Not on the same track?

Tracking age and gender inequality in education

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Chapter 3
Female Advantage and Disadvantage: The Role of Educational Tracking in Vertical and Horizontal Gender Segregation in Education

Abstract Even though male-female differences in educational attainment have narrowed worldwide, gender differences across fields of study remain surprisingly large. Previous studies have shown an association between the tracking age and vertical gender segregation, but it remains unclear whether the tracking age is also related to horizontal gender segregation. Using individual-level data from the European Union Labour Force Survey (EU LFS) and contextual-level data on educational reforms, we study to what extent policy changes concerning the tracking age between 1966 and 2006 influenced gender gaps in educational attainment and field of study in 20 European countries. We exploit a within-country over-time design, implementing linear and multinomial models with country and cohort fixed effects. This chapter shows the importance of the tracking age for both vertical and horizontal gender segregation. We find that late tracking increases vertical segregation to the benefit of women and, among the higher-educated people, decreases horizontal segregation, as both men and women become more likely to complete a degree in gender-atypical fields. Thus, the gender revolution in education extends to a reduction of gender segregation across fields of study when tracking is postponed in educational systems.

1 A slightly different version of this chapter has been submitted to an international peer-reviewed journal as Scheeren, Lotte and Herman G. Van de Werfhorst. “Female Advantage and Disadvantage: The Role of Educational Tracking in Vertical and Horizontal Gender Segregation in Education.”
3.1 Introduction

Recent studies show that the age at which students are selected into distinct educational tracks, i.e., the tracking age, affects male-female differences in educational outcomes. Thus far, previous research has focused on the impact of the tracking age on the vertical dimension of gender segregation, showing that women’s advantage in educational performance and attainment is larger in late-tracking educational systems than in early-tracking systems (Hadjar and Buchmann 2016; Pekkarinen 2008; Scheeren, Van de Werfhorst, and Bol 2018; Van Hek, Buchmann, and Kraaykamp 2019). In this study, we examine whether the tracking age also has an impact on the horizontal dimension of gender segregation in education, which has been shown to be greater and more stable over time than vertical gender segregation (Barone 2011; Bradley 2000; Charles and Bradley 2002). Persistent gender-specific educational choices translate into different distributions of women and men across fields of study, with women typically ending up in fields that, in general, are less lucrative in terms of future occupational status and income (Gerber and Cheung 2008; Roksa 2005). Educational tracking may affect both dimensions of gender segregation.

A few studies discuss the potential impact of the tracking system on horizontal gender segregation and argue that early gendered career aspirations are less likely to be translated into final educational outcomes in late-tracking systems compared to early-tracking systems (Charles 2005; Charles et al. 2001). This suggests that late tracking not only increases women’s advantage in educational attainment but also decreases gender segregation across fields of study. However, it has also been suggested that in late-tracking countries, traditionally female-dominated educational fields, such as nursing and teaching, are represented at higher educational levels (e.g., tertiary instead of secondary level) than in early-tracking countries (Bradley and Charles 2004; Breen et al. 2010). Women in late-tracking systems may complete higher levels of education, but field-of-study decisions remain highly gender-segregated, and therefore, women in these different tracking systems end up in similar occupations. Thus far, the impact of educational tracking on gender segregation across fields of study has not yet been tested.

The aim of this study is to understand whether the tracking age has an impact on vertical and horizontal gender segregation in education. Using individual-level data from the European Union Labour Force Survey (EU LFS) and contextual-level data on educational reforms (Braga, Checchi, and Meschi 2013), we study to what extent policy changes concerning the age of first selection that were implemented between 1966 and 2006 influenced gender differences in educational attainment and field of study in 20 European countries. Including several countries over a long time period allows us to examine the cross-
national and temporal trend in vertical and horizontal gender segregation. We exploit a within-country over-time design, implementing linear and multinomial regression models with country and cohort fixed effects. In addition to controlling for all time-invariant country-specific factors and unobserved general time trends affecting all countries, we also control for several time-varying contextual level features, such as the gender-ideological climate and labour market demand.

3.2 Theory

Tracking in different educational systems

At some point in the educational career, in all educational systems, students are separated into different educational trajectories on the basis of performance, aspirations and/or teacher evaluations (Buchmann and Park 2009; Vanfossen, Jones, and Spade 1987). The age at which students are allocated into these different educational programmes is known as the tracking age or the age of first selection. In this study, we focus on the age at which between-school tracking occurs (Chmielewski 2014; Maaz et al. 2008). Between-school tracking occurs when students are separated for several years into different curricular programs, often labelled the (pre-)vocational and general/academic tracks. These tracks are hierarchically ranked, in which the academic track is generally considered to be the more prestigious and rewarding track (Allmendinger 1989). Between-school tracking is especially important, as it limits future educational options and, therefore, has a large impact on final educational outcomes (Dustmann 2004; Jürges and Schneider 2011). In the Western societies that we study, between-school tracking occurs at the age of 10 in the earliest-tracking countries and at the age of 16 in the latest-tracking countries.

Tracking age and vertical gender inequality

In general, track placement is, at least partially, based on previous educational performance and expectations about a student’s educational potential. As gender differences in cognitive and non-cognitive skills are not constant over the educational career, the timing of educational tracking decisions becomes essential. The female-favourable gender gap in educational performance has been shown to widen over the educational career (Dekkers, Bosker, and Driessen 2000; DiPrete and Buchmann 2013; Machin and McNally 2005; Sammons 1995). During secondary education, girls have also been shown to be (temporarily) ahead of boys with respect to non-cognitive traits such as attentiveness, goal-directed behaviour, and task persistence, which have been demonstrated to be important for academic choices and conducive to educational success (Best, Miller, and Naglieri 2011; DiPrete and...
Jennings 2012; Downey and Vogt Yuan 2005; Jacob 2002; Knouse, Feldman, and Blevins 2014; OECD 2015a). Hence, when tracking decisions are made at a later age, girls are ahead of boys with respect to both cognitive and non-cognitive skills, indicating that girls are more likely to advance to the higher tracks. Higher track enrolment has long-term consequences with respect to later educational achievement, attainment and labour market outcomes (Dustmann 2004; Guyon, Maurin, and McNally 2012).

Only recently have studies started to investigate the association between the tracking age and gender differences in educational outcomes. In line with our expectations, these studies show a positive relationship between tracking age and vertical gender inequality to the advantage of women. More specifically, studies on gender differences in educational achievement show that later tracking is related to smaller male-favourable gaps in mathematics and science (Bedard and Cho 2010) and larger female-favourable gaps in reading (Van Hek, Buchmann, and Kraaykamp 2019). Additionally, with respect to educational attainment, research has shown that later tracking is beneficial for women, suggesting late tracking increases gender differences in education to the advantage of women (Hadjar and Buchmann 2016; Pekkarinen 2008; Scheeren, Van de Werfhorst, and Bol 2018). Thus, in line with previous research, we hypothesize that a higher tracking age is beneficial for women’s educational attainment (hypothesis 1).

Tracking age and horizontal gender inequality

The relationship between the tracking age and horizontal gender differences has rarely received attention. Studies suggest a relationship between the tracking system and the combination of fields of study represented at specific educational levels. These works argue that traditionally female-dominated fields of study, such as nursing and teaching, are represented at higher educational levels (e.g., tertiary instead of secondary level) in late-tracking systems than in early-tracking systems (Bradley and Charles 2004; Breen et al. 2010). If this is the case, women in late-tracking countries might complete higher levels of education, but women in both systems end up with the same occupational credentials. This would indicate no relationship between the tracking age and horizontal gender segregation. However, in this study, we argue that the tracking age might also have an impact on gender differences in fields of study. Our argumentation is twofold. We argue that early tracking indicates higher internal differentiation as well as greater decision-making responsibilities at a young age, and discuss how these two features might be related to horizontal gender segregation.

Charles and Bradley (2009) argue that educational diversification, which they define as internal differentiation within higher education, fosters gender differences in aspirations as
well as their realization. Within a diversified curriculum, students have more opportunities to exercise expressive choices. The more options students can choose from, the higher the tendency towards gender stereotypes being enacted. These educational decisions, made within a given set of structured alternatives, limit future curricular choices. Thus, a highly diversified system of higher education, for instance, in two-tier binary systems comprising universities of applied science and research universities, sorts students into gender-segregated educational tracks, which limits future gender-atypical educational and occupational decisions.

The same argumentation could apply to differentiation within secondary school. When secondary education is strongly differentiated in tracks, early in the educational career, students need to choose from a number of different educational programmes. Even though this decision is mostly about which educational level to pursue, it often involves some type of curricular decision as well. For instance, whether to choose a track with a curriculum that contains Greek and Latin, which is often necessary when someone wants to pursue a medical career. Moreover, this track decision forces students to think about their aspirations, as it limits future educational options. Additionally, a two-tier system of higher education is often found in countries where the secondary school system is differentiated (Shavit, Arum, and Gamoran 2007). In line with this argumentation, Charles et al. (2001), who compare the United States and Switzerland, argue that the highly differentiated educational system in Switzerland provides more opportunities for gender segregation in secondary school, which, subsequently, exacerbates gender-stereotyped career choices later in life.

Second, it is not just about diversification but also about having to make these educational decisions at a young age. The age at which students are selected into separate educational trajectories is related to the amount of information available on students’ abilities. More specifically, the amount of (objective) information on students’ abilities is much smaller when they are younger; therefore, the uncertainty about their educational potential and chances of success at higher levels of education is much higher (Berger and Combet 2017; Jackson and Jonsson 2013; Van Elk, Van der Steeg, and Webbink 2011). As a consequence, teachers, parents and students, who all can have an impact on track placement, must rely on other sources of information to determine the expected success of the student, such as stereotypes related to gender. Later tracking reduces uncertainty about a student’s potential and decreases the need for information from other sources.

To summarize, we argue that early tracking is related to higher internal differentiation, which increases the number of opportunities to exercise expressive choices. Moreover, we argue that the young age at which students have to make decisions in early-tracking systems increases uncertainty about a student’s educational potential, and therefore the chance to rely
on gender stereotypes for educational decisions. These arguments suggest that making decisions about different educational programmes at a young age sorts students into gender-segregated impermeable tracks, which enhances gender-typed field choices later in the educational career. Later tracking, on the other hand, decreases the number of opportunities to exercise expressive choice and the uncertainty about one’s educational potential, and, therefore, decreases the likelihood of making gender-typical decisions. Hence, we hypothesize that a higher tracking age decreases gender segregation across fields of study (hypothesis 2).

3.3 Data and methods

Data
The individual-level data for this study are derived from the European Union Labour Force Survey (EU LFS), which is a large cross-national household sample survey collected in 31 European countries. The survey is conducted by national statistical institutes across Europe and centrally processed by Eurostat. The data began to be collected in 1983 and have been collected quarterly ever since. In this study, we use the EU LFS waves from 2005, 2010 and 2015. Moreover, we focus on 20 European countries for which we have information on the educational institutional structure as well as other contextual-level features over a long time period. Information on these (time-varying) contextual-level features is obtained from various other sources, which we describe below.

The individual-level data are matched with contextual-level data on the basis of country-specific cohorts. Respondents are grouped into 5-year birth cohorts (e.g., 1971-1975, 1976-1980) within their countries and subsequently connected to the tracking age of the system in which they were educated when they were young. All other contextual-level variables are linked to when respondents within the 5-year birth cohorts were, on average, 20 years of age. We choose the age of 20, because contextual characteristics during adolescence might be specifically important for educational decision-making, such as decisions regarding the level and field of education.

2 The survey question on the field of study has only been asked since 2003. Moreover, the only information we have on the birth year is age in 5-year age bands, which enables us to group individuals into 5-year birth cohorts. However, to make sure that individuals from different survey-years are from the same birth-cohort, we can only focus on the surveys gathered five years apart.

3 The countries included in this study are Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, the Netherlands, Poland, Portugal, Slovakia, Slovenia, and Sweden.

4 Here we provide an example of our data structure: a person who was born in Italy in 1978 is grouped into the Italian 1976-1980 birth cohort, and the information for all contextual-level variables for this person is attributed using data for the period 1996-2000 in Italy, when respondents in the birth cohort were, on average, 20 years of age.
First, we examine vertical gender segregation in education. In this analysis, all respondents are nested within 7 birth cohorts (1956-1960 to 1986-1990) and 20 European countries. The sample size in this analysis, nested in 112 country-specific cohorts, is N=3,442,853, which includes only the native-born population above 25 years of age.  

Second, we examine horizontal gender segregation in education. The question on field of study was asked only if respondents’ level of education was at least level 3 in the International Standard Classification of Education (ISCED), as levels lower than ISCED 3 are mostly general in nature. Moreover, if respondents stated that their highest completed level of education was a generic programme, we excluded them from the sample. We perform separate analyses for respondents who finished ISCED levels 3/4 and ISCED levels 5/6 because the gender composition across the fields of study is different within different levels of education. Again, respondents are nested within 7 birth cohorts and 20 European countries. We only focus on the native-born population above 25 years of age. The sample including respondents who finished ISCED levels 3 or 4 is N= 979,814, nested within 112 country-cohorts. The sample including respondents who finished ISCED levels 5 or 6 is N= 788,141, nested within 111 country-cohorts.

**Dependent variables**
The dependent variable in our analysis on vertical gender inequality, educational attainment, is operationalized as the number of years of education. In the survey, respondents were asked to report their highest completed level of education according to ISCED. We converted these ISCED levels into years of schooling: 6 years for ISCED=0-1 (less than lower secondary education completed), 9 years for ISCED=2 (lower secondary education completed), 12 years for ISCED=3 (upper secondary education completed), 14 years for ISCED=4 (post-secondary non-tertiary education completed), and 16 years for ISCED=5-6 (tertiary education completed). In this study, we prefer completed years of education, as this allows for a comparison with previous studies on the relationship between the tracking age and gender differences in educational attainment (Scheeren, Van de Werfhorst, and Bol 2018).

The dependent variable in our analysis on horizontal gender inequality, field of study, is the field of the programme completed at the highest education level. The data used in this study allow us to distinguish between eight fields of study: (1) teacher training and education...
sciences, (2) humanities and arts, (3) social sciences, business and law, (4) science, mathematics and computing, (5) engineering, manufacturing and construction, (6) agriculture and veterinary studies, (7) health and welfare, and (8) services (including personal services, hygiene and occupational health services, security services and transport services).\(^8\)\(^9\)

**Independent variables**

Information on the *tracking age*, i.e., the age at which student selection into distinct educational trajectories occurs, is drawn from the educational reform dataset constructed by Braga et al. (2013). This dataset contains information on several reforms that affected the educational systems in various European countries between 1929 and 2000. To obtain information up until 2006, which is needed for our youngest cohort, we supplement the data with information from OECD and Eurydice reports. We aggregate this measure from a country-year-level measure to a country-cohort-level measure and, subsequently, match our birth cohorts to the (average) tracking age of the system that they were educated in. Countries with a comprehensive educational system are assigned the age at which students leave secondary education because this is the age at which students separate into various (educational) trajectories. This measure ranges from 10 to 16, but for ease of interpretation, we subtract 10 from this measure so that 0 refers to the earliest tracking age.

The individual-level variable *gender* is coded as female=1 and male=0.

**Control variables**

We control for several contextual-level features that have been related to male-female differences in educational outcomes before. We mainly focus on features that are potentially related to (changes in) the tracking age (Scheeren, Van de Werfhorst, and Bol 2018). All these variables are at the country-cohort level and are connected to respondents when they were 20 years of age. One exception is the vocational orientation of the educational system, which is connected to respondents when they were 15 years of age.

The *vocational orientation* of the educational system, which is the extent to which educational systems offer occupation-specific programmes, is operationalized as the percentage of students in secondary education (public and private) enrolled in vocational programmes relative to students enrolled in all secondary education programmes. The

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\(^8\) Finer-grained distinctions among the eight fields of study are possible in some countries. Since this is not the case in all countries in our sample, we focus on these 8 fields of study.

\(^9\) Not all these fields of study exist at all educational levels in all countries. We coded a field as non-existent if fewer than 20 respondents completed a specific field of study within a country-specific cohort and within an educational level. For instance, the field “teacher training and education sciences” only exists in Finland at the ISCED 5-6 level. This means that in the analysis in which we focus on ISCED levels 3 and 4, only 7 fields of study exist in Finland.
UNESCO Institute for Statistics provides us with country-specific information on this measure from 1970 onwards. Unlike the other contextual-level variables, this measure is connected to the time when birth cohorts were 15 years of age, as this is approximately the age at which students have to make decisions about entering general or vocational programmes in secondary education. In line with previous research, we observe a (small) negative correlation (-.26) between vocational orientation and the tracking age at the country-cohort level, which indicates that the percentage of students in secondary school who are enrolled in vocational programmes is higher in early-tracking systems than in late-tracking systems (Bol and Van de Werfhorst 2013).

To take into account demand in the labour market, we also include a measure of the size of the tertiary sector, which is operationalized as the percentage of total hours worked by employees in the tertiary sector. The EU KLEMS database (November 2009 release) provides us with country-specific information on internationally comparable industry-level indicators of input, output and productivity from 1970 up to 2007 (O’Mahony and Timmer 2009). With the use of information on total hours worked by employees in the different industries, we calculate the percentage of hours worked by employees in the tertiary sector relative to the total hours worked by employees in all sectors.

We obtain our measure of the gender-ideological climate from the World Values Survey (WVS, 1981-2014) and European Values Study (EVS, 1981-2008). Based on the use of these items in prior research as well as the coverage of these items concerning countries and survey-years (Davis and Greenstein 2009; McDaniel 2008), we construct an index of gender-egalitarian attitudes based on the degree of agreement with the following eight items: (1) When jobs are scarce, men should have more right to a job than women. (2) A woman has to have children to be fulfilled. (3) Women truly want a home and children. (4) Being a housewife is as fulfilling as having a paid job. (5) A working mother can establish as warm a relationship with her children as a woman who does not work. (6) A pre-school child suffers by having a working mother. (7) A woman can be a single parent. (8) A child needs a home with a father and a mother. Principal component analysis demonstrates that all eight items load above 0.4 on one factor, and the Cronbach’s alpha of these items is 0.65. The mean of the eight standardized items is taken to construct the index of gender-egalitarian attitudes. Responses are coded as missing if respondents replied to less than four of the eight items. To
obtain a gender-ideological climate measure for specific country-cohorts and not the full population, first, we employ a regression to predict gender attitudes by country, birth-cohort, and age, as well as interactions among all three. Second, we use marginal effects to predict the average attitudes of young adults (21- to 30-year-old population) for the country-cohorts in our sample. A higher score on this gender-ideological climate scale indicates a more gender-egalitarian climate.

To control for economic development, we include a measure of per capita gross domestic product (GDP) in US dollars. The data are gathered from the World Data Bank, which contains country-specific information on this measure from 1960 onwards. To control for the skewness of the variable, we take the logarithm.

Income redistribution is operationalized as the difference between the Gini index scores of gross- and net-income inequality, which reflects the degree of redistribution of income by taxes. A high degree of redistribution can be interpreted as a more egalitarian political climate. As reforms to postpone tracking age are possibly embedded in wider political shifts towards equality, a more egalitarian political climate might be related to postponing the tracking moment as well as smaller gender inequalities. Data are collected from the Standardized World Income Inequality Database (SWIID), which contains country-specific information from 1960 onwards.

Descriptive statistics on all variables, separated by model, are presented in Table 3.1.

Method
To examine the impact of the tracking age on vertical gender inequality in education, we employ a multilevel linear regression model including country and cohort fixed effects. The two-level multilevel model takes into account that respondents are nested within country-cohorts. Country fixed effects ensure that our model only looks at within-country variation and, therefore, we can disregard time-invariant unmeasured country-specific characteristics (Verbeek 2004). By including cohort fixed effects, we control for unobserved general time trends in education as well as unobserved general time trends in the gender gap in education that affected all countries equally. Hence, in this model, we exploit within-country temporal variation in tracking age to investigate whether educational reforms affected gender differences in educational attainment.

To examine the impact of the tracking age on horizontal gender inequality in education, we employ multinomial regression models including country and cohort fixed effects. Again, we include country fixed effects to control for all unobserved time-constant heterogeneity between countries and cohort fixed effects to control for a general time trend affecting all countries equally. Moreover, to account for the nesting of respondents in country-cohorts, we
adjust for clustering in the analysis. Thus, in this model, we examine whether changes in the tracking age within countries over time affected gender differences in the field of study.

Table 3.1. Descriptive statistics, separated by dependent variable

<table>
<thead>
<tr>
<th>Model: Years of education</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual-level variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of education</td>
<td>12.253</td>
<td>2.919</td>
<td>6</td>
<td>16</td>
<td>3,442,853</td>
</tr>
<tr>
<td>Female</td>
<td>.508</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3,442,853</td>
</tr>
</tbody>
</table>

| Model: Field of study      |       |       |     |        |      |
| Individual-level variables|       |       |     |        |      |
| Field of study             |       |       | 1  | 8      | 1,767,955 |
| Teacher training/education sciences | .061 |       |     |        |      |
| Humanities/arts            | .068  |       |     |        |      |
| Social sciences/business/law | .300 |       |     |        |      |
| Science/mathematics/computing | .060 |       |     |        |      |
| Engineering/Manufacturing/Construction | .277 |       |     |        |      |
| Agriculture/Veterinary     | .035  |       |     |        |      |
| Health and Welfare         | .113  |       |     |        |      |
| Services                   | .086  |       |     |        |      |
| Female                     | .512  | 0     | 0   | 1      | 1,767,955 |

Both models

<table>
<thead>
<tr>
<th>Contextual-level variables</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking age (10 years=0)</td>
<td>3.838</td>
<td>2.072</td>
<td>0</td>
<td>6</td>
<td>112</td>
</tr>
<tr>
<td>Vocational enrolment</td>
<td>28.112</td>
<td>12.372</td>
<td>2.129</td>
<td>53.734</td>
<td>112</td>
</tr>
<tr>
<td>Tertiary sector</td>
<td>64.358</td>
<td>7.360</td>
<td>45.491</td>
<td>79.660</td>
<td>112</td>
</tr>
<tr>
<td>Gender climate</td>
<td>.191</td>
<td>.216</td>
<td>-.202</td>
<td>.823</td>
<td>112</td>
</tr>
<tr>
<td>Log(GDP)</td>
<td>9.594</td>
<td>.786</td>
<td>7.769</td>
<td>10.969</td>
<td>112</td>
</tr>
<tr>
<td>Income redistribution</td>
<td>17.558</td>
<td>3.755</td>
<td>4.691</td>
<td>24.489</td>
<td>112</td>
</tr>
</tbody>
</table>

* The model of field of study (ISCED 5-6) is based on 111 instead of 112 country-cohorts, due to the high number of missing values on field of study in this country-cohort. The difference in descriptive statistics, when this country-cohort is excluded, is extremely small, therefore, we only show the descriptive statistics for all 112 country-cohorts.

3.4 Results

Descriptive results
Figure 3.1 displays how women’s and men’s average years of education evolved over time between the 1956-1960 and 1986-1990 birth cohorts within the 20 European countries
included in our sample. As expected, we observe a slight upward trend, with the mean years of education increasing over time for both men and women in almost all countries. Moreover, even though men outperform women in the early birth cohorts in most countries, the upward trend for women is often steeper than for men, which results in women outperforming men in the later birth cohorts. Hence, in line with previous research (Vincent-Lancrin 2008), this figure shows that the relative educational attainment of women is increasing in almost all countries. However, it also displays large cross-country and temporal variation, e.g., in the timing of when women surpassed men and in the magnitudes of the gender gap among countries.

Figure 3.2 displays the dissimilarity index by the eight fields of study, separately by the ISCED 3/4 and ISCED 5/6 educational levels. This index measures the degree of segregation and can be interpreted as the proportion of people that need to switch fields to equalize the distribution of men and women across all fields of study. In line with prior research, we observe that in general, gender segregation across fields of study is much lower at the higher educational levels. We also observe that not only the overall level but also the trend in gender segregation varies among the educational levels. This suggests the importance of examining horizontal gender segregation separately for the different levels. If we look at changes in segregation over time, we do not observe a clear overall trend, in contrast to Figure 3.1. Even though among the individuals who finished ISCED levels 5 or 6, we observe some form of desegregation over time in most countries, this is interspersed with periods of stability and even increase in segregation. Among the individuals who completed ISCED levels 3 or 4, we do not observe a general trend at all; depending on the country or time period, we observe increases, decreases and stability.

Figure 3.3 displays how the percentage of women in the eight different fields of study evolved over time between the 1956-1960 and 1986-1990 birth cohorts. Separate graphs are shown for the individuals who finished ISCED levels 3 or 4 (left panel) and the individuals who finished ISCED levels 5 or 6 (right panel). The dashed line in the figure highlights the point where the distribution is equal. Overall, we observe that the percentage of women decreased slightly in all fields of studies at the ISCED 3/4 levels, and increased slightly in all fields of studies at the ISCED 5/6 levels. This reflects the fact that, in general, over the last 50 years the percentage of women who finished ISCED levels 5 or 6 went up and the percentage of women who finished ISCED levels 3 or 4 went down.
Figure 3.1. Descriptive statistics of completed years of education separated for men and women.

Birth cohort

Source: EU LFS
Figure 3.2. Index of dissimilarity by gender across fields of study, separated by levels of education.

Source: EU LFS
Among the individuals who completed ISCED levels 3 or 4, we observe that especially within the male dominated fields, i.e., engineering, manufacturing and construction, agriculture and veterinary, and science, mathematics and computing, the percentage of women decreased even more over time. Among the other fields of study, we observe that the distribution became a bit more equal, especially within social sciences, business and law, and teacher training and educational sciences. Among the individuals who completed ISCED levels 5 or 6, we observe that the percentage of women increased especially within the male dominated fields of study, i.e., engineering, manufacturing and construction, agriculture and veterinary, and services, resulting in a more equal distribution within these fields among the younger generations. Moreover, we observe an increase in segregation within social sciences, business and law, as the percentage of women within this field increased. In the other fields of study, the percentage of women remained relatively stable.

In this study, we examine whether changes in the tracking age (partly) explain changes in gender differences in educational attainment and field of study. Therefore, we also need to know whether the tracking age changed within countries over time. The oldest birth cohort in our study is 1956-1960, and this birth cohort experienced tracking in 1966 in the earliest-tracking countries. Figure 3.4 displays the variation in the tracking age within countries.
between 1966 and 2006. This figure shows that even though larger variation in the tracking age exists between countries, sometimes the tracking age also changed within countries. In most countries in our sample, the tracking age changed at least once. Even though some countries lowered their tracking age at some point in time, most countries postponed their moment of tracking.

Figure 3.4. Variation in tracking age within countries over time (1956-2006)

Source: Braga et al. (2013)

13 We keep the countries where the tracking age did not change, as this allows us to control for general time trends that affected all countries equally.
Multivariate results on educational attainment

The results of the two-level multilevel regression model of years of education are displayed in Table 3.2. This model includes country and cohort fixed effects. We also include fixed effects to control for the gender time trend, and the reference category in this interaction between gender and cohort is the middle cohort (1971-1975). Moreover, the model includes gender and tracking age and their cross-level interaction, as well as several contextual-level control variables and their cross-level interaction with gender.

Table 3.2. Multilevel linear regression model of years of education

<table>
<thead>
<tr>
<th>Model 1</th>
<th></th>
<th>B</th>
<th>SE</th>
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<tbody>
<tr>
<td>Female</td>
<td></td>
<td>.148</td>
<td>.097</td>
</tr>
<tr>
<td>Tracking age</td>
<td></td>
<td>.103 **</td>
<td>.037</td>
</tr>
<tr>
<td>Tracking age * female</td>
<td></td>
<td>.084 ***</td>
<td>.016</td>
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<tr>
<td>Vocational enrolment a</td>
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<td>-0.015 **</td>
<td>.005</td>
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<td>.003</td>
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<td>.346</td>
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<td>Tertiary sector a</td>
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<td>.008</td>
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<tr>
<td>Log(GDP) a</td>
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<td>.180</td>
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<td>Income inequality a</td>
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<td>.010</td>
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<tr>
<td>Constant</td>
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<td>12.917 ***</td>
<td>.198</td>
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</table>

| Country fixed effects |   | Yes |
| Cohort fixed effects |   | Yes |
| Cohort * female fixed effects |   | Yes |

Variance components

| Country-cohort |   | .061 |
| Individuals |   | 7.239 |

Random slope for female

| Country-cohort |   | .079 |

N(individuals) (10% sample) |   | 344,285 |
N(country-cohorts) |   | 112 |

Note: This model includes country and cohort fixed effects and the interaction between cohort and gender (the reference group is the middle cohort (1971-1975)). Two-tailed test: * p < .05. ** p < .01. *** p < .001.

a For ease of interpretation, these variables have been mean centered in the models.
In this model, we do not observe a significant main effect of gender, which indicates that, on average, men and women do not significantly differ in their completed years of education when the tracking age is 10 (in the birth cohort 1971-1975). The positive and significant main effect of the tracking age shows that when the tracking age increases by 1 year, completed years of education increase, on average, by 0.103 years for men. In line with our expectations, the cross-level interaction between the tracking age and gender shows that this positive effect of the tracking age is significantly stronger for women than for men. This also suggests that even though men and women do not differ in their completed years of education when the tracking age is 10, women outperform men when the tracking age is higher. More specifically, it shows that the gender effect of being female increases by .084 for every year that the tracking age is postponed.

Figure 3.5 displays the marginal effect of gender on years of education. In line with hypothesis 1, this figure demonstrates that when the tracking age is postponed, women benefit more. More specifically, it shows that when the tracking age is 10, we do not predict a significant difference in completed years of education between men and women. However, women outperform men when the age of first selection is 11 or higher. When the tracking age is 16, women outperform men in education, with a difference of approximately one-fifth of a standard deviation in years of education.

**Figure 3.5.** Marginal effects of gender(female) on years of education, by age of first selection

*Note:* This figure is based on model 1, Table 3.2. The 95 percent confidence intervals are presented.
Multivariate results on the field of study

We employ two multinomial logit regression models of the field of study for respondents who finished ISCED levels 3 or 4 and ISCED levels 5 or 6, respectively. The baseline category in these analyses is social sciences, business and law, as this is a large field with lower gender segregation than that of other (large) fields. These models include country and cohort fixed effects, as well as the interaction between cohort and gender. Again, the middle cohort (1971-1975) is the reference category. Moreover, the models include gender and tracking age and their interaction, as well as various contextual-level control variables and their interaction with gender. In these models, we adjust for clustering of respondents in country-cohorts.

As the coefficients of a multinomial logit model can only be interpreted in reference to the baseline category, i.e., they describe how a predictor relates to the probability of observing a particular outcome category relative to the reference category, they are difficult to interpret. Significance, effect size and even the direction of the regression coefficients are only meaningful when compared to the baseline category. Therefore, here, we only present the marginal effects, which gives us the average probability of completing a degree in a specific field of study and can be interpreted independent of the baseline category. The regression coefficients of the multinomial logit models can be found in Appendix D.

Figure 3.6 displays the marginal effect of gender on completing a degree in specific fields of study by the tracking age for respondents who finished ISCED levels 3 or 4. This figure shows that among individuals who finished ISCED levels 3 or 4, women are overrepresented in teacher training and education sciences, humanities and arts, social sciences, business and law, health and welfare and services. Women are underrepresented in science, mathematics and computing, engineering, manufacturing and construction and agriculture and veterinary studies.

We observe that the tracking age is associated with changes in the gender disparity in several fields of study, but we do not observe a clear trend towards smaller or larger gender disparities when the tracking age changes. On the one hand, we observe that in teacher training and education sciences, health and welfare and engineering, manufacturing and construction, later tracking increases gender segregation. More specifically, in teacher training and education sciences and health and welfare, we observe that when the tracking age increases, women’s overrepresentation increases by up to a maximum of 2.5 and 7 percentage points, respectively. In engineering, manufacturing and construction, women have a 47 percent lower probability of completing a degree when the tracking age is 10, and this underrepresentation increases by up to a maximum of 4 percentage points when the tracking age increases.
Figure 3.6. Marginal effects of female on fields of study (ISCED levels 3-4) by age of first selection

Note: This figure is based on Table D.1, Appendix D. The 95 percent confidence intervals are presented. The ranges on the Y-axes differ. Complete names of the fields of study that are shortened in this figure: Teacher training=teacher training and educational sciences, social sciences=social sciences, business and law, mathematics=mathematics, science and computing and engineering=engineering, manufacturing and construction.
Figure 3.7. Marginal effects of female on fields of study (ISCED levels 5-6) by age of first selection

Note: This figure is based on Table D.2, Appendix D. The 95 percent confidence intervals are presented. The ranges on the Y-axes differ. Complete names of the fields of study that are shortened in this figure: Teacher training=teacher training and educational sciences, social sciences=social sciences, business and law, mathematics=mathematics, science and computing and engineering=engineering, manufacturing and construction.
On the other hand, in the five other fields of study, there is at least a tendency towards smaller gender gaps when the tracking age increases. In humanities and arts and agriculture and veterinary studies, the decrease in segregation is small, by up to a maximum of 0.5 percentage points, when the tracking age increases. With respect to social sciences, business and law and services, we observe that when the tracking age increases, women’s overrepresentation decreases by up to a maximum of 4 and 3 percentage points, respectively. With respect to science, mathematics and computing, we observe that the underrepresentation of women decreases when the tracking age increases. More specifically, we observe that when the tracking age increases, women’s underrepresentation decreases by up to a maximum of 2.5 percentage points. Even though in these fields of study, we observe that gender segregation decreases when the tracking age increases, later tracking does not decrease segregation in all fields of study, providing us with mixed evidence for our second hypothesis.

Figure 3.7 displays the marginal effect of gender on completing a degree in specific fields of study by the tracking age for respondents who finished ISCED levels 5 or 6. This figure shows that also among individuals who finished ISCED levels 5 or 6, women are overrepresented in teacher training and education sciences, humanities and arts, social sciences, business and law, health and welfare and underrepresented in science, mathematics and computing, engineering, manufacturing and construction and agriculture and veterinary studies. In services, women are over- and underrepresented dependent on the tracking age.

Again, we observe that tracking age is associated with gender gaps in some fields of study. Later tracking increases segregation in teacher training and education science and services. More specifically, in teacher training and education sciences, we observe that when the tracking age increases, women’s overrepresentation increases by up to a maximum of 2.5 percentage points. With respect to the service field, the figure shows that whereas women are 1 percent more likely to complete a degree in services when the tracking age is 10, this reverses to an underrepresentation, with men being almost 5 percent more likely to complete a degree in this field, when the tracking age is 16.

In mathematics, science and computing, the underrepresentation of women reduces when the tracking age increases, up to a maximum of 2.5 percentage points. With respect to engineering, manufacturing and construction, we also see that the gender differences decline when the tracking age increases. When the tracking age is 10, women have a 27.5 percent lower probability of completing a degree in this field, whereas this probability decreases to 18.3 percent when the tracking age is 16. In social sciences, business and law and health and welfare, we observe that women’s overrepresentation (slightly) decreases when the tracking age is higher, up to a maximum of 6 and 1 percentage points, respectively. This shows, in line
with hypothesis 2, that when societies postpone the moment of tracking, gender segregation in STEM, health and welfare and the social sciences decreases.

Hence, the tracking age does not affect all fields of study and in some fields, later tracking even increases gender segregation. However, among most fields of study, we find, in line with hypothesis 2, that later tracking reduces horizontal gender segregation.

3.5 Conclusion and discussion

To what extent does the tracking age affect male-female differences in educational outcomes? In this paper, we tried to answer this question by investigating the impact of educational reforms concerning the age of first selection on vertical and horizontal gender segregation in education. With the use of a within-country over-time design, we examined the relationship between the tracking age and gender differences in completed years of education and fields of study in several European countries over a long time period. Moreover, within these models, we controlled for several other contextual-level features that potentially affected gender differences in educational outcomes, such as the gender-ideological climate and labour market demand.

In line with previous research, we find that later tracking is beneficial for women’s completed years of education relative to men’s. Our study shows that even though the postponement of tracking positively affects men’s years of education, this impact is much stronger for women, resulting in increased vertical gender inequality in education to the benefit of women. Previous studies have argued that the positive impact of later tracking on women’s completed years of education may be a consequence of different educational systems. These works have argued that in late-tracking countries, traditionally female-labelled education fields are represented at higher educational levels, resulting in more years of education for women but comparable occupational credentials.

Therefore, in this study, we also examined whether the impact of the tracking age extends to horizontal gender segregation in education. We find that educational reforms concerning the tracking age have an impact on male-female differences in fields of study as well, at least in most fields. However, the results are somewhat mixed. While we find, in line with our expectation, that later tracking reduces gender segregation in most fields of study, we also find that it increases segregation in some fields.

Especially among the individuals who finished ISCED levels 3 or 4, we observe that later tracking is not just associated with smaller gender gaps. In engineering, manufacturing and construction and health and welfare in particular, the gender disparities increase even more when the tracking age increases. Previous research argues that desegregation is more
likely among the higher educated (England 2010). When upward mobility within the gender boundaries is possible, people prefer that option over transgressing those boundaries. This means that people prefer to improve their level of education within gender-typical fields of study than to switch to a gender-atypical field of study. Upward mobility among the higher educated is more difficult within the gender boundaries, as their educational level is already high. Therefore, higher-educated individuals are more likely to transgress gender boundaries and switch to a gender-atypical field of study. Late-tracking systems may provide students with more opportunities to be upwardly mobile, which results in women and men attaining higher levels of education in late-tracking systems and in higher-educated students switching to gender-atypical fields of study.

Among the individuals who finished ISCED levels 5 or 6, we find that later tracking is associated with smaller gender gaps in STEM fields in particular. The theoretical explanation suggested in our study is that later tracking decreases the number of opportunities to exercise expressive choice and the uncertainty about one’s educational potential and, therefore, decreases the likelihood of gender-typical decisions. Potentially, these mechanisms mainly apply to the case of STEM fields. The high uncertainty about a student’s potential and about the expected success in STEM subjects in early-tracking systems might be higher for women due to gender stereotypes and the low number of female role models in these fields. However, as these fields are highly related to subjects taught in secondary education and as girls achieve better grades in STEM courses than boys (Buchmann, DiPrete, and McDaniel 2008), at the end of secondary education, girls might be less uncertain about their educational potential and might be more likely to enter STEM fields. Moreover, from an upward-mobility perspective, it makes sense that women move into STEM fields in particular. The theoretical explanation underlying this relationship requires further study, however, as we were unable to test the specific mechanism.

Even though in this study we observe that later tracking decreases segregation in STEM fields, we find that later tracking does not just lead to asymmetric desegregation (England 2010). Our results provide evidence that when the tracking age is postponed, not only do women move into male-dominated fields, but men also move into female-dominated fields, especially into social sciences, business and law. Hence, not only women but also men choose less gender-typical fields of study when the tracking age is postponed. This suggests that educational reforms concerning the tracking age also have an impact on male-female differences in occupational credentials, which makes it likely that these reforms have (long-term) consequences for gender differences in future economic and labour market outcomes as well.

In this article, we focused explicitly on between-school tracking, which is only one way
in which educational tracking can be organized. Several countries that are categorized as having no between-school tracking, such as the United States and the United Kingdom, employ another type of ability sorting, also known as within-school tracking or course-by-course tracking (Chmielewski 2014; Maaz et al. 2008). Even though within-school tracking is a less rigid form of educational tracking, as students are not separated for the full curriculum, students are separated by courses at varying levels of difficulty in some subjects. This type of ability sorting can also affect gender differences in educational outcomes. For instance, if students have to make decisions at an early age about the content and level of specific courses, such as mathematics, this can also have a large impact on horizontal gender segregation later in the educational career. In this study, we argue that the timing of educational decisions is important for gender differences in educational outcomes. Potentially, this is irrespective of whether these decisions concern between-school track decisions or within-school curriculum decisions. Future research should look at these different types of tracking systems and investigate whether tracking has comparable effects when it takes a less institutionalized form.

In conclusion, our article suggests that educational reforms can have long-term consequences for gender inequality, as our paper shows that reforms concerning tracking have an impact on both the vertical and horizontal dimensions of gender segregation in education. We find, in line with previous research, that later tracking enhances women’s advantage in educational attainment, thereby contributing to the gender revolution in education. Moreover, we observe that later tracking affects horizontal gender segregation in education. Among the higher-educated people in particular, we observe that both men and women become more likely to complete a degree in gender-atypical fields when the tracking age is postponed. Hence, educational reforms towards later tracking not only contribute to the gender revolution in education but also reduce gender segregation across fields of study.