MAX PLANCK INSTITUTE
FOR DEMOGRAPHIC RESEARCH

Konrad-Zuse-Strasse 1 · D-18057 Rostock · Germany · Tel +49 (0) 3 81 20 81 - 0 · Fax +49 (0) 3 81 20 81 - 202 · www.demogr.mpg.de

MPIDR Working Paper WP 2022-022 | October 2022
https://doi.org/10.4054/MPIDR-WP-2022-022

Educational field, economic uncertainty, and fertility decline in Finland in 2010–2019

Julia Hellstrand
Jessica Nisén
Mikko Myrskylä | office-myrskyla@demogr.mpg.de

Educational field, economic uncertainty, and fertility decline in Finland in 2010–2019

Julia Hellstrand (1,2), Jessica Nisén (2,3), Mikko Myrskylä (1,2)

1. Centre for Social Data Science and Population Research Unit, University of Helsinki, Helsinki, Finland

2. Max Planck Institute for Demographic Research, Rostock, Germany

3. INVEST Research Flagship, University of Turku, Turku, Finland

Acknowledgements

The work was supported by the Academy of Finland [grant numbers 332863, 320162] (INVEST Research Flagship) and the Strategic Research Council of the Academy of Finland [grant numbers 345130, 345131] (Family Formation in Flux – Causes, Consequences, and Possible Futures, FLUX). We thank Professor Hill Kulu for his helpful comments.

Abstract

Fertility declined sharply and unexpectedly in Finland in the 2010s. Using detailed Finnish register data, we calculated total fertility rates (TFRs) and the proportion of women expected to have a first birth (TFRp1) in 2010–2019 for 153 fields of education and estimated how the characteristics of each field predicted its fertility decline. As educational field predicts factors related to economic uncertainty, heterogeneity in fertility decline across fields could shed light on the role of economic uncertainty behind the recent fertility decline. In general, women with the highest initial fertility levels (health, welfare, and education) and women in agriculture experienced weaker fertility declines (around -20% or less), while women with the lowest initial fertility levels (ICT, arts and humanities) experienced stronger fertility declines (around -40% or more). The extent of the fertility decline increased with higher unemployment and lower income levels of the field, and with a lower share employed in the public sector. These uncertainty measures together explained one-fourth of the decline in TFR and two-fifths of the decline in first births. The results imply that groups characterized by stable job prospects escaped very strong fertility declines and that objective economic uncertainty fueled the fertility decline in Finland.

Keywords: Finland, fertility decline, educational field, economic uncertainty

Introduction

Finland and the Nordic countries have a long history of relatively high fertility (Andersson et al. 2009). However, while female fertility differences across levels of education are small – completed fertility differs by around 0.1 children per educational category (primary, upper secondary, tertiary) in Finland, and in other Nordic countries the gradient disappeared by the cohorts born in the 1970s (Jalovaara et al. 2019) – the high average fertility levels mask large variation within the field of education. In many countries, including the Nordic countries, women in the fields of health and teaching form a class of their own, with the highest levels of fertility and the lowest levels of childlessness (Hoem, Neyer, and Andersson 2006b; Begall and Mills 2012; Michelmore and Musick 2014; Oppermann 2017). This is often attributed to the better working conditions and more supportive work-family environment in these fields (Hoem, Neyer, and Andersson 2006a), but also to the higher family orientation of women in these commonly female-dominated fields (Van Bavel 2010). In turn, the fields of arts and humanities are characterized by low fertility and high levels of childlessness. Given that gender equality and family-work compatibility are explicit policy goals in the Nordic countries, the differences in fertility by field of education caused by structural factors represent an important policy concern, as they suggest that family-work reconciliation may not be as easy for women in all fields (Rønsen and Skrede 2010).

During the 2010s the Nordic countries have witnessed pronounced fertility declines – declines mainly driven by first births (Hellstrand et al. 2021). The fertility decline was particularly strong in Finland, where the total fertility rate (TFR) fell from 1.87 in 2010 to 1.35 in 2019 (Official Statistics of Finland (OSF) 2020). The Nordic fertility decline appears to be a relatively universal phenomenon; beyond the much faster reduction in first births among childless women than in subsequent childbearing among mothers (Hellstrand et al. 2021), previous studies have not found large variation across other population subgroups, e.g. by sub-national region, educational level, or migration background (Campisi et al. 2020; Ohlsson Wijk and Andersson 2022). However, the first

birth decline has been somewhat more pronounced among the lower educated (Comolli et al. 2020; Hellstrand, Nisén, and Myrskylä 2022) and those with a weaker labour market attachment (Ohlsson Wijk and Andersson 2022).

The lack of strong variation in the decline has made it difficult to identify the drivers of the decline, and consequently, they remain poorly understood. However, no studies have examined how fertility in the 2010s has declined by field of education. Besides the importance of monitoring fertility variation across fields in times of changing overall fertility levels, differences in the extent of the fertility decline by field could provide clues of the mechanisms underlying the decline. In particular, analysing the decline in fertility by field of education provides one with a critically important window into understanding the role of economic uncertainty in the recent declines.

Recent Finnish surveys suggest that perceived uncertainty together with preferences for a child-free life were important reasons for postponing childbearing in the 2010s (Savelieva, Jokela, and Rotkirch 2021). The field of education strongly predicts factors related to uncertainty, such as future employment conditions, income security, and work environment, and the prospects for finding a job that matches the field of study (Kogan and Müller 2003; Salas-Velasco 2007; Begall and Mills 2012). It is possible that more stable employment conditions have hindered strong declines. In such a case, we might observe slower fertility declines in the fields of health and teaching, which are fields with both high employment rates and high shares in the public sector. The somewhat stronger decline observed in previous studies among the least educated and those with a weaker labour market position suggest that objective economic uncertainty may be fueling the declines.

However, rather similar declines across fields are also possible. The recently developed Narrative Framework hypothesized that uncertainty has increased in peoples' lives particularly in the last decade and that uncertainty stemming from expectations and perceptions of the future that do not necessarily depend on one's own current circumstances is important in shaping fertility decisions (Vignoli, Bazzani, et al. 2020). This Narrative Framework was developed in response to the

unexpected declines in fertility observed across many European countries in the 2010s. The strength of the fertility declines in these countries was not related to standard factors explaining fertility change (e.g. severity of recession or extent of family policies). The same logic could be applied to different fields of education in a country – the extent of the declines might not necessarily be related to objective uncertainty within fields but more so to broader perceived uncertainty irrespective of the actual circumstances within a field.

This study examined how fertility declined by field of education in Finland since 2010. We aimed first to describe the variation in fertility levels and declines across educational fields, and second to test whether the characteristics associated with different fields are related to the extent of the fertility declines, consequently revealing some of the potential mechanisms behind the fertility decline. Our research questions were as follows:

1. Does the extent of the fertility decline vary across different educational fields?
2. Can characteristics of the field reflecting economic uncertainty explain the extent of the fertility decline?

We hypothesized finding notable variation by field of education, with stronger declines in fields characterized by higher (objective) uncertainty, e.g. lower employment. To test these hypotheses, we used the Finnish full population register data and calculated total fertility rates between 2010 and 2019 for 153 fields of education. As the fertility decline in the 2010s is strongly connected to declines in first birth (Hellstrand, Nisén, and Myrskylä 2020), we also present results for first births.

The aggregate analysis of this study is a strength because it allows evaluation of fertility patterns and trends for an exceptionally large number of detailed fields of education identified from individual-level data. This is the first study to provide fertility estimates by field of education in Finland. Finland is a particularly interesting study setting because it is considered a Nordic

vanguard country in childbearing behaviour and because fertility declined markedly in Finland in the 2010s.

Background

Nordic fertility regime and policy challenges

Finland is often situated within the Nordic fertility regime – a concept that refers to the combination of high and stable fertility, high support for working mothers, and high female labour force participation (Neyer et al. 2006; Merz and Liefbroer 2018). Within this regime, the Nordic countries share many similar traits in their family policies and childbearing patterns (Andersson et al. 2009; Jalovaara et al. 2019). Gender equality is an explicit policy goal in the Nordic countries (Esping-Andersen 1990), and family policies are also designed to promote gender equality rather than to promote childbearing (Rønsen 2004). However, it is generally assumed that the family policies have contributed to a favourable setting for childbearing, as they reduce work-family conflicts among women (Brewster and Rindfuss 2000; Adserà 2004). The dual earner-dual caregiver model prevalent in the Nordic countries expects both men and women to take part in the labour force and in childrearing, and is promoted by relatively generous family polices, e.g. earmarked parts of paid parental leave to both parents and affordable childcare for all children (Ellingsæter and Leira 2006; Gornick and Meyers 2009).

The combination of high levels of female labour force participation with relatively high levels of fertility in the Nordic countries suggests that the policy goal to promote gender equality has been successful. However, some trends in the Nordic countries have caused concerns, as they are less compatible with gender equality in the labour market and in the family. First, gender segregation in the labour market – i.e. women being more likely to work in female-typed jobs and less likely to hold managerial positions than men – is among the highest in Nordic countries across high-income countries (Mandel and Semyonov 2006). Further, women educated to work in female-dominated

occupations in the public sector (e.g. health and teaching) have much higher fertility than women educated in less gender-segregated professions or in male-dominated fields (Lappegård and Rønsen 2005; Hoem, Neyer, and Andersson 2006b). Hence, the relatively high and stable cohort fertility levels have existed concurrently with high gender segregation and high fertility variation between educational fields. This indicates that work-family reconciliation might be more difficult in some fields, although selection into certain fields of education based on family preferences may also play a role.

Educational field and fertility

In most developed countries, higher educated women tend to have less children than lower educated women. This negative gradient by education is often explained by the higher opportunity costs of motherhood among those more highly educated (Oppenheimer 1994), by selection due to differences in childbearing preferences, and by increased possibilities of lifestyles other than motherhood being available to the higher educated (Surkyn and Lesthaeghe 2004). However, the negative education gradient in fertility is small in Finland (the difference was -0.16 between tertiary and primary-educated of the late 1960s cohort, compared with an average of -0.36 for 15 European countries (Nisén et al. 2021)) and has even vanished in other Nordic countries for the early 1970s cohort (Jalovaara et al. 2019), often considered to result from the Nordic family policies supporting the combination of work and family (Brewster and Rindfuss 2000; Adserà 2004).

While most studies on fertility and education dynamics have focused on educational level or educational enrolment, an increasing number of studies pays attention to the educational field, which has turned out to be a strong predictor of fertility in high-income countries (e.g. Martín-García and Baizán 2006; Begall and Mills 2012) and even stronger than the mere level of education in Nordic countries (Lappegård and Rønsen 2005; Hoem, Neyer, and Andersson 2006a, 2006b). For instance, in the 1955–1959 Swedish cohorts, among those educated to the lower tertiary level, midwifes had on average 2.39 children while women educated in the field of arts had only 1.65

children (Hoem, Neyer, and Andersson 2006a). In comparison, those with only primary education had 2.1 and those with tertiary education had 1.9 children on average (Jalovaara et al. 2019). Similarly, childlessness levels varied from 10% for primary-school teachers to above 30% in humanities among the tertiary educated 1955–1959 Swedish cohort, but remained close to 15% across the different levels of education (Hoem, Neyer, and Andersson 2006a). Following the more recent cohorts, childlessness has increased particularly among the least educated, and lower educated women nowadays have both high childlessness and a high proportions of large families relative to higher educated women, who more often have exactly two children (Jalovaara, Andersson, and Miettinen 2020).

There are a number of reasons suggested to explain the variation in fertility across different fields of study, and the literature suggests both causal (field of study affects employment prospects and attitudes, and thereby, fertility) (e.g. Cook and Minnotte 2008) and selection (personality traits and attitudes about family life affect both the choice of field and fertility) (e.g. Van Bavel 2010) effects. Reverse causality is also possible, as childbearing may influence women's choice of field, i.e. they may educate to another field after childbearing (Tesching 2012). Although this study does not aim to test the relative importance of these different mechanisms, in the following we briefly outline the reasons depicted by the literature to shed light on the mechanisms behind fertility variation across fields, which may help to explain potential variation in the strength of recent fertility decline as well.

Educational field and labour market

Different fields of education lead to occupations with different characteristics. First, educational fields differ in how challenging it is to enter the labour market. Those who have studied in fields that do not lead to any particular occupation may face difficulties in becoming established in the labour market and are at high risk of unemployment. Examples of such fields are general education, fine arts and humanities, and general social sciences. These fields have the lowest fertility levels in

both the Nordic countries (Hoem, Neyer, and Andersson 2006b) and elsewhere (Michelmore and Musick 2014).

Second, employment stability varies between educational fields. Fields that lead to jobs in the public sector may have a positive impact on childbearing because they provide stable employment prospects and a secure income. For instance, health care and teaching work is predominantly carried out in the public sector in the Nordic countries. Generally, employment in the public sector is less subject to fluctuations of the economy than employment in the private sector (e.g. Kopelman and Rosen 2016), as services provided by the public sector (e.g. health and teaching) need to be organized regardless of the business cycle, while companies in the private sector may suffer from downsizing in economic downturns. The public sector is also considered less competitive than the private sector and could therefore provide better possibilities for employee-driven flexibility and generous parental leave arrangements (Begall and Mills 2012; Tesching 2012). In many countries, the public sector was the first to introduce parental leave and part-time work to facilitate the compatibility of motherhood and employment (Hoem, Neyer, and Andersson 2006a; Feeney and Stritch 2017). However, evidence for the transition to motherhood across different occupations in Sweden found that the positive effect of working in the public sector was limited mainly to caring and teaching occupations (Ohlsson Wijk 2015).

Income is another aspect that provides security to the family and alleviates the direct costs of childbearing (Becker 1993). Higher female income has been shown to promote motherhood, particularly in the Nordic countries (Jalovaara and Miettinen 2013; Andersson, Kreyenfeld, and Mika 2014). Artists, humanists, and librarians are examples of fields with high childlessness and relatively low income compared with other fields with the same education level, but income alone does not explain the variation in fertility across fields in Sweden (highest income was found in male-dominated fields, which had average levels of fertility) (Hoem, Neyer, and Andersson 2006a). Further, skill depreciation during family-related work absence is another potential factor that could

explain fertility differences by field of education (Hoem, Neyer, and Andersson 2006a). Moreover, the possibility to work part-time promotes fertility in some contexts (Begall and Mills 2012), but in the case of Finland part-time employment is notably uncommon (Eurostat 2019).

Self-selection and social environment

Lifestyle preferences and self-selection have been shown to be important in shaping both career and childbearing paths (Hakim 2003). Hence, women with a stronger family orientation have been argued to choose certain types of fields that emphasize the care of other individuals. The social environment during education and employment is also assumed to affect family-related attitudes and childbearing. Fields that convey stereotypical female qualities are assumed to foster the preferences to have (more) children (Hoem, Neyer, and Andersson 2006a; Van Bavel 2010). The opposite is also true; high levels of childlessness are observed in the humanities, fine arts, and social sciences, fields that were the first to question norms related to motherhood and childbearing (Neyer, Hoem, and Andersson 2017).

Female-dominated fields tend to have higher fertility, with the prime example being, again, women in health and teaching. Also fields in the private sector that are highly dominated by women (e.g. food production, textile industries, and beauty and hairdressing) have been shown to have low levels of childlessness (Neyer, Hoem, and Andersson 2017). Female-dominated fields are considered more flexible and considerate of needs to care for children. On the other hand, women educated in fields with a more balanced distribution of men and women (e.g. business and journalism) are assumed to face more competition from men at the workplace, which is more likely to discourage childbearing (Neyer, Hoem, and Andersson 2017). Further, it has been argued that women who choose the most gender-atypical fields are also less likely to conform to traditional gender roles and childbearing patterns (Ohlsson Wijk 2015). Empirical evidence based on data from the early 2000s confirmed that women across several European countries with more traditional gender role attitudes were less likely than others to postpone their first birth (Van Bavel 2010).

Partnership status explains some, but not all, of the variation in fertility across fields; the fields with the lowest (health and teaching) and the highest (humanities) levels of childlessness also represent the top and bottom groups, respectively, in ever getting married in Sweden (Hoem, Neyer, and Andersson 2006a). Nevertheless, it was found in a study examining the postponement of motherhood across European women that the effects of the characteristics of field of study – family roles attitudes, share females in the field, and earnings – remained significant also after controlling for partnership status (Van Bavel 2010).

Economic uncertainty and fertility decline

Economic constraints and uncertainty are important factors in explaining trends in fertility patterns (e.g. Kreyenfeld 2010; Kreyenfeld and Andersson 2014). Empirical evidence shows that fertility patterns tend to follow business cycles; individuals often postpone childbearing in economically uncertain times and favour it in times of economic growth (Sobotka, Skirbekk, and Philipov 2011). Of all parities, particularly the first birth tend to be affected by economic uncertainties (Blossfeld and Hofmeister 2006; Kreyenfeld and Andersson 2014).

The fertility decline in the 2010s in the Nordic countries (and elsewhere) was initially linked to the great recession in 2008, but the decline continued and even accelerated after macro-economic recovery. Perceived uncertainty has then been introduced as a broader framework to explain fertility patterns (Comolli et al. 2020). Scholars argue that perceived uncertainty, which is not necessarily rooted in objective dimensions of economic uncertainty, has increased in the 2010s due to globalization dynamics, new technologies, and media channels (Comolli et al. 2020; Vignoli, Guetto, et al. 2020). Hence, the future is perceived by individuals to have become less predictable, adding an additional source of economic uncertainty. Therefore, individuals increasingly shape expectations and perceptions of the future based on past experiences and the social context (e.g. shared narratives from peers, the media, and others) in which they live and not necessarily on their

own current economic situation. These expectations and perceptions of the future are emphasized to play an increasingly important role in shaping fertility decisions (Vignoli, Bazzani, et al. 2020).

This idea of perceived uncertainty, which is not necessarily related to own economic situation as a driver of fertility decline is supported by empirical evidence from the Nordic countries showing pronounced fertility declines also in high education and income groups (Comolli et al. 2020; Hellstrand, Nisén, and Myrskylä 2022), groups that tend to experience less objective economic uncertainty. Additionally, Finnish surveys find that perceived uncertainty was one of the main self-reported reasons for postponing (or forgoing) childbearing in the 2010s, and this was reported to be irrespective of socioeconomic background (Savelieva, Jokela, and Rotkirch 2021). However, the first birth decline (which accounts for most of the total decline) accelerated more in the lowest education group than in the higher educated (Comolli et al. 2020) and more in those with the weakest labor market attachment (Ohlsson Wijk and Andersson 2022) in conditions of greater objective labor market and economic uncertainty. These findings indicate that in addition to perceived uncertainty actual economic constraints are also relevant in the recent changes.

We extend this line of research by focusing on the aspect of uncertainty in the study of fertility across educational fields. More precisely, we look into the fertility decline in Finland by field of study with different degrees of objective economic uncertainty, as measured by quantifiable characteristics of the fields. We hypothesize that in times of increasing perceived uncertainty combined with a childfree life becoming more popular, those educated in fields with less stable employment and earning prospects might be more prone to postpone their childbearing than before. On the other hand, as suggested by the Narrative Framework, it is possible that the perception of uncertainty and the related fertility decisions are not linked to such objective measures, in which case the variation in the fertility decline by field would not be explained by our measures of economic uncertainty (e.g. share employed, average income, and share working in the public sector).

The Finnish context

The education system

The Finnish education system is flexible without early track differentiation, and there are wide possibilities to continue to higher education or to change the field of education (Blossing, Imsen, and Moos 2014). After the nine-year compulsory basic education ends, students can apply for two different types of upper secondary education: general upper secondary schools or vocational institutions. General upper secondary education provides general education that prepares for further studies but does not qualify students for any particular occupation. General upper secondary education ends with a nationally graded matriculation examination, and those who pass the examination are eligible to apply for further studies at universities and universities of applied sciences (UAS)[1]. Vocational upper secondary institutions provide basic skills required in the field and often qualify students for particular occupations. It is common to study for multiple vocational degrees in Finland (also within different fields); more than half of all new students in vocational education (including further and specialized vocational qualification) have already completed at least one secondary or higher level of education (Finnish National Agency for Education 2019).

Education in Finland is free of charge and interruptions to educational careers are not unusual (Orr, Gwosc, and Netz 2011). Further, graduates from vocational upper secondary institutions are eligible to apply for further studies at UAS and may formally qualify for some fields of university education. There are also possibilities to transition between UAS and universities, e.g. to conduct a university Master's degree after an UAS Bachelor's degree. An important difference between UAS and universities is that UAS Bachelor's degrees tend to lead to an occupation, whereas a university Bachelor's degree tends to prepare for Master's studies (Kilpi 2011; Blossing, Imsen, and Moos

[1] UAS provide more practical education than universities, they do not offer postgraduate degrees, and UAS Master's degrees require some prior work experience before acceptance.

2014). Notably, the fields of education are heavily gender-segregated in Finland; women constitute almost 90% of the population in the field of health and welfare and almost 80% in the field of education, while they constitute less than or close to 20% in the fields of engineering, manufacturing and construction, and ICT (Official Statistics of Finland (OSF) 2021).

Unemployment, income levels, and public sector work

The female unemployment rate was 6.2% in 2019 in Finland, right below the EU-27 average of 7.2% (Eurostat 2022c). During the 2010–2019 period female unemployment rose from 7.7% to a peak of 8.6% in 2015 but dropped below the initial level towards the end of the period. The unemployment rate for women was 15.9% in the age group 15–24 years and 4.9% in the age group 25–54 years in 2019, being 3.6 and 0.4 percentage points, respectively, below the unemployment rate for Finnish men.

Income levels have risen faster among the higher income groups in the 2010s, but income inequalities in Finland remain rather small by international standards (OECD 2020). However, inequality in earnings by gender is high in Finland: the median wage for full-time employment was 18% lower for women than for men in 2019, compared with an OECD average of 14% and around 5–7% in other Nordic countries (OECD 2020).

Just above 40% of all women work in the public sector, and this share has been stable in the last decade (Official Statistics of Finland (OSF) 2022). Of the total public sector, women constitute the majority of workers. Further, the largest groups working in the public sector include health care, education, and social service (e.g. children's day care, care for the elderly, and social work) (Ministry of Finance 2006). Finland's public sector together with that of other Nordic countries ranks the highest of all European countries; government employment constitutes 25% of total employment, compared with 16% in the European Union, and these proportions have been stable over time (Eurostat 2022b).

Data and Methods

Categorization of fields

We used register data from Statistics Finland for women born in Finland and aged 15–49 years in 2000–2019 and permanently living in Finland at the end of the year. These individual-level data were used to identify exceptionally detailed groups of educational fields each year during the period of analysis, and these groups were further used in an aggregate-level regression analysis. We first used the ISCED 2011 classification to separate between broad field and level of education. We considered four levels of education: primary (ISCED 0–2), secondary (ISCED 3–4), lower tertiary (ISCED 5–6), and higher tertiary (ISCED 7–8). In order to form more detailed groups beyond the ISCED 2011 classification, we used a 6-digit code provided by Statistics Finland. Hence, we are able to distinguish, for instance, between nurses, health care providers, and midwives within the broad field of nursing and midwifery (ISCED 0913), and between general teachers and special teachers within the broad field of teacher training without subject specification (ISCED 0113).

We identified in total 153 fields[2] of education, which are shown in Appendix Table A 1. Women educated in the broad field of health and teaching constitute one-third of all women, and around 20% are educated in the field of business and social sciences. The fields of engineering, agriculture, ICT, and natural sciences combined constitutes almost 13% and the field of services another 13%, followed by general education and broad programmes (12%), and arts and humanities (10%). Of the detailed groups, the largest groups are nursing and business at secondary and lower tertiary levels, social work at tertiary level, and hotel and restaurant at secondary level. At higher tertiary level, the largest groups are women educated in business and as general teachers, physicians, and lawyers.

[2] 45 groups at secondary level, 55 groups at lower tertiary level, 52 groups at higher tertiary level, and one group consisting of those with only primary education, which is not included in the regression analyses.

Fertility outcome

For the 153 fields of education, we calculated total fertility rates (TFR) using 5-year age-specific fertility rates, and the share expected to ever have a first birth (TFRp1) using 5-year age-specific first birth rates (first births per number of childless women) and a lifetable approach. In order to increase the stability of rates, we grouped together observations in 2009–2011 (the fertility peak) and 2017–2019 (latest available years). The change in TFR and in TFRp1 between 2009–2011 and 2017–2019 is the main outcome of interest for our analysis.

Independent variables in regression models

Characteristics of the field analysed in this study are the proportion unemployed (i.e. percentage of the labour force without a job), mean annual income[3] among the employed (on log scale), and the share working in the public sector (of those employed)[4]. These characteristics were measured in 2018 at age 25–29 years to capture the uncertainty level early in the career and at or before the prime childbearing age.

Methods

We use scatter plots and weighted trend lines to illustrate the fertility decline by field and level of education. The weights are based on the size of the educational fields at age 30–34 years. Further, we use weighted linear regression to analyse the association between the characteristics measuring uncertainty (unemployment, income, and public sector work) and the fertility decline across fields. These characteristics are strongly intertwined, but with the regression we are able to analyse how much each factor matters net of other factors. To compare the predictive power of different predictors, the models are fit to normalized data such that each variable has a standard deviation of 1. Finally, we use counterfactual predictions to estimate how much the fertility decline could have been reduced had factors reflecting uncertainty (e.g. unemployment) been low.

[3] This refers to total earned income subject to state taxation.
[4] Employed students who received student benefits were not included when these characteristics were calculated.

Results

Fertility decline by broad field of education

Figure 1 shows the TFR and the TFRp1 (displayed by three-year moving averages) in 2004–2019 and the changes relative to 2010 by level and broad field of education. As expected, we observe the highest TFR and TFRp1 levels in health and teaching, and the lowest levels in arts and humanities, ICT, and general education at the secondary level. For instance, comparing the levels before the onset of the fertility decline in 2010, among the secondary educated, women in health and welfare had TFR of 2.22 and TFRp1 of 0.85. Correspondingly, women with only general education or those educated in ICT had TFR 1.35–1.40 and TFRp1 0.63–0.65. Among the lower tertiary educated, women educated in social sciences had the lowest fertility with TFR of 1.19 and TFRp1 of 0.59. Among the higher tertiary educated, the TFR and TFRp1 of women educated in teaching were 2.51 and 0.90, respectively, while women educated in ICT and arts and humanities had TFR 1.70–1.73 and TFRp1 0.75–0.78.

Comparing the declines in the 2010s by level of education, the declines in TFR were typically rather similar, but the declines in TFRp1 were somewhat more pronounced among the secondary and lower tertiary educated than among the higher tertiary educated. However, the variation in the strength of the decline by field of education was much more pronounced than by level of education; the fields with the lowest levels at the onset of the fertility decline typically had the strongest declines, and the variation across fields appeared larger among the secondary and the lower tertiary educated than among the higher tertiary educated. Women educated in health and welfare and agriculture typically experienced the weakest declines in TFR, around a 23% decline at all levels. The strongest declines in TFR were observed in ICT, arts and humanities, and general education at secondary level (34–39%), in ICT at lower tertiary level (more than 40%), and in ICT, natural sciences, and engineering at higher tertiary education (31–35%).

The strength of the decline in TFRp1 varied from 12% in health and welfare, to 27% in general education and arts and humanities, and further to 40% in ICT among the secondary educated. Among the higher tertiary educated, the strength of the decline in TFRp1 varied from 4–7% in agriculture, health and welfare, and education, to 10–12% in engineering, ICT, and arts and humanities, and to 16% in natural sciences.

In absolute terms, we also observe divergence in the TFRp1 patterns across fields, but for the TFR, the absolute declines are more similar; for instance, among the secondary educated the absolute change ranges from -0.41 children in agriculture to -0.57 in arts and humanities, and the change in health and welfare amounts to -0.51 children.

[FIGURE 1 ABOUT HERE]

Fertility decline by detailed field of education

The relationship between the initial fertility level in 2009–2011 and the relative fertility decline in the 2010s by detailed field of education is illustrated in Figure 2. The top panels show the TFR and the bottom panels the TFRp1. The exact values can be found in Appendix Table A 1. In terms of TFR, the strongest fertility declines are in fields with the lowest initial fertility (e.g. fine arts, library science, and ICT) among women educated to the secondary or lower tertiary level. Among women educated to the higher tertiary level, there is no relationship between the initial level and the strength of the decline. In terms of first births (TFRp1), the decline is stronger in fields with lower initial levels regardless of educational level, but this relationship between initial level and decline is much weaker at the higher tertiary level. In absolute terms, the TFR declines are rather similar regardless of initial level, but for the TFRp1, the absolute decline is similar to the relative decline (Appendix Figure A 1).

[FIGURE 2 ABOUT HERE]

Fertility decline and economic uncertainty in the field

The relationship between the characteristics reflecting economic uncertainty (share unemployed, mean annual income, and share in the public sector) in the field in 2018 and the relative change in TFR and TFRp1 is shown in

Table 1 and answers the question of how current characteristics of the fields reflecting uncertainty predict fertility declines of a field. The variables are standardized so that a change of one standard deviation in the predictor is associated with a change of β standard deviations of the change in fertility. Scatter plots of these associations based on unstandardized variables can be seen in Figure 3 (TFR) and Appendix Figure A 2 (TFRp1). In bivariate analyses, the changes in the TFR and in the TFRp1 are associated with all three measures of uncertainty. The strength of the fertility decline increased with higher unemployment, lower mean income, and lower share working in the public sector within the field.

[TABLE 1 ABOUT HERE]

[FIGURE 3 ABOUT HERE]

Multivariate regression models

The multivariate regression models include all three uncertainty indicators simultaneously and show how much the predictors combined explain the variation in the fertility decline between fields (

Table 1). This model explains 24% of the decline in TFR and 40% of the decline in TFRp1. Net of other uncertainty measures, unemployment remains the strongest predictor, while the effect of income is no longer significant. Hence, the fields with high unemployment also tend to have low income among those employed but including both measures does not add information to the model (results not shown). In addition, the effect of public sector work remains significant in the multivariate model, although the coefficients are somewhat smaller than in the univariate model. We further show the results of the uncertainty model, including interactions between the uncertainty measures and education level, and this model is used in the prediction and counterfactual analysis.

In

Appendix Table A 2 and

Appendix Table A 3 we demonstrate how the uncertainty model is influenced by inclusion of other factors, such as occupational match, proportions in unions, and proportion of students, variables also strongly associated with the strength of the fertility decline. The decline is stronger with lower occupational match and lower proportions in unions and weaker when the proportion of students is larger. The associations between uncertainty measures with the decline remain largely similar when these other factors are controlled for. However, union status clearly attenuates the effects of uncertainty measures (i.e. including the proportion single in the TFRp1 model halves the effect of unemployment, and the effect of the public sector is no longer significant).

Predicted declines and counterfactual scenarios

The observed and predicted declines based on the uncertainty model (with interactions) are presented in Figure 4. The uncertainty model shown in

Table 1 typically correctly predicted the stronger declines in TFR and TFRp1 in some of the fields in arts and humanities, engineering, and natural sciences (e.g. handicrafts, history, materials, and wild life), the intermediate decline in business, and the weaker decline in health and teaching. However, the model systematically underpredicted both the most severe declines and the weakest declines in TFR and TFRp1. The model underpredicted especially the strong decline in natural sciences at the tertiary level.

[FIGURE 4 ABOUT HERE]

We further estimate how much the fertility decline would have been reduced in a counterfactual scenario where uncertainty was low (Figure 5). Unemployment was set to the minimum rate observed at a given level (1.1% at secondary level, 0% at tertiary level), and the share working in the public sector was set to the maximum share observed at a given level (69.7% at secondary level, ~94% at tertiary level). Rather than a plausible future scenario for Finland, this scenario is meaningful in illustrating the differences in the fertility decline associated with these uncertainty factors. The light blue dotted line represents the scenario where unemployment is low, and the dark blue dotted line the scenario where both unemployment is low and the share working in the public sector is high. If uncertainty was low in all fields, the decline in TFR would have been reduced on average from -26.2% to -19.2% for the secondary educated, from -27.6% to -21.5% for the lower tertiary educated, and from -25.4% to -18.5% for the higher tertiary educated. Moreover, the decline in TFRp1 would have been reduced on average from -16.6% to -7.5% for the secondary educated, from -12.8% to -8.1% for the lower tertiary educated, and from -9.3% to -4.8% for the higher tertiary educated. Hence, the TFR reduction is mid-sized (a reduction by one-fourth), while the TFRp1 reduction is larger (a reduction by one-half at secondary and higher tertiary level, and one-third at lower tertiary).

More than half of this reduction in TFR was due to low unemployment at secondary and higher tertiary level, and up to 67% and 84%, respectively, for the reduction in TFRp1. At lower tertiary

level, a high share in the public sector reduced more (two-thirds) than low unemployment. We also set income to the highest average value at a given educational level[5] (grey dotted line), but this scenario should be interpreted with caution, as income was not significant in the model. Net of unemployment and public sector work, high income reduced the declines further only for the lower tertiary educated.

[FIGURE 5 ABOUT HERE]

Completed fertility and the impact of changing field

To compare the period trends with completed fertility levels, Appendix Table A 4 shows completed fertility and ultimate childless levels for the most recent Finnish cohorts (1971–1975) with full education and childbearing histories. The variation across fields is highly consistent with the variation in TFR and TFRp1 observed in 2010. Completed fertility and ultimate childlessness vary among the secondary educated from 1.48 children and one-third childless (ICT) to 2.32 children and 12% childless (health and welfare). Similarly, at higher tertiary level the women educated in ICT and arts and humanities had 1.59 children on average and one-fourth remained childless, and the women educated in health, welfare, and education had more than two children and 12–13% remained childless. The variation in completed fertility and ultimate childlessness is also consistent with the variation observed in other Nordic countries (Hoem, Neyer, and Andersson 2006a, 2006b).

To gain an overview of the process of changing educational field and its consequences on fertility variation by educational field in the Finnish context, we also calculated the proportion earning a degree in another field than the highest obtained degree at the time of the first birth, and by initial field for mothers and the childless. The latter is to overcome the underlying variation in the propensities to re-educate by different initial fields irrespective of children. The overall propensity to change field after the first birth is higher among the lower educated, but regardless of educational

[5] This refers to 32 740 euros for the secondary educated, 38 531 euros for the lower tertiary educated, 63 915 euros for the higher tertiary educated.

level the propensity to change field is the highest in arts and humanities, ICT, services, and natural sciences, and the lowest in health, welfare, and education. Further, those that change field re-educate most typically in health, followed by business. Comparing the transition rates among mothers and childless women reveals, however, that re-educating in another field after a secondary-level degree is higher among mothers than among childless women in all fields but health. On the contrary, at the tertiary levels, childless women are generally more likely to change their field than mothers, and those initially educated in teaching and health are particularly more likely to attain a degree in another field if they are childless compared with mothers. These findings suggest that work in fields such as health, welfare, and education is indeed more compatible with childbearing.

Discussion

This study examined how the fertility decline in the 2010s in Finland is related to the field of study and the economic uncertainty in that field. Calculating the change in total fertility rates (TFR) and the expected share ever having a first birth (TFRp1) in the 2010s for 153 fields of education showed declines across the fields, but there was considerable variation in the strength of decline especially in the case of first births. Stronger declines (around -40% in TFR and -30% in TFRp1) were found in fields with initially lower levels, such as ICT, arts and humanities, and general education, but also in natural science and engineering with more average levels. Weaker declines (around -20% in TFR and -10% in TFRp1) were observed in fields with initially higher levels (health and teaching) but also in agriculture. In absolute terms, the declines across fields were more similar in total fertility, but variation was notable in the case of first births. Hence, we observed evidence of diverging fertility patterns across fields of education, especially for first births. Further, we observed that the strength of the fertility decline increased with higher unemployment levels, lower shares working in the public sector, and lower income levels. Together, these uncertainty measures

explained one-fourth of the variation in the decline in total fertility and two-fifths in the decline in first births. The results indicate that the fertility declines have been milder among women educated in fields characterized by lower levels of economic uncertainty.

Fertility has for several decades been relatively high in the Nordic countries, and these countries have unlike many other European countries had less to worry about when it comes to future population structures. However, the variation seen in fertility across fields of education over the past decades has raised concern and is often seen as an important policy challenge in the Nordic countries, given that gender equality in the family and in the public sphere is an explicit policy goal (Rønsen and Skrede 2010). Low fertility in fields with less secure employment could indicate that work-family reconciliation might be more difficult in certain fields. Previous studies have already shown that the decline in the Nordic countries is not only resulting in later but also in less eventual childbearing (Hellstrand et al. 2021). Hence, it is plausible that also the diverging period fertility trends found in this study may turn into diverging cohort patterns in fertility across study fields.

Previous research has described pronounced and rather similar declines in the 2010s across population sub-groups, which has made it difficult to identify the underlying drivers. Still, by now one feature stands out; the decline in first births has accelerated among the least educated (Comolli et al. 2020) in all Nordic countries, and at least in Sweden, among those with weaker labour market attachment and lower earnings (Ohlsson Wijk and Andersson 2022). The findings of this study are in line with these previously observed patterns but highlight that first births are being increasingly postponed or foregone not only among those without a degree but also by those with a degree but educated in fields characterized by higher economic uncertainty. Before the onset of the decline, the Nordic countries experienced increasing levels of ultimate childlessness among those with only basic education, and the negative gradient in childlessness across educational levels was turning positive (Jalovaara et al. 2019). The current findings provide further support for the claim that

social inequality in childbearing is growing in the Nordic countries. Groups experiencing higher economic uncertainty may be facing increasing difficulties in family formation.

Scholars highlight perceived uncertainty, which makes the future less predictable (Vignoli, Bazzani, et al. 2020; Vignoli, Guetto, et al. 2020) and more difficult to control by one's own means (Neyer et al. 2022), as a factor explaining fertility change in the 2010s. These uncertainties are assumed to have increased in the 2010s as a consequence of features like increased globalization, the spread of social media, large migration flows, and ever-growing concerns about climate change. However, based on the current results together with recent results from Sweden (Ohlsson Wijk and Andersson 2022), objective uncertainty seems also to fuel the current fertility declines. Perceived uncertainties together with a changing labour market (e.g. increased globalization and automation) (Blossfeld and Mills 2005; Sutela, Pärnänen, and Keyriläinen 2019), weaker income growth among the lower paid (OECD 2020), and rising living costs (especially rents and house prices) (Eurostat 2022a) may contribute to particular difficulty among those with more objective uncertain employment in realizing childbearing plans.

As we observed clear fertility declines also in more family-friendly fields with more stable employment and/or fields with higher income, there are obviously also factors besides those related to labour market uncertainties underlying the fertility decline. For instance, although the fields of health and teaching typically experienced weaker declines in first births, some fields (e.g. pre-school teachers and social workers) had mainly average declines in total fertility. In addition, some fields might be more affected by uncertainties other than employment uncertainties. For instance, those educated in natural sciences (e.g. chemistry, biology, and earth science) experienced relatively strong declines – much stronger than those predicted by the uncertainty model – and women educated in these fields may be more strongly aware of climate change, which might make them hesitant to have children.

This study has several limitations. We were unable to include the (potential) partner's characteristics since this would have implied excluding single individuals, which is not optimal in analysing aggregate fertility trends. Further, this study was focused on women. We would expect that also among men the fertility decline has been more pronounced in fields characterized by higher economic uncertainty, as the declines by educational attainment and income level have been similar for men and women (Hellstrand, Nisén, and Myrskylä 2022), but the role of the public sector for the declines may be gender-specific, given that men much less often work in this sector (Official Statistics of Finland (OSF) 2022). Moreover, we could not distinguish between permanent and temporary employment, which could have provided additional insight. Finally, our study was unable to identify potential changes in childbearing preferences across fields, although they have been suggested to be important drivers of the recent decline (Savelieva, Jokela, and Rotkirch 2021).

To conclude, this study provided important insights into the strong and unexpected fertility declines in the 2010s in Finland. The results showed variation in fertility declines by field of study, with more pronounced declines in fields characterized by higher economic uncertainty, implying that the social divergence in fertility is growing. Policy measures should aim at supporting the barriers to childbearing, which in contemporary Finland are mainly not related to incompatibility of a well-established career with childbearing, but more often to the lack of a well-established career.

Data Availability

The data underlying this article were provided by Statistics Finland (licence number TK/780/07.03.00/2020-4). Individual level register data from Statistics Finland are not freely available.

Appendix tables and figures

Appendix Table A 1: TFR by field of education in 2009–2011 and 2017–2019, and the change between these two periods.

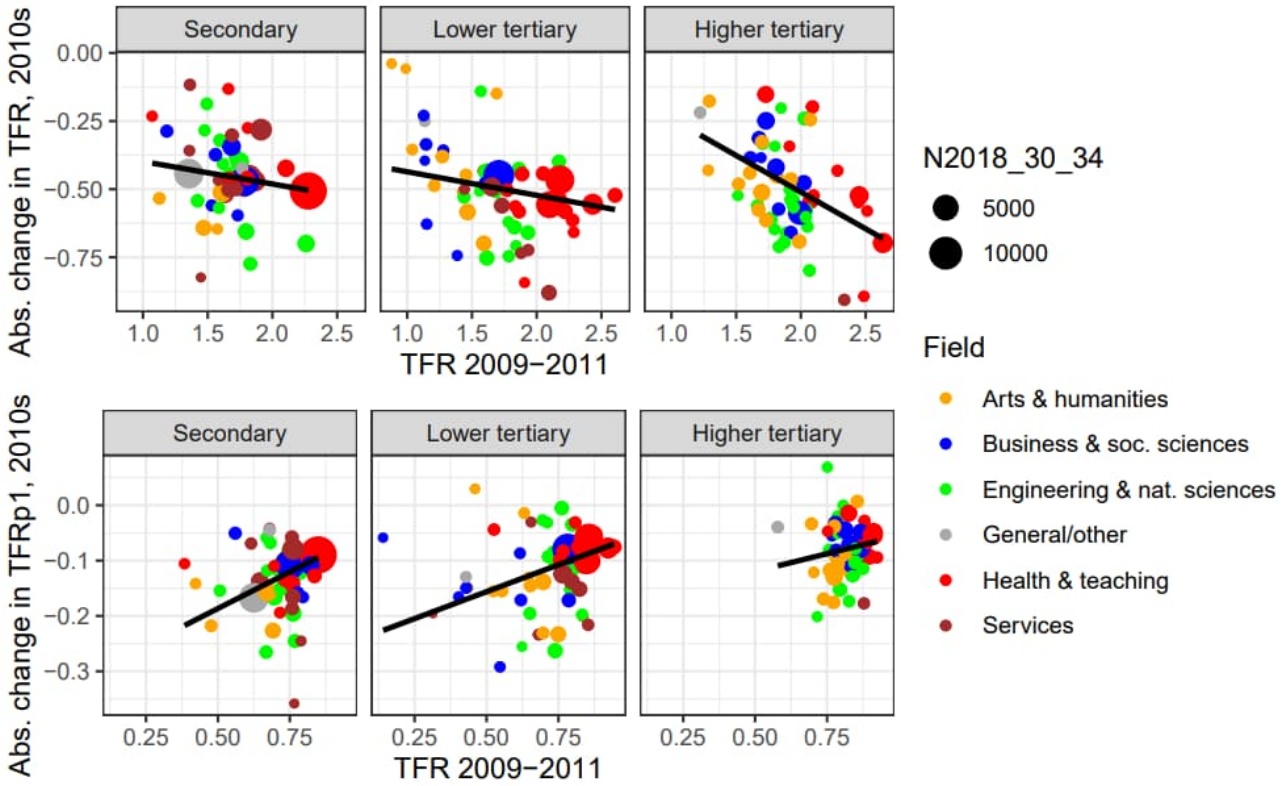
	N2017–19 (15–49)	N2018 (30–34)	TFR 2009–11	TFR 2017–19	Change, %
Arts & humanities					
Higher tertiary					
Speech science	4537	401	2.07	1.83	-11.6
Finnish language	9021	606	1.99	1.29	-35.2
Religion, theology, philosophy, & ethics	6751	493	1.92	1.46	-24
Music & performing arts	8518	530	1.81	1.36	-24.9
Interdisciplinary fields in art	9175	573	1.73	1.12	-35.3
Swedish language	6347	456	1.70	1.37	-19.4
Languages (excluding Finnish and Swedish)	18107	1243	1.70	1.19	-30
History & archeology	7641	508	1.67	1.10	-34.1
Literature & linguistics	6167	424	1.61	1.17	-27.3
Translator (excluding Swedish)	5113	351	1.52	1.04	-31.6
Cultural studies	5345	358	1.29	1.12	-13.2
Fine arts	2878	163	1.28	0.85	-33.6
Lower tertiary					
Translator (UAS or similar)	2095	179	1.69	1.54	-8.9

Fashion, interior and industrial design	12222	1079	1.61	1.18	-26.7
Interdisciplinary fields in art	13620	873	1.59	0.89	-44
Audio-visual techniques and media production	12143	1064	1.47	0.88	-40.1
Music & performing arts	3868	299	1.45	1.01	-30.3
Humanities (excluding history and languages)	1879	77	1.42	0.91	-35.9
Languages (excluding Finnish)	7649	416	1.27	0.89	-29.9
Fine arts	3925	306	1.21	0.72	-40.5
History & archeology	3301	175	1.04	0.69	-33.7
Finnish language	1694	76	0.99	0.93	-6.1
Literature & linguistics	1607	92	0.88	0.84	-4.5
Secondary					
Handicrafts	27177	1874	1.61	1.10	-31.7
Fashion, interior and industrial design	8126	385	1.59	1.27	-20.1
Music & performing arts	3475	155	1.57	0.93	-40.8
Audio-visual techniques and media production	17241	913	1.47	0.83	-43.5
Fine arts	5273	292	1.13	0.59	-47.8
Business, law, & social sciences					
Higher tertiary					
Psychology	13312	827	2.02	1.55	-23.3
Interdisciplinary fields in business	55305	3790	1.99	1.40	-29.6
Civics	5761	393	1.92	1.26	-34.4
Interdisciplinary fields in social sciences	5702	368	1.83	1.26	-31.1
Sociology	19999	1279	1.81	1.39	-23.2
Law	17213	1327	1.73	1.48	-14.5
Economics	1825	105	1.69	1.31	-22.5
Politics	8285	577	1.68	1.36	-19
Journalism & reporting	7668	460	1.61	1.22	-24.2
Lower tertiary					
Interdisciplinary fields in business: UAS	182172	8302	1.71	1.26	-26.3
Secretarial and office work	6591	513	1.60	1.12	-30
Journalism & reporting	2190	109	1.39	0.64	-54
Interdisciplinary fields in business: University	6814	188	1.28	0.92	-28.1
Library, information, & archival studies	2250	141	1.15	0.52	-54.8
Sociology & psychology	6250	267	1.15	0.81	-29.6
Law	2459	63	1.14	0.74	-35.1
Politics & civics	3181	164	1.13	0.90	-20.4
Secondary					
Interdisciplinary fields in business	130139	7224	1.79	1.31	-26.8
Marketing and advertisement	3068	198	1.73	1.14	-34.1
Wholesale and retail sales	25517	1605	1.68	1.34	-20.2
Secretarial and office work	5919	385	1.56	1.19	-23.7
Accounting and taxation	3774	200	1.53	0.97	-36.6
Management and administration	6454	332	1.18	0.90	-23.7
Engineering, agriculture, ICT, & natural sciences					
Higher tertiary					
Electricity, energy, electronics, & automation	4382	284	2.07	1.27	-38.6
Building and civil engineering	3705	245	2.05	1.41	-31.2
Chemical engineering and processes	4582	294	2.04	1.47	-27.9

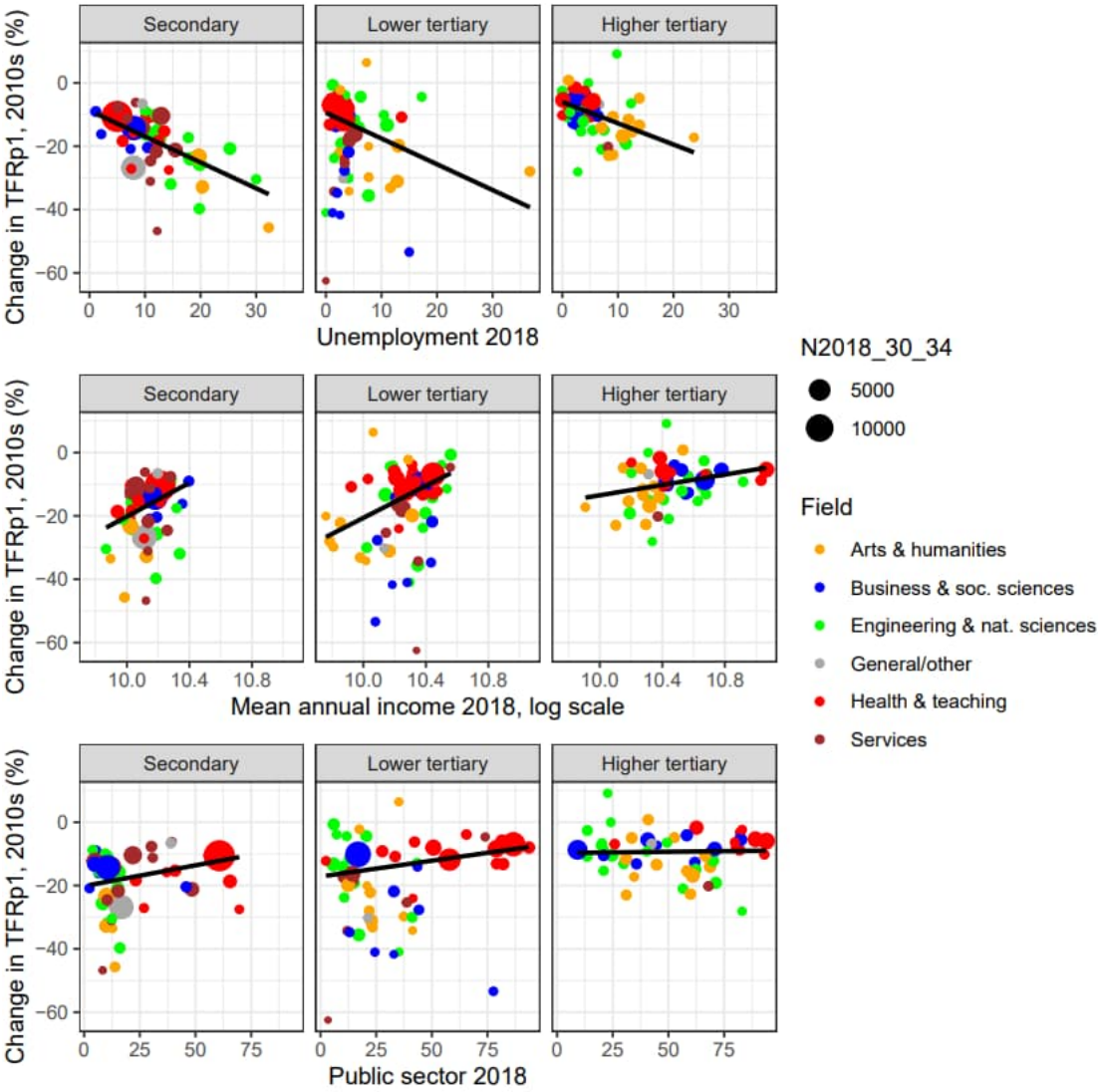
Veterinary	3248	230	2.04	1.44	-29.4
Mathematics and statistics	5893	458	2.03	1.79	-11.8
Interdisciplinary fields in processing and manufacturing	3658	245	1.94	1.38	-28.9
Interdisciplinary fields in engineering	10632	740	1.93	1.39	-28
Interdisciplinary fields in agriculture	3483	264	1.92	1.41	-26.6
Biochemistry	4370	321	1.89	1.23	-34.9
Earth science	5802	391	1.87	1.17	-37.4
Crop and livestock production	2271	148	1.85	1.64	-11.4
Chemistry	5060	262	1.83	1.12	-38.8
Forestry	2055	129	1.80	1.46	-18.9
Environmental studies	3678	205	1.80	1.15	-36.1
Biology	8874	590	1.76	1.15	-34.7
Architecture and town planning	4126	339	1.70	1.37	-19.4
Information and communication technologies	8145	362	1.67	1.10	-34.1
Physics	1972	124	1.51	0.99	-34.4
Lower tertiary					
Crop and livestock production	8001	517	2.17	1.77	-18.4
Interdisciplinary fields in engineering	7578	598	1.93	1.27	-34.2
Building and civil engineering	7714	580	1.86	1.44	-22.6
Electricity, energy, electronics, & automation	3111	138	1.84	1.13	-38.6
Chemical engineering and processes	9017	608	1.83	1.19	-35
Interdisciplinary fields in processing and manufacturing	5046	241	1.78	1.04	-41.6
Mechanics and metal trades	2464	181	1.78	1.16	-34.8
Forestry	3348	212	1.68	1.17	-30.4
Environmental protection technology	4117	308	1.68	1.19	-29.2
Information and communication technologies	20039	763	1.62	0.86	-46.9
Horticulture	2907	191	1.57	1.43	-8.9
Architecture and town planning	2054	79	1.56	1.05	-32.7
Interdisciplinary fields in natural sciences	6612	323	1.44	0.91	-36.8
Secondary					
Food processing	24711	1310	2.26	1.56	-31
Chemical engineering and processes	8806	499	1.83	1.06	-42.1
Horticulture	14314	741	1.80	1.36	-24.4
Materials (glass, paper, plastic, and wood)	15920	1048	1.80	1.14	-36.7
Crop and livestock production	29639	1702	1.75	1.35	-22.9
Building and civil engineering	9815	526	1.72	1.34	-22.1
Textiles (clothes, footwear, and leather)	19558	954	1.68	1.23	-26.8
Mechanics and metal trades	4417	244	1.62	1.21	-25.3
Natural environments and wildlife	3142	239	1.59	1.02	-35.8
Motor vehicles, ships, and aircraft	5818	304	1.49	1.31	-12.1
Electricity, energy, electronics, & automation	4204	240	1.48	1.19	-19.6
Information and communication technologies	7535	416	1.42	0.88	-38
Health, welfare, & teaching					
Higher tertiary					
Teacher (without subject specification)	38617	2253	2.63	1.94	-26.2
Teacher: home economics	2481	166	2.51	1.93	-23.1

Teacher: study adviser, music, other	1910	142	2.49	1.59	-36.1
Medicine	23442	1767	2.45	1.93	-21.2
Education science: early childhood education	3170	228	2.44	1.90	-22.1
Special teacher	3564	217	2.28	1.85	-18.9
Pharmacy	4454	295	2.10	1.57	-25.2
Dental studies	4329	389	2.09	1.89	-9.6
Education science (excluding early childhood education)	16408	874	2.08	1.53	-26.4
Teacher: handicrafts	2439	160	1.91	1.57	-17.8
Interdisciplinary studies in health & welfare	24984	1164	1.73	1.58	-8.7
Lower tertiary					
Midwife	8822	652	2.61	2.08	-20.3
Health care provider	33559	2539	2.43	1.88	-22.6
Optics	2901	173	2.29	1.63	-28.8
Dental studies	5519	389	2.28	1.66	-27.2
Pre-school teacher	16190	749	2.22	1.64	-26.1
Nurse	114318	7007	2.18	1.71	-21.6
Physical therapy	25565	1903	2.16	1.62	-25
Social work	78941	5541	2.10	1.54	-26.7
Pharmacy	11361	600	2.05	1.61	-21.5
Occupational therapy	2434	113	1.91	1.06	-44.5
Laboratory	8515	619	1.89	1.44	-23.8
X-ray and other technical matters	5669	458	1.86	1.28	-31.2
Interdisciplinary studies in health & welfare	6925	279	1.84	1.27	-31
Teacher (with subject specification)	6389	428	1.77	1.27	-28.2
Education science	7769	257	1.59	1.16	-27
Secondary					
Nurse	237972	13897	2.28	1.77	-22.4
Child care	25455	1278	2.10	1.68	-20
Pharmacy	3165	186	1.81	1.53	-15.5
Youth services	10377	609	1.81	1.35	-25.4
Therapy & rehabilitation (massage and pedicure)	11136	545	1.70	1.21	-28.8
School care	17559	1014	1.67	1.20	-28.1
Interdisciplinary studies in health & welfare	5556	183	1.66	1.53	-7.8
Medical diagnostic & treatment (equipment maintenance)	2717	140	1.07	0.84	-21.5
Services					
Higher tertiary					
Sports	3407	241	2.34	1.43	-38.9
Lower tertiary					
Hotel & business	11136	810	2.09	1.21	-42.1
Sports	3809	241	1.93	1.21	-37.3
Hair & beauty services	2614	185	1.88	1.14	-39.4
Hotel & catering	19002	885	1.73	1.17	-32.4
Tourism	21810	1803	1.65	1.16	-29.7
Domestic services	3987	32	1.63	1.15	-29.4
Interdisciplinary fields in services	1814	113	1.44	0.94	-34.7

Secondary					
Restaurant & catering	35044	2872	1.91	1.63	-14.7
Hairdresser	37675	2301	1.87	1.40	-25.1
Hotel, restaurant, & catering	78212	4291	1.82	1.36	-25.3
Beautician	16708	921	1.78	1.28	-28.1
Transport services	8242	420	1.72	1.22	-29.1
Security services	8959	466	1.69	1.38	-18.3
Tourism	15040	881	1.67	1.17	-29.9
Domestic services	37034	1336	1.64	1.12	-31.7
Waitress	4203	108	1.58	1.11	-29.7
Sales and customer services in hotels	3127	55	1.45	0.62	-57.2
Sports	5284	233	1.36	1.25	-8.1
Chef	14304	159	1.36	1.00	-26.5
General/other					
Higher tertiary					
Other	4557	270	1.22	1.00	-18
Lower tertiary					
Other	3459	174	1.14	0.88	-22.8
Secondary					
Other	6962	287	1.76	1.34	-23.9
General	327556	7380	1.35	0.91	-32.6
Primary					
General	502306	9148	1.72	1.24	-27.9



Appendix Figure A 1: Top panels: TFR in 2009–2011 and absolute change in TFR in the 2010s by level and field of education. Bottom panels: TFRp1 in 2009–2011 and absolute change in TFRp1 in the 2010s by level and field of education.



Appendix Figure A 2: Uncertainty measures and the relative decline in TFRp1 in the 2010s.

Appendix Table A 2: Uncertainty model + additional factors explaining the change in TFR.

	Change in TFR							
	Separate models		Uncertainty model, M	M + Occupational match	M + Single	M + Cohabitation	M + Married	M + Student
	Est.	R^2	Est.	Est.	Est.	Est.	Est.	Est.
Intercept			0.36***	0.35***	0.24**	0.34***	0.24**	0.26**
Unemployment	-0.40***	0.17	-0.33***	-0.30***	-0.20*	-0.27**	-0.27**	-0.36***
log(Income)	0.23**	0.06	0.00	-0.08	-0.09	-0.04	-0.06	-0.12
Public sector	0.25***	0.14	0.19***	0.13*	0.07	0.20***	-0.01	0.15**
Occupational match	0.27***	0.17		0.17**				
Single	-0.43***	0.30			-0.33***			
Cohabitation	0.24***	0.09				0.16*		
Married	0.40***	0.27					0.34***	
Student	-0.40***	0.13						-0.33***
Lower tertiary			-0.54***	-0.58***	-0.49***	-0.56***	-0.43**	-0.45***
Higher tertiary			-0.35 .	-0.32 .	-0.16	-0.28	-0.20	-0.32 .
R^2			0.24	0.29	0.33	0.27	0.33	0.31
Adjusted R^2			0.22	0.26	0.31	0.24	0.30	0.28

Appendix Table A 3: Uncertainty model + additional factors explaining the change in TFRp1.

	Change in TFRp1							
	Separate models		Uncertainty model, M	M + Occupational match	M + Single	M + Cohabitation	M + Married	M + Student
	Est.	R^2	Est.	Est.	Est.	Est.	Est.	Est-
Intercept			0.17*	0.15*	-0.01	0.11	0.03	0.01
Unemployment	-0.45***	0.37	-0.36***	-0.32***	-0.18**	-0.23**	-0.30***	-0.42***
log(Income)	0.32***	0.23	0.07	-0.06	-0.07	-0.01	0.00	-0.11
Public sector	0.19***	0.23	0.12**	0.03	-0.06	0.15***	-0.10 .	0.06 .
Occupational match	0.36***	0.45		0.28***				
Single	-0.51***	0.61			-0.49***			
Cohabitation	0.41***	0.39				0.33***		
Married	0.40***	0.43					0.39***	
Student	-0.57***	0.42						-0.52***
Lower tertiary			-0.11	-0.18 .	-0.03	-0.15	0.02	0.03
Higher tertiary			0.13	0.17	0.41**	0.27 .	0.30*	0.17
R^2			0.40	0.54	0.63	0.52	0.53	0.60
Adjusted R^2			0.38	0.52	0.62	0.50	0.51	0.58

Appendix Table A 4: Completed fertility, % childless, % changing field of education after first birth by age 44 years, % changing field of education after the first initial field of education at respective level, Finnish native women born in 1971–1975.

	N (44)	CFR	% childless	N (first birth)	Change field after FB	Distribution of new fields (top 3)	N (first initial field)	Change field, parents	Change field, childless
Primary	8379	2.07	23.2	14493	55.7	health 49%, business 20%, services 18%	19113	58.0	45.5
Secondary									
Health & welfare	15383	2.32	11.9	8210	9.9	business 37%, services 17%, education 11%	9341	10.0	16.3
Services	12462	1.97	21.0	12144	36.8	health 60%, business 24%, engineering 6%	21064	51.8	45.0
Engineering	4280	1.86	23.7	4149	42.2	health 49%, business 24%, services 16%	5798	51.8	47.2
Business	7667	1.86	19.5	3561	25.3	health 60%, services 18%, engineering 6%	6414	30.1	24.9
Agriculture	1831	1.84	25.3	1385	36.2	health 43%, business 24%, services 11%	1704	45.0	42.5
Arts & humanities	2000	1.72	29.2	1654	41.1	health 43%, business 26%, services 11%	2176	54.2	43.6
General	4302	1.57	31.2	8855	69.2	health 29%, business 19%, arts & hum. 16%	72143	94.8	90.9
ICT	383	1.48	33.7	170	41.8	health 38%, business 31%, engineering 13%	226	51.2	32.8
Lower tertiary									
Education	1777	2.18	12.0	1619	5.3	arts & hum. 57%, health 16%, soc. sciences 15%	2696	8.0	14.2
Health & welfare	18677	2.12	13.1	13306	5.3	soc. sciences 38%, education 26%, arts & hum. 12%	20968	7.6	12.0
Agriculture	975	1.89	22.5	688	9.4	health 25%, business 22%, engineering 15%	1067	12.7	14.6
Services	4006	1.79	19.9	3161	12.3	health 37%, business 26%, education 18%	4803	20.4	21.4
Engineering	2225	1.71	22.0	1585	7.9	health 30%, business 26%, nat. sciences 11%	2568	14.1	14.3
Business	16886	1.69	22.2	13067	7.4	health 36%, soc. sciences 14%, arts & hum. 13%	21164	16.5	17.1
ICT	1657	1.63	23.1	1152	10.8	business 46%, health 23%, education 11%	1510	21.3	21.1
Social sciences	506	1.47	30.2	266	8.3	business 36%, education 23%, arts & hum. 18%	789	14.9	15.6
Arts & humanities	2513	1.42	32.0	1613	11.8	education 29%, health 27%, business 15%	4297	12.5	9.7
Natural sciences	101	1.24	40.6	42	19.0	health 50%	278	19.0	14.5
Higher tertiary									
Education	5172	2.13	12.4	3153	1.9	arts & hum. 36%, soc. sciences 34%, health 12%	5198	2.7	5.6
Health & welfare	4188	2.03	13.2	1752	1.2	business 29%, soc. sciences 19%, arts & hum. 14%	3967	1.5	3.8
Engineering	1982	1.87	17.0	1275	2.9	business 49%, ICT 19%, soc. sciences 14%	1976	4.7	6.1

Agriculture	799	1.83	18.4	498	3.6	business 28%, education 22%, health 22%	792	5.3	6.2
Natural sciences	2730	1.77	21.1	1853	8.8	health 62%, engineering 10%, agriculture 10%	3060	12.7	10.8
Business	4542	1.72	18.8	2611	1.3	soc. sciences 26%, arts & hum. 21%, education 21%	4398	1.9	2.9
Services	410	1.68	22.7	167	1.8	-	400	2.6	0.0
Social sciences	4475	1.67	20.3	2469	2.8	business 36%, education 24%, arts & hum. 17%	4409	4.1	5.0
Arts & humanities	6466	1.59	25.4	3451	2.6	soc. sciences 42%, education 23%, business 14%	6606	3.9	4.8
ICT	517	1.59	25.2	228	5.3	engineering 33%, soc. sciences 25%)	461	4.0	8.0

References

Adserà, A. 2004. 'Changing fertility rates in developed countries. The impact of labor market institutions', *Journal of Population Economics*, 17: 17-43.

Andersson, G., M. Kreyenfeld, and T. Mika. 2014. 'Welfare state context, female labour-market attachment and childbearing in Germany and Denmark', *Journal of Population Research*, 31: 287-316.

Andersson, G., M. Rønsen, L. B. Knudsen, T. Lappegård, G. Neyer, K. Skrede, K. Teschner, and A. Vikat. 2009. 'Cohort fertility patterns in the Nordic countries', *Demographic Research*, 20: 313-52.

Becker, G. 1993. *A treatise on the family* (Cambridge: Harvard University Press).

Begall, K., and M. C. Mills. 2012. 'The Influence of Educational Field, Occupation, and Occupational Sex Segregation on Fertility in the Netherlands', *European Sociological Review*, 29: 720-42.

Blossfeld, H.-P., and H. Hofmeister. 2006. *Globalization, uncertainty and women's careers: An international comparison.*

Blossfeld, H.-P., and M. Mills. 2005. 'Globalization, uncertainty and the early life course. A theoretical framework', *Globalization, Uncertainty and Youth in Society.*

Blossing, U., G. Imsen, and L. Moos. 2014. *The Nordic education model* (Springer).

Brewster, K., and R. R. Rindfuss. 2000. 'Fertility and Women's Employment in Industrialized Nations', *Annual Review of Sociology*, 16: 271-96.

Campisi, N., H. Kulu, J. Mikolai, S. Klüsener, and M. Myrskylä. 2020. 'Spatial variation in fertility across Europe: Patterns and determinants', *Popul Space Place*, 26: e2308.

Comolli, C. L., G. Neyer, G. Andersson, L. Dommermuth, P. Fallesen, M. Jalovaara, A. Jónsson, M. Kolk, and T. Lappegård. 2020. 'Beyond the Economic Gaze: Childbearing during and after Recessions in the Nordic countries ', *European Journal of Population*.

Cook, A., and K. L. Minnotte. 2008. 'Occupational and Industry Sex Segregation and the Work–Family Interface', *Sex Roles*, 59: 800-13.

Ellingsæter, A. L., and A. Leira. 2006. *Politicising parenthood in Scandinavia: Gender relations in welfare states* (Policy Press, Bristol University Press).

Esping-Andersen, G. 1990. *The three worlds of welfare capitalism* (Princeton, New Jersey: Princeton University Press).

Eurostat. 2019. 'Part-time employment and temporary contracts - annual data'.

———. 2022a. 'Housing price statistics - house price index'. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Housing_price_statistics_-_house_price_index&stable=1#Long_term_trends_in_House_prices_and_rents.

———. 2022b. 'Share of government employment nearly stable'. https://ec.europa.eu/eurostat/cache/digpub/european_economy/bloc-4d.html?lang=en.

———. 2022c. 'Unemployment by sex and age – annual data', Accessed 18.5.2022. https://ec.europa.eu/eurostat/web/main/data/database.

Feeney, M., and J. Stritch. 2017. 'Family-Friendly Policies and Work-Life Balance in the Public Sector', *SSRN Electronic Journal*.

Finnish National Agency for Education. 2019. "Key figures on vocational education and training in Finland." In.

Gornick, J. C., and M. K. Meyers. 2009. *Gender Equality: Transforming Family Divisions of Labor* (London and New York: Verso).

Hakim, C. 2003. 'A New Approach to Explaining Fertility Patterns: Preference Theory', 29: 349-74.

Hellstrand, J, J Nisén, V Miranda, P Fallesen, L Dommermuth, and M Myrskylä. 2021. 'Not Just Later, but Fewer: Novel Trends in Cohort Fertility in the Nordic Countries', *Demography*, 58: 1373-99.

Hellstrand, J., J. Nisén, and M. Myrskylä. 2020. 'All-time low period fertility in Finland: Demographic drivers, tempo effects, and cohort implications', *Population Studies*, 74: 315-29.

———. 2022. 'Less Partnering, Less Children, or Both? Analysis of the Drivers of First Birth Decline in Finland Since 2010', *European Journal of Population*.

Hoem, J. M., G. Neyer, and G. Andersson. 2006a. 'Education and childlessness: The relationship between educational field, educational level, and childlessness among Swedish women born in 1955-59', *Demographic Research*, 14: 331-80.

———. 2006b. 'Educational attainment and ultimate fertility among Swedish women born in 1955-59', *Demographic Research*, 14: 381-404.

Jalovaara, M., L. Andersson, and A. Miettinen. 2020. 'Parity disparity: Educational differences in Nordic fertility across parities and number of reproductive partners', *SocArXiv*.

Jalovaara, M., and A. Miettinen. 2013. 'Does his paycheck also matter?: The socioeconomic resources of co-residential partners and entry into parenthood in Finland', *Demographic Research*, 28: 881-916.

Jalovaara, M., G. Neyer, G. Andersson, J. Dahlberg, L. Dommermuth, P. Fallesen, and T. Lappegård. 2019. 'Education, Gender, and Cohort Fertility in the Nordic Countries', *European Journal of Population*, 35: 563-86.

Kilpi, E. 2011. 'The Finnish education system over the past hundred years.' in S.L. Schneider (ed.), *The International Standard Classification of Education (ISCED-97): An evaluation of content and criterion validity for 15 European countries* (Mannheimer Zentrum für Europäische Sozialforschung: Mannheim).

Kogan, I., and W. Müller. 2003. *School-to-work transitions in Europe: analyses of the EU LFS 2000 ad hoc module* (Mannheimer Zentrum für Europäische Sozialforschung: Mannheim).

Kopelman, J. L., and H. S. Rosen. 2016. 'Are Public Sector Jobs Recession-proof? Were They Ever?', 44: 370-96.

Kreyenfeld, M. 2010. 'Uncertainties in Female Employment Careers and the Postponement of Parenthood in Germany', *European Sociological Review*, 26: 351-66.

Kreyenfeld, M., and G. Andersson. 2014. 'Socioeconomic differences in the unemployment and fertility nexus: Evidence from Denmark and Germany', *Advances in Life Course Research*, 21: 59-73.

Lappegård, T., and M. Rønsen. 2005. 'The Multifaceted Impact of Education on Entry into Motherhood', *European Journal of Population / Revue européenne de Démographie*, 21: 31-49.

Mandel, H., and M. Semyonov. 2006. 'A Welfare State Paradox: State Interventions and Women's Employment Opportunities in 22 Countries1', *American Journal of Sociology*, 111: 1910-49.

Martín-García, T., and P. Baizán. 2006. 'The Impact of the Type of Education and of Educational Enrolment on First Births', *European Sociological Review*, 22: 259-75.

Merz, E.-M., and A. C. Liefbroer. 2018. 'Cross-national differences in the association between educational attainment and completed fertility. Do welfare regimes matter? ', *Vienna Yearbook of Population Research*, 1: 95-120.

Michelmore, K., and K. Musick. 2014. 'Fertility patterns of college graduates by field of study, US women born 1960–79', *Population Studies*, 68: 359-74.

Ministry of Finance. 2006. "The finnish public sector as employer." In. Edita Prima PLC, Helsinki.

Neyer, G. , G. Andersson, J. Dahlberg, S. Ohlsson Wijk, L. Andersson, and S. Billingsley. 2022. 'Fertility Decline, Fertility Reversal and Changing Childbearing Considerations in Sweden: A turn to subjective imaginations?', *Stockholm Research Reports in Demography*, Preprint.

Neyer, G., G. Andersson, J. Hoem, M. Rønsen, and A. Vikat. 2006. 'Fertilität, Familiengründung und Familienerweiterung in den nordischen Ländern', *Max Planck Institute for Demographic Research, Rostock, Germany. (MPIDR Working Paper WP 2006-022)*.
Neyer, G., J. M. Hoem, and G. Andersson. 2017. 'Education and Childlessness: The Influence of Educational Field and Educational Level on Childlessness among Swedish and Austrian Women.' in Michaela Kreyenfeld and Dirk Konietzka (eds.), *Childlessness in Europe: Contexts, Causes, and Consequences* (Springer International Publishing: Cham).
Nisén, J., S. Klüsener, J. Dahlberg, L. Dommermuth, A. Jasilioniene, M. Kreyenfeld, T. Lappegård, P. Li, P. Martikainen, K. Neels, B. Riederer, S. te Riele, L. Szabó, A. Trimarchi, F. Viciana, B. Wilson, and M. Myrskylä. 2021. 'Educational Differences in Cohort Fertility Across Sub-national Regions in Europe', *European Journal of Population*, 37: 263-95.
OECD. 2020. *OECD Economic Surveys: Finland 2020*.
Official Statistics of Finland (OSF). 2020. 'Births [e-publication]', Accessed 17.1.2022. https://www.stat.fi/til/synt/2020/synt_2020_2021-04-23_tie_001_en.html.
———. 2021. 'Education', Statistics Finland. https://www.stat.fi/tup/tasaarvo/education/index_en.html#segregation.
———. 2022. "Employed labour force in area (workplaces) by area, employer sector, sex and year, 1987-2019." In.
Ohlsson Wijk, S. 2015. 'Type of Occupation and the Transition to Parenthood in Sweden', *Stockholm Research Reports in Demography*, Preprint.
Ohlsson Wijk, S., and G. Andersson. 2022. 'Disentangling the Swedish Fertility Decline of the 2010s', *Stockholm Research Reports in Demography*.
Oppenheimer, V. K. 1994. 'Women's Rising Employment and the Future of the Family in Industrial Societies', *Population and Development Review*, 20: 293-342.
Oppermann, A. 2017. 'Educational field and fertility in western Germany

an analysis of women born between 1955 and 1959', *Vienna Yearbook of Population Research*, 15: 239-67.
Orr, D., C. Gwosc, and N. Netz. 2011. *Social and Economic Conditions of Student Life in Europe: Synopsis of indicators-Final report-Eurostudent IV 2008-2011* (W. Bertelsmann Verlag).
Rønsen, M., and K. Skrede. 2010. 'Can public policies sustain fertility in the Nordic countries?: Lessons from the past and questions for the future', *Demographic Research*, 22: 321-46.
Rønsen, Marit. 2004. 'Fertility and family policy in Norway - A reflection on trends and possible connections', *Demographic Research*, 10: 265-86.
Salas-Velasco, M. 2007. 'The Transition from Higher Education to Employment in Europe: The Analysis of the Time to Obtain the First Job', *Higher Education*, 54: 333-60.
Savelieva, K, M. Jokela, and A. Rotkirch. 2021. 'Reasons to postpone or renounce childbearing during fertility decline in Finland', *SocArXiv*.
Sobotka, T., V. Skirbekk, and D. Philipov. 2011. 'Economic Recession and Fertility in the Developed World', *Population and Development Review*, 37: 267-306.
Surkyn, J., and R. Lesthaeghe. 2004. 'Value orientations and the second demographic transition (SDT) in Northern, Western and Southern Europe: An update', *Demographic Research*, 3: 45-86.
Sutela, H., A. Pärnänen, and M. Keyriläinen. 2019. *Digiajan työelämä– työolotutkimuksen tuloksia 1977– 2018* (Statistics Finland).
Tesching, K. 2012. 'Education and Fertility : Dynamic Interrelations between Women's Educational Level, Educational Field and Fertility in Sweden'.
Van Bavel, J. 2010. 'Choice of study discipline and the postponement of motherhood in Europe: The impact of expected earnings, gender composition, and family attitudes', *Demography*, 47: 439-58.

Vignoli, D., G. Bazzani, R. Guetto, A. Minello, and E. Pirani. 2020. 'Uncertainty and Narratives of the Future: A Theoretical Framework for Contemporary Fertility.' in Robert Schoen (ed.), *Analyzing Contemporary Fertility* (Springer International Publishing: Cham).
Vignoli, D., R. Guetto, G. Bazzani, E. Pirani, and A. Minello. 2020. 'A reflection on economic uncertainty and fertility in Europe: The Narrative Framework', *Genus*, 76: 28.

TABLES & FIGURES

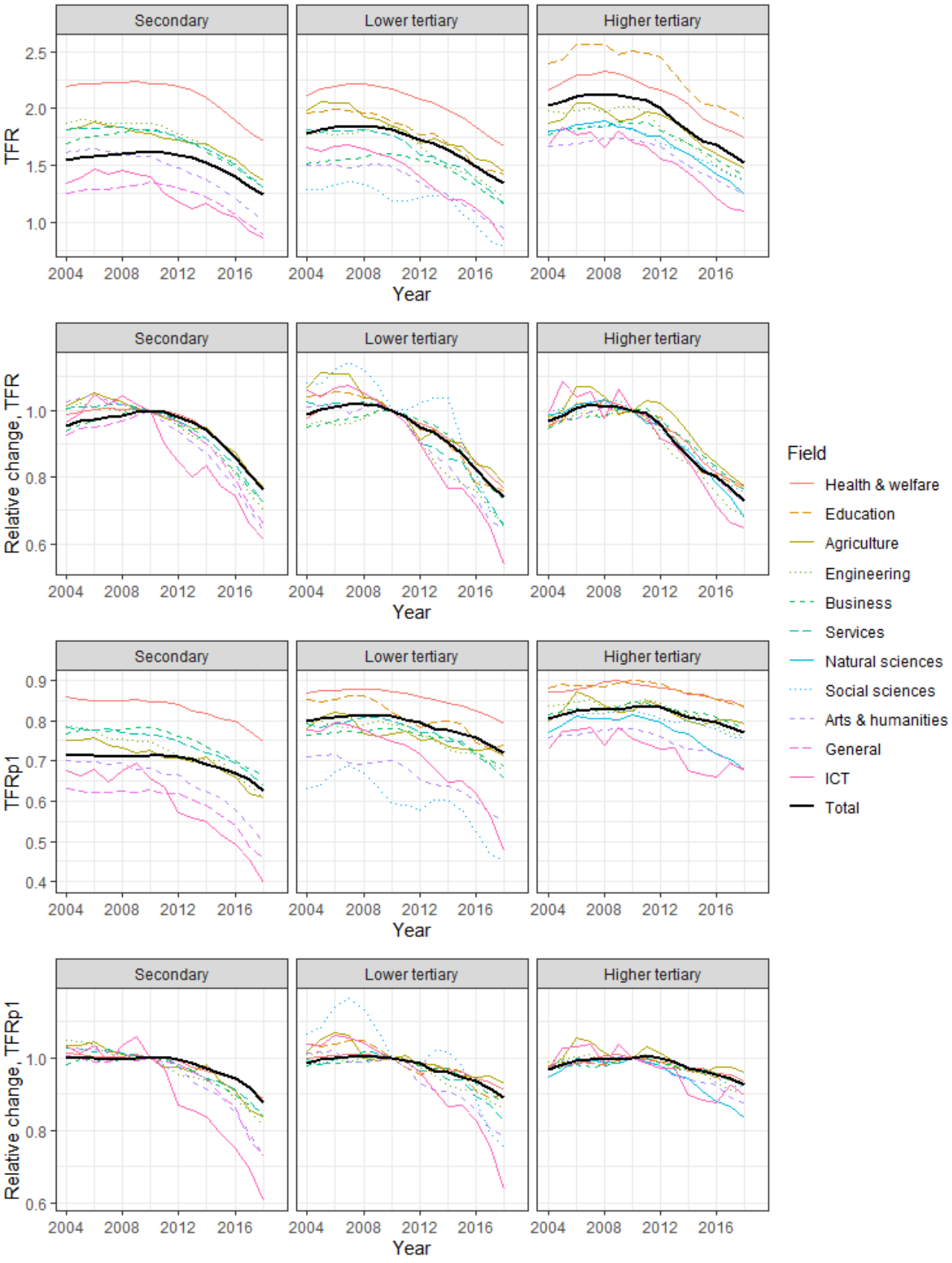


Figure 1: TFR (three-year moving average), relative change (baseline 2010) in TFR, TFRp1 (three-year moving average), and relative change in TFRp1 (baseline 2010) by level and broad field of education in 2004–2019.

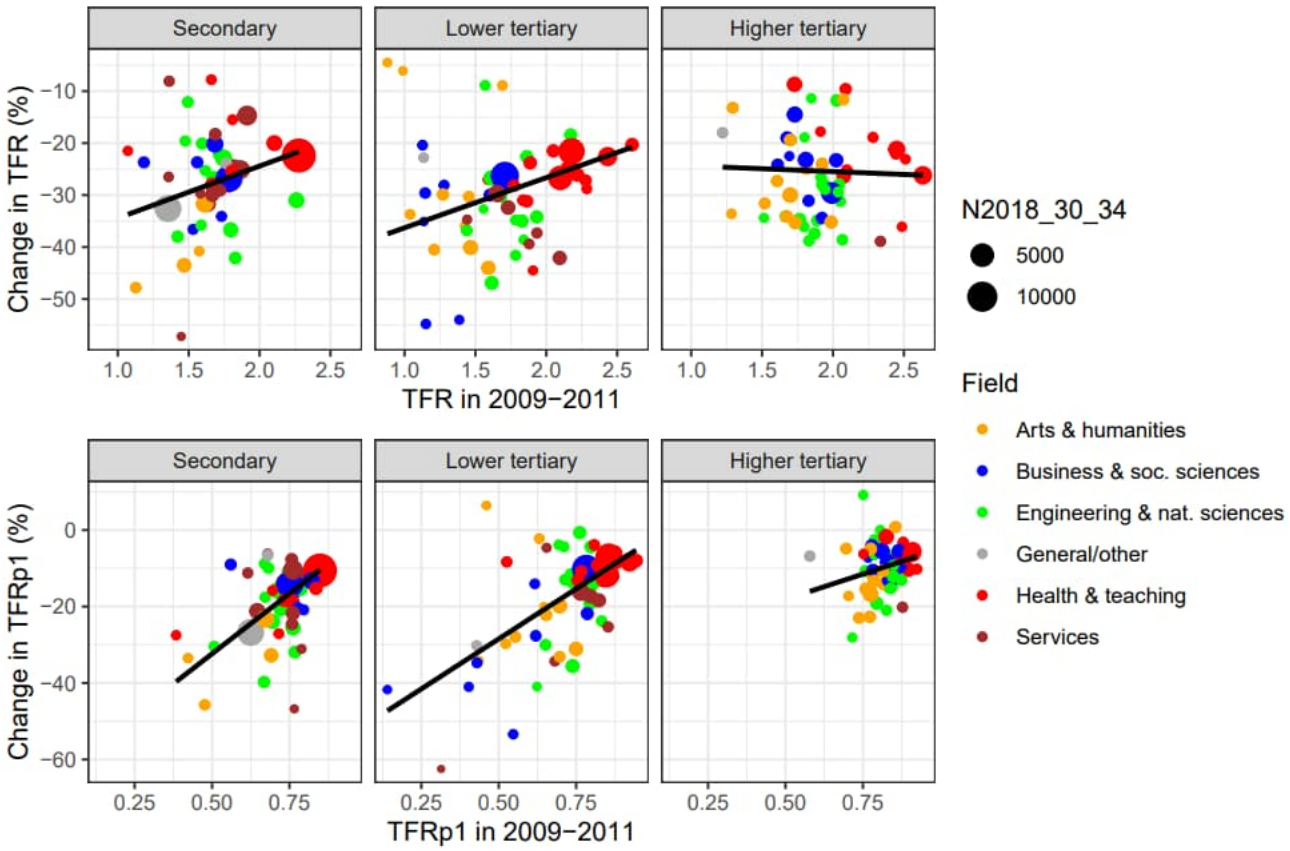


Figure 2: Top panel: TFR in 2009–2011 on the x-axis and relative change in TFR in the 2010s on the y-axis by level and field of education. Bottom panel: TFRp1 in 2009–2011 on the x-axis and relative change in TFRp1 in the 2010s on the y-axis by level and detailed field of education. The regression slope is weighted by the size of the field. Note: Some of the groups had low numbers of childless individuals in certain age groups, and the number of age groups on which TFRp1 is based therefore differs across fields. Consequently, the very low levels (e.g. 0.14 in law at lower tertiary level in 2009–2011) in some small fields should be interpreted with caution. However, for each group, TFRp1 is calculated based on the same number of age groups over time. Further, excluding the small fields where TFRp1 is based on only a few age groups did not significantly change the results.

Table 1: Regression models estimating the relative change in TFR and TFRp1 in the 2010s. In the separate models for each predictor, educational level is included in the model. The models are weighted by size of the field.

	Change in TFR (%)				Change in TFRp1 (%)			
	Separate models		Multivariate model [6]	Multivariate model, interactions	Separate models		Multivariate model [6]	Multivariate model, interactions
	Estimate	R^2	Estimate	Estimate	Estimate	R^2	Estimate	Estimate
Intercept			0.36***	0.22			0.17*	0.12
Unemployment	-0.40***	0.17	-0.33***	-0.32*	-0.45***	0.37	-0.36***	-0.41***
log(Income)	0.23**	0.06	0.00	-0.21	0.32***	0.23	0.07	-0.03
Public sector	0.25***	0.14	0.19***	0.19	0.19***	0.23	0.12**	0.16
Lower tertiary			-0.54***	-0.42*			-0.11	-0.02
Higher tertiary			-0.35	-0.23			0.13	0.31
Lower tertiary X Unemp.				-0.03				0.20
Higher tertiary X Unemp.				-0.26				-0.03
Lower tertiary X log(Income)				0.22				0.34
Higher tertiary X log(Income)				0.13				-0.01
Lower tertiary X Public sector				0.02				-0.02
Higher tertiary X Public sector				-0.01				-0.12
R^2			0.24	0.25			0.40	0.42
Adjusted R^2			0.22	0.19			0.38	0.37

[6)] Removing educational level from the model would reduce R^2 by 8 percentage points for the change in TFR and by 1 percentage point for the change in TFRp1.

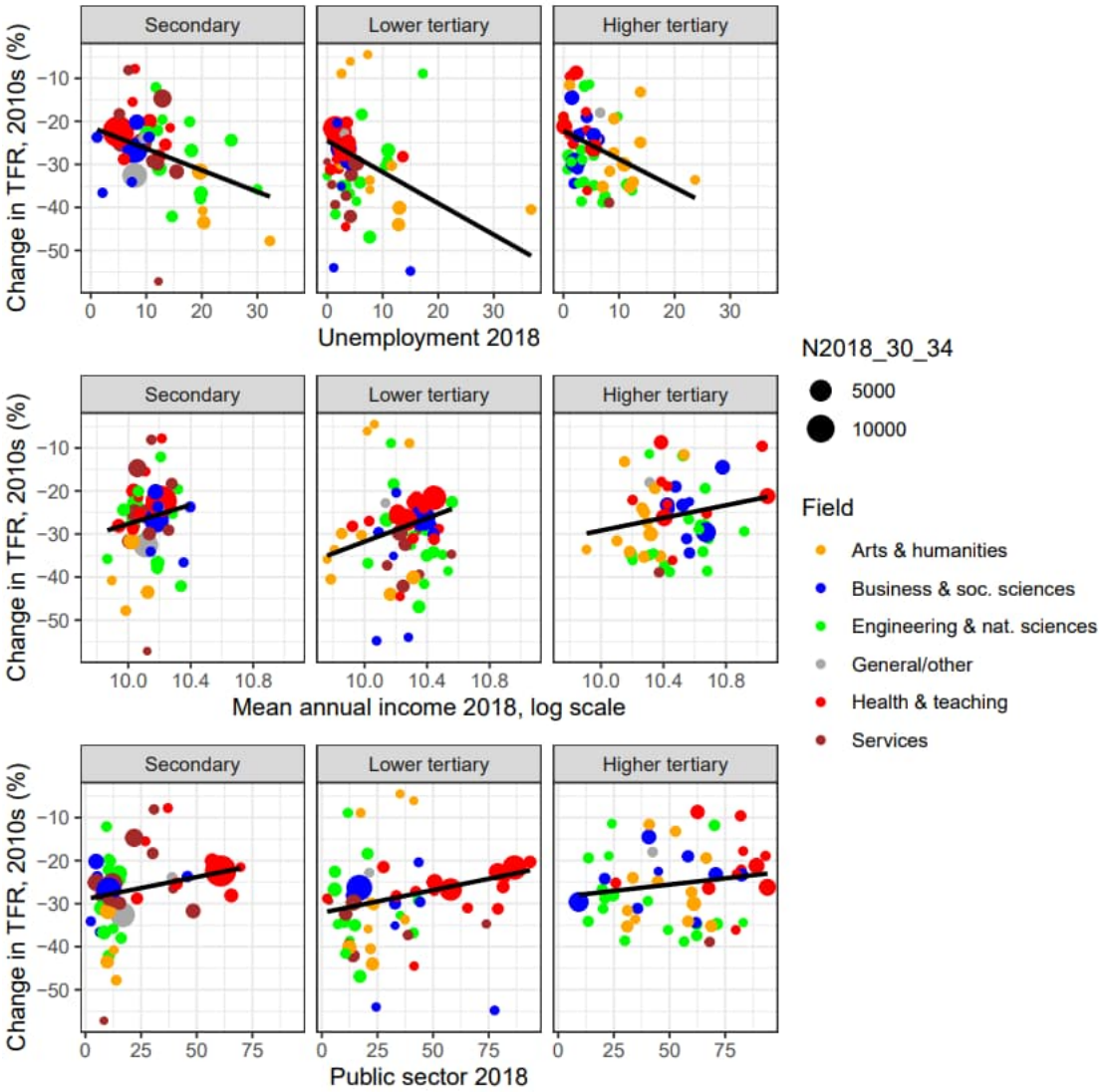


Figure 3: Uncertainty measures and relative decline in TFR in the 2010s.

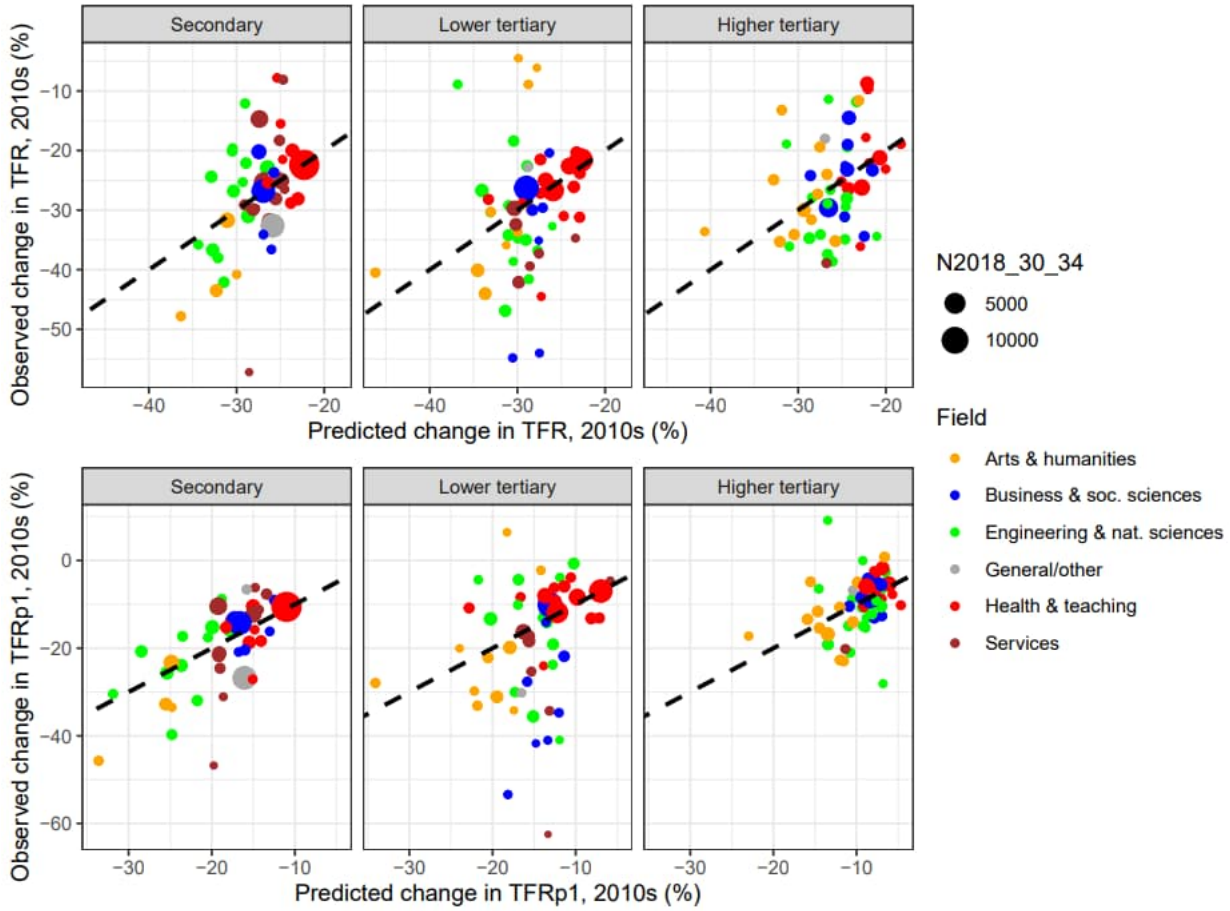


Figure 4: Observed (y-axis) and predicted change (x-axis) in TFR and TFRp1 in the 2010s based on uncertainty model (with interactions) in Table 1 by level and detailed field of education.

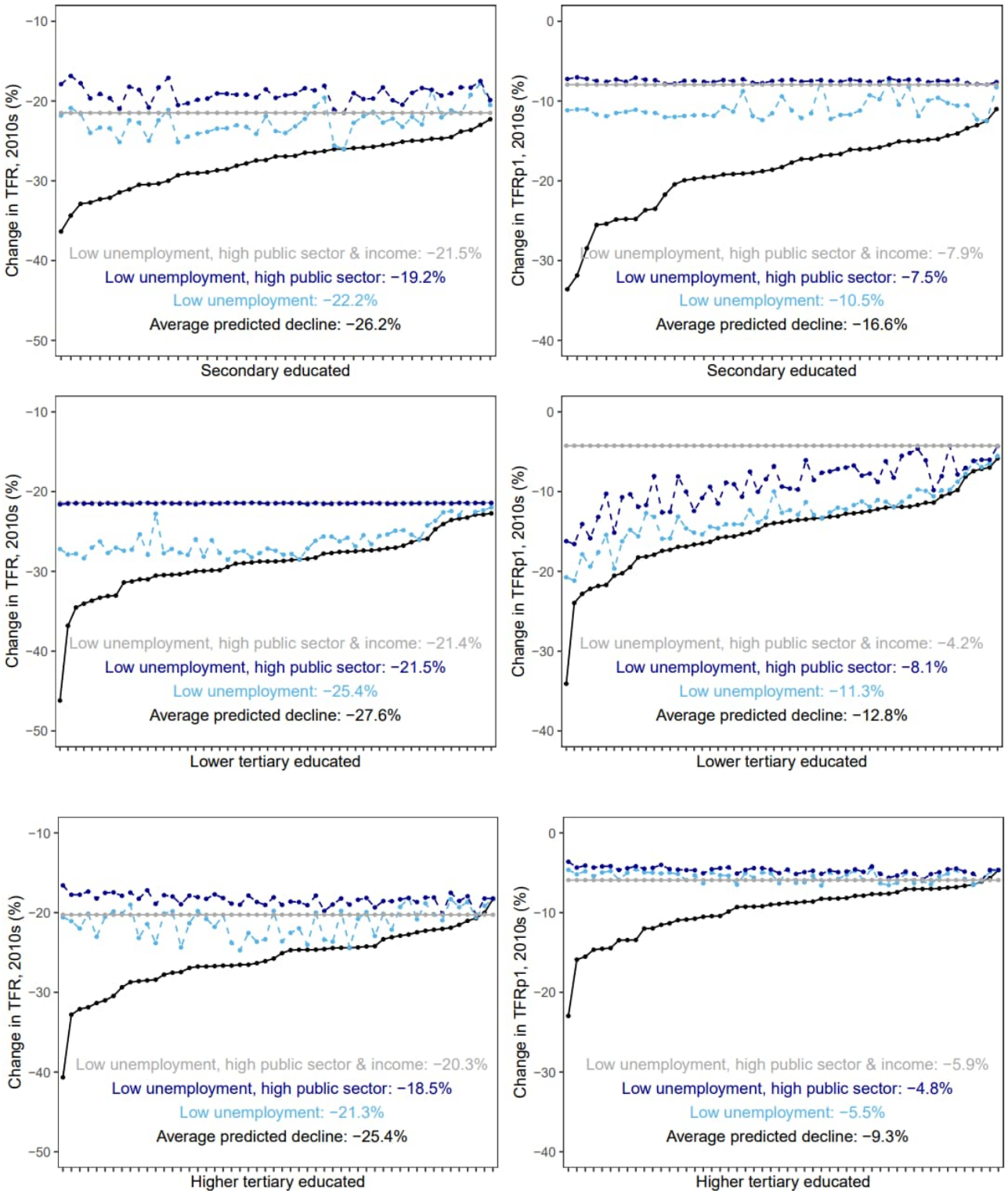


Figure 5: Predicted declines and counterfactual scenarios in change in TFR (left-hand side) and TFRp1 (right-hand side).