022). Changing childbearing age norms in Europe in times of fertility postponement. *SocArXiv*, Article xbheq. https://ideas.repec.org//p/osf/socarx/xbheq.html

Leridon, H. (2008). A new estimate of permanent sterility by age: Sterility defined as the inability to conceive. *Population Studies*, *62*(1), 15–24. https://doi.org/10.1080/00324720701804207

Lesnard, L., Cousteaux, A.-S., Chanvril, F., & Viviane, L. H. (2016). Do Transitions to Adulthood Converge in Europe? An Optimal Matching Analysis of Work–Family Trajectories of Men and Women from 20 European Countries. *European Sociological Review*, *32*, jcw003. https://doi.org/10.1093/esr/jcw003

Lesthaeghe, R. (2010). The Unfolding Story of the Second Demographic Transition. *Population and Development Review*, *36*(2), 211–251. https://doi.org/10.1111/j.1728-4457.2010.00328.x

Lutz, W. (2021). *Advanced introduction to demography*. Edward Elgar Publishing.

Martín-García, T., Seiz, M., & Castro-Martín, T. (2023). Ideals and norms related to fatherhood in Europe: A comparative perspective from the European Social Survey. *Journal of Family Research*, *35*, 17–36. https://doi.org/10.20377/jfr-795

Matysiak, A., Sobotka, T., & Vignoli, D. (2021). The Great Recession and Fertility in Europe: A Sub-national Analysis. *European Journal of Population*, *37*(1), 29–64. https://doi.org/10.1007/s10680-020-09556-y

Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria). (2023a). *Human Fertility Collection*. https://www.fertilitydata.org/

Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria). (2023b). *Human Fertiltiy Database*. https://www.humanfertility.org/

Mills, M., Rindfuss, R. R., McDonald, P., te Velde, E., & on behalf of the ESHRE Reproduction and Society Task Force. (2011). Why do people postpone parenthood? Reasons and social policy incentives. *Human Reproduction Update*, *17*(6), 848–860. https://doi.org/10.1093/humupd/dmr026

Miret-Gamundi, P. (2000). Fathers and Families in Contemporary Spain: From Dictatorship to Democracy. In C. Bledsoe, S. Lerner, & J. Guyer (Hrsg.), *Fertility and the Male Life Cycle in the Era of Fertility Decline* (S. 275–290). Clarendon Press.

Ní Bhrolcháin, M., & Beaujouan, É. (2012). Fertility postponement is largely due to rising educational enrolment. *Population Studies*, *66*(3), 311–327. https://doi.org/10.1080/00324728.2012.697569

Ní Bhrolcháin, M., Beaujouan, E., & Berrington, A. (2010). Stability and change in fertility intentions in Britain, 1991–2007. *Population Trends*, *141*(1), 13–35. https://doi.org/10.1057/pt.2010.19

Ni Bhrolchain, M., & Sigle-Rushton, W. (2005). Partner supply in Britain and the US: Estimates and gender contrasts. *Population*, *60*(1–2), Article 1–2.

Nilsen, A. B. V., Waldenström, U., Rasmussen, S., Hjelmstedt, A., & Schytt, E. (2013). Characteristics of first-time fathers of advanced age: A Norwegian population-based study. *BMC Pregnancy and Childbirth*, *13*(1), 29. https://doi.org/10.1186/1471-2393-13-29

Nisén, J., Martikainen, P., Silventoinen, K., & Myrskylä, M. (2014). Age-specific fertility by educational level in the Finnish male cohort born 1940–1950. *Demographic Research*, *31*, 119–136.

Nordfalk, F., Hvidtfeldt, U. A., & Keiding, N. (2015). TFR for males in Denmark: Calculation and tempo-correction. *Demographic Research*, *32*, 1421–1434. https://doi.org/10.4054/DemRes.2015.32.52

Nybo Andersen, A.-M., & Urhoj, S. K. (2017). Is advanced paternal age a health risk for the offspring? *Fertility and Sterility*, *107*(2), 312–318. https://doi.org/10.1016/j.fertnstert.2016.12.019

Ortega, J. A. (2014). A Characterization of World Union Patterns at the National and Regional Level. *Population Research and Policy Review*, *33*(2), 161–188. https://doi.org/10.1007/s11113-013-9301-x

Paavilainen, M., Bloigu, A., Hemminki, E., Gissler, M., & Klemetti, R. (2016). Aging fatherhood in Finland – first-time fathers in Finland from 1987 to 2009. *Scandinavian Journal of Public Health*, *44*(4), 423–430. https://doi.org/10.1177/1403494815620958

Paksi, V., & Szalma, I. (2009). Age norms of childbearing early, ideal and late childbearing in european countries. *Review of Sociology*.

Pohl, K. (2000). Fatherhood in east and west Germany: Results of the German Family and Fertility Survey. In C. Bledsoe, S. Lerner, & J. Guyer (Hrsg.), *Fertility and the Male Life Cycle in the Era of Fertility Decline* (S. 257–274). Clarendon Press.

Presser, H. B. (1975). Age Differences Between Spouses: Trends, Patterns, and Social Implications. *American Behavioral Scientist*, *19*(2), 190–205. https://doi.org/10.1177/000276427501900205

Presser, H. B. (2001). Comment: A Gender Perspective for Understanding Low Fertility in Post-Transitional Societies. *Population and Development Review*, *27*, 177–183. JSTOR.

Prioux, F. (2005). Late fertility in Europe: Some comparative and historical data. *Revue d'Épidémiologie et de Santé Publique*, *53*, 3–11. https://doi.org/10.1016/S0398-7620(05)84763-7

Qian, Y. (2017). Gender Asymmetry in Educational and Income Assortative Marriage. *Journal of Marriage and Family*, *79*(2), 318–336. https://doi.org/10.1111/jomf.12372

Sartorius, G. A., & Nieschlag, E. (2010). Paternal age and reproduction. *Human Reproduction Update*, *16*(1), 65–79. https://doi.org/10.1093/humupd/dmp027

Schimmel, M. S., Bromiker, R., Hammerman, C., Chertman, L., Ioscovich, A., Granovsky-Grisaru, S., Samueloff, A., & Elstein, D. (2015). The effects of maternal age and parity on maternal and neonatal outcome. *Archives of Gynecology and Obstetrics*, *291*(4), 793–798. https://doi.org/10.1007/s00404-014-3469-0

Schmidt, L., Sobotka, T., Bentzen, J. G., Nyboe Andersen, A., & on behalf of the ESHRE Reproduction and Society Task Force. (2012). Demographic and medical consequences of the postponement of parenthood. *Human Reproduction Update*, *18*(1), 29–43. https://doi.org/10.1093/humupd/dmr040

Schmitt, C. (2005). Kinderlosigkeit bei Männern—Geschlechtsspezifische Determinanten ausbleibender Elternschaft. In A. Tölke & K. Hank (Hrsg.), *Männer—Das „vernachlässigte" Geschlecht in der Familienforschung* (S. 18–43). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-322-80681-9_2

Schoumaker, B. (2019). Male Fertility Around the World and Over Time: How Different is it from Female Fertility? *Population and Development Review*, *45*(3), 459–487. https://doi.org/10.1111/padr.12273

Schytt, E., Nilsen, A. B. V., & Bernhardt, E. (2014). Still childless at the age of 28 to 40 years: A cross-sectional study of Swedish women's and men's reproductive intentions. *Sexual and Reproductive Healthcare*, *5*(1), Article 1. https://doi.org/10.1016/j.srhc.2013.11.001

Settersten, R. A., & Mayer, K. U. (1997). The Measurement of Age, Age Structuring, and the Life Course. *Annual Review of Sociology*, *23*(1), 233–261. https://doi.org/10.1146/annurev.soc.23.1.233

Sobotka, T. (2010). Shifting Parenthood to Advanced Reproductive Ages: Trends, Causes and Consequences. In J. Tremmel (Hrsg.), *A Young Generation Under Pressure?* (S. 129–154). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-03483-1_7

Sobotka, T. (2023). *Fertility in Central and Eastern Europe after 1989: Collapse and Gradual Recovery*.

Statistic Finland. (2023). *Live births by sex, birth order and age of mother (1-year), 1990-2022*. https://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/StatFin__synt/statfin_synt_pxt_12dm.px/

Statistics Denmark. (2023). *Average age of women given birth and new fathers—StatBank Denmark—Data and statistics*. https://www.statbank.dk/statbank5a/selectvarval/saveselections.asp

Statistics Norway. (2023). *Mean age of parent at first child's birth 1961—2022. Statbank Norway*. SSB. https://www.ssb.no/en/system/

Statistics Sweden. (2023). *Mean age at birth of the child by region, Live-birth order, parent and year. PxWeb*. https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101H/MedelAlder1/table/tableViewLayout1/

Toulemon, L. (1995). Très peu de couples restent volontairement sans enfant. *Population*, *50*(4/5), Article 4/5. https://doi.org/10.2307/1534316

Toulemon, L. (2000). Demographic Patterns of Motherhood and Fatherhood in France. In C. Bledsoe, S. Lerner, & J. Guyer (Hrsg.), *Fertility and the Male Life Cycle in the Era of Fertility Decline* (S. 293–330). Clarendon Press.

University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). (2019). *Human Mortality Database*. https://www.mortality.org/

Van Bavel, J., Jansen, M., & Wijckmans, B. (2012). Has Divorce Become a Pro-Natal Force in Europe at the Turn of the 21st Century? *Population Research and Policy Review*, *31*(5), 751–775. https://doi.org/10.1007/s11113-012-9237-6

Van de Putte, B., Van Poppel, F., Vanassche, S., Sanchez, M., Jidkova, S., Eeckhaut, M., Oris, M., & Matthijs, K. (2009). The Rise of Age Homogamy in 19th Century Western Europe. *Journal of Marriage and Family*, *71*(5), 1234–1253. https://doi.org/10.1111/j.1741-3737.2009.00666.x

van Hek, M., Kraaykamp, G., & Wolbers, M. H. J. (2016). Comparing the gender gap in educational attainment: The impact of emancipatory contexts in 33 cohorts across 33 countries. *Educational Research and Evaluation*, *22*(5–6), 260–282. https://doi.org/10.1080/13803611.2016.1256222

Vergauwen, J., Wood, J., De Wachter, D., & Neels, K. (2015). Quality of demographic data in GGS Wave 1. *Demographic Research*, *32*, 723–774. https://doi.org/10.4054/DemRes.2015.32.24

Weeden, J., Abrams, M. J., Green, M. C., & Sabini, J. (2006). Do high-status people really have fewer children? *Human Nature*, *17*(4), 377–392. https://doi.org/10.1007/s12110-006-1001-3

Wischmann, T., & Thorn, P. (2013). (Male) infertility: What does it mean to men? New evidence from quantitative and qualitative studies. *Reproductive Biomedicine Online*, *27*(3), 236–243. https://doi.org/10.1016/j.rbmo.2013.06.002

13 Appendix

13.1 Abstract in English and German

English abstract: Since the 1970s, European countries have experienced a rise in the mean age at birth. While many studies have focused solely on women's fertility delay, this thesis aims to analyse fertility delay and the gender gap in mean age at birth among men and women in Europe. Furthermore, the causes and drivers widening or narrowing the gender gap in mean age at birth are examined. Register-based and survey data were used, and the latter was checked for its quality. Besides analysing demographic rates, decomposition methods were employed to determine how structure and rate effects contribute to the decline in the gender gap in mean age at birth. Consistent with previous research on European countries, the findings show that, on average, men tend to be three years older than women at the birth of their children. However, in recent years, this gender gap has narrowed in Western, Southern, and Northern European countries due to a stronger fertility delay, particularly for first-time births, observed among women compared to men. The narrowing gap is likely the result of a convergence in the life course of men and women, possibly influenced by various factors, including increased educational attainment among women. While greater gender equality may contribute to narrowing the gender gap, the stronger fertility delay among women could potentially lead to the emergence of new inequalities.

German abstract: Seit den 1970er Jahren ist in den europäischen Ländern ein Anstieg des durchschnittlichen alters bei der Geburt zu verzeichnen. Während sich viele Studien ausschließlich auf den Aufschub von Frauen konzentriert haben, zielt diese Arbeit darauf ab, den Aufschub und den geschlechtsspezifischen Gap beim durchschnittlichen Alter bei der Geburt bei Männern und Frauen in Europa zu analysieren. Darüber hinaus werden die Ursachen und Triebkräfte für die Vergrößerung und die Verkleinerung des Gaps beim durchschnittlichen bei der Geburt untersucht. Register- und Umfragedaten wurden verwendet, wobei letztere auf ihre Qualität geprüft wurden. Neben der Analyse der demografischen Raten wurden Dekompositionsmethoden angewandt, um festzustellen, wie Struktur- und Rateneffekte zum Rückgang des Gaps im durchschnittlichen Alter bei der Geburt beitragen. Die Ergebnisse stimmen mit früheren Untersuchungen zu europäischen Ländern überein und zeigen, dass Männer bei der Geburt ihrer Kinder im Durchschnitt drei Jahre älter sind als Frauen. In den letzten Jahren hat sich dieser geschlechtsspezifische Unterschied in den west-, süd- und nordeuropäischen Ländern jedoch verringert, da Frauen im Vergleich zu Männern einen stärkeren Aufschub der Geburt, insbesondere bei erster Geburt, erlebten. Die Verkleinerung des Gaps ist wahrscheinlich auf eine Konvergenz im Lebensverlauf von Männern und Frauen zurückzuführen, die durch verschiedene Faktoren beeinflusst wird, darunter ein höheres Bildungsniveau bei Frauen. Während eine größere Gleichstellung der Geschlechter zur Verringerung des geschlechtsspezifischen Unterschieds beitragen kann, könnte der stärkere Fertilitätsaufschub bei Frauen möglicherweise auch zum Entstehen neuer Ungleichheiten führen.

13.2 List of Figures

13.3 List of Tables