The impact of the female advantage in education on the marriage market

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Job Market Paper

January 30, 2020

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Abstract

In recent years, the traditional gender gap in educational attainment in favor of men has been reversed in many countries. This development may have far-reaching consequences for the family, challenging traditional patterns of union formation and potentially affecting marriage and fertility outcomes. I study the implications of the female advantage in education on family formation through changes in the marriage market. Exploiting the gradual implementation of a school reform in Finland that increased the female-male gap in educational attainment, I isolate the effect of changes in the educational gender gap at the marriage market level, controlling for individuals' own exposure to the reform. The results show decreases in marriage and fertility in marriage markets with a larger female advantage in education. I provide suggestive evidence that these results are driven by the mismatch between high-educated women and low-educated men. These effects can account for a substantial fraction of the recent trends in family structure in Finland.

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1 Introduction

Recent decades have seen a decline and reversal of the traditional gender gap in education in favor of men in many countries. In the US, for instance, in 1960 there were above 50% more men than women with university degrees in the working-age population. This difference gradually declined during the second half of the twentieth century, and by the 2000's the gap had been reversed.[1] This period also witnessed dramatic changes to family structure. Fertility rates fell, dropping below replacement levels in many countries; the age at first birth increased, and marriage now takes place later and less often. This transformation of the family and the increases in female education and labor force participation have been studied as closely connected phenomena (Goldin, 2006; Goldscheider et al., 2015; Oláh et al., 2018).

The reversal of the gender gap in education and the emerging female advantage could have far-reaching consequences for the family. Traditional heterosexual mating patterns have been characterized by women marrying men at least as educated as them, and men marrying women at most as educated as themselves. These patterns are likely to be challenged as women's education levels exceed those of men but, so far, we lack evidence on how family formation may be affected as a consequence.

The aim of this paper is to understand the causal impact of relative increases in women's educational attainment on marriage and fertility. While the direct consequences of educational attainment for women and men have been widely researched, the focus here is on the effects of changes in the gender gap in education in the marriage market. To investigate this question, I exploit the gradual implementation of a school reform in Finland that increased the female advantage in education.

Conditional on own educational attainment, changes in the educational composition of the marriage market might affect union formation and family outcomes, as these have been shown to depend on the availability of suitable partners (Abramitzky et al., 2011; Angrist, 2002). In the context of marriage models à la Becker (1973), a larger female advantage could enable more spe-

[1] See this evolution in Figure A1 with data for the US for the OECD average.

cialization between spouses, and thus increase the gains from marriage.[2] On the other hand, if individuals prefer a partner with their same level of education, we would expect an increasing mismatch between the distributions of educational attainment of men and women to lower marriage rates, and potentially fertility. This effect would be reinforced in the presence of gender identity norms that make a situation where the wife has higher education than her husband particularly undesirable (Bertrand et al., 2015).

Finland implemented a large school reform in the 1970s, transforming the former selective school model, where students were separated into different tracks at age 11, into a comprehensive system where they were kept together until age 16. The choice between vocational and academic track was thus delayed from age 11 to age 16, and a national curriculum was introduced. This reform has been found to widen the gender differences in education, increasing the female advantage in pursuing the academic track and entering into university (Pekkarinen, 2008).[3]

The reform followed a gradual implementation plan, with different municipalities adopting the new system in different years during the period 1972-1977. This adoption path generates variation in exposure to the new school system within municipalities across cohorts, and within cohorts across municipalities, which can be used to identify the impact of individual exposure to the reform. Crucially, I can also exploit variation in the degree of exposure to the reform of a person's marriage market, even conditional on own exposure. This is because marriage markets do not coincide fully with municipality-cohort groups, given that individuals do not marry only within municipalities or within cohorts—men tend to marry slightly younger women and women tend to marry slightly older men.

Exploiting these sources of variation, I first show that the reform increased the female advantage

[2]These types of models predict positive assortative matching in education, but this only refers to the ranks of individuals in their gender-specific distribution of traits. Absolute differences in the education levels between men and women play no significant role in this context (Bertrand et al., 2015). Education is seen as an input for both market and non-market sectors. While the closing of the male-female gap in education could reduce the gains from specialization, if the new female advantage in education becomes larger than the former male advantage, gains from specialization could in principle increase, with an inversion of the role of spouses.

[3]A potential explanation for the differential effect of this reform is related to the gender differences in the timing of puberty, with girls entering adolescence before boys. The gender gap in maturity by age 16 might exacerbate differences in academic performance and aspirations, and educational choices at this age might be affected as a result (Pekkarinen, 2008).

in educational attainment. I find that the female-male gap in continuing education beyond secondary school increased by 19%, and the gender gap in university education was reversed. I then estimate the impact of higher marriage market exposure to the reform, conditional on own exposure, on marriage and fertility patterns. In my baseline specification, marriage markets are based on region of birth and on the whole distribution of the age gap within couples in pre-reform cohorts. I measure marriage market exposure to the reform as the proportion of people in a person's marriage market who were enrolled in the new school system. In marriage markets with higher exposure there was thus a larger female advantage in education.

My results show that in marriage markets more affected by the reform, women married and had children later, and were more likely to remain childless by age 40. These effects are sizeable. For instance, an increase in marriage market exposure to the reform of one standard deviation, which leads to a 0.3 pp larger female educational advantage in the marriage market, increases female childlessness by 7.5%. This change can explain around 40% of the rise of childlessness in Finland over this period.

I provide suggestive evidence that the negative effects on marriage and fertility are mainly driven by the mismatch between high-educated women and low-educated men. However, the results are not purely explained by an increase in the gender difference in education, as there are also negative effects in marriage markets where the male-female educational gap was reversed but mismatch did not increase in absolute terms. My findings thus suggest that the sign of the gender gap, and not only its size, matter, consistent with the importance of gender identity norms.

This paper contributes to several strands of the literature. It first contributes to the studies on the implications of the reversal of the gender gap in education. So far, these works have been descriptive in nature. For instance, Esteve et al. (2012, 2016) study the association between the reversal of the educational gender imbalance and patterns of assortative mating, and show that, as the female advantage in education increases, so does the prevalence of couples in which the wife has more education. Schwartz and Han (2014) document that, while in the past couples where the wife is more educated than her husband were more likely to divorce, this difference

has attenuated over time. I contribute to this literature by providing causal estimates of the effect of an increase in the female advantage in education on a set of family outcomes.

Second, this paper speaks to the literature on the causal impact of women's education on fertility and marriage outcomes. This literature generally finds that, in developed countries, increases in educational attainment at the lower end of the distribution (such as those induced by extensions of compulsory schooling) decrease teenage births, but have small or even positive effects on completed fertility (Black et al., 2008; Fort et al., 2016; McCrary and Royer, 2011; Monstad et al., 2008).[4] Regarding marital outcomes, higher female education has been found not to affect the probability of marriage, but to improve spouse quality (Anderberg and Zhu, 2014; Lefgren et al., 2006; McCrary and Royer, 2011).[5] My results on the effect of direct exposure to the reform are in line with this previous evidence. I find that being exposed to the new school system, which led to higher educational attainment for women, does not have significant effects on the probability of marriage, and has a small positive impact on fertility. More importantly, my findings show that, beyond the impact of individual changes in education, changes in the relative levels of education of men and women in a given marriage market also affect family outcomes.[6]

Finally, this study is related to the literature exploring the consequences for the family of changes in the relative position of men and women that violate traditional gender norms. Bertrand et al. (2015) study the causes and implications of relative income within spouses, and find evidence consistent with social aversion to a situation in which the wife outearns her husband. Using a Bartik-style instrument, they show that when, in a given marriage market, women are more likely to earn more than men, marriage rates decline. Autor et al. (2019), in turn, exploit trade shocks to show that relative decreases in men's earnings lead to lower marriage rates and fertility.[7] Tur-Prats (2017) shows that relative decreases in female unemployment levels, compared

[4]The relationship between schooling extensions and fertility seems to depend, at least in part, on the institutional context. For instance, Cygan-Rehm and Maeder (2013) find that extensions of compulsory schooling are related to decreases in total fertility in Germany, where the opportunity cost of childrearing is high. Similarly, Fort et al. (2016) finds that female education has a negative effect on fertility in England, but not in continental Europe.

[5]In developing countries, increased female education has been found to delay (and in some cases decrease) fertility, delay marriage and improve spouse quality (Heath and Jayachandran, 2017).

[6]In this sense, this paper is also related to the literature on how changes in marriage market conditions, and in particular sex ratios, affect the family (Angrist, 2002; Charles and Luoh, 2010; Abramitzky et al., 2011; Mechoulan, 2011; Lafortune, 2013; Brainerd, 2017; Grosjean and Khattar, 2019).

[7]In a related paper, Kearney and Wilson (2018) use the fracking boom and find that increases in men's earnings

to male's, increase the incidence of intimate-partner violence in Spanish regions with more traditional gender norms. Lastly, Folke and Rickne (2020) study the tension between women's career success and marital stability. They find that women's promotions, but not men's, increase their probability of divorce, based on the analysis of just-winning and just-losing candidates in parliamentarian and mayor elections in Sweden, and CEO promotions.[8] In this paper, I study the implications of changes in the relative position of men and women in educational attainment. This is a closely-related but different dimension, which has been ignored so far, despite being highly relevant in the context of most developed countries.[9] My findings corroborate that relative advances in women's economic position can generate frictions in marriage markets.

The rest of the paper is structured as follows. In section 2 I describe the content and implementation of the Finnish comprehensive school reform. I section 3 I lay out the identification strategy. Section 4 describes the data used and provides descriptive statistics. Section 5 shows the results, section 6 provides supplementary analyses and robustness checks to corroborate the main findings, and section 7 concludes.

2 Background: Finnish comprehensive school reform

In the 1970s, Finland transformed its school system and adopted a comprehensive school model, with the aim of equalizing educational opportunities for all students. Similar reforms had taken place some years before in Sweden (Meghir and Palme, 2005; Meghir et al., 2018) and Norway (Aakvik et al., 2010; Monstad et al., 2008).

Before the reform, Finland had a selective school system. Children entered in primary school at age 7, and there were only four years of common education for all students. At age 11, they could choose to apply for admission to a general secondary school or to continue in primary

potential increase marital and non-marital births, but not marriage.

[8] Similarly, Stuart et al. (2018) find that winning a Best Actress Oscar increases actresses' probability of divorce, while the same is not true for Best Actor Oscar winners.

[9] The reversal of the gender gap in education has been a common phenomenon in most developed and some developing countries in recent years, certainly more common than the closing of the gender wage gap. In fact, while educational attainment is related to earnings potential, changes in the gender gap in educational might not necessarily lead to a reversal of the wage gap: education and labor market segregation, motherhood penalties, and gender norms might all complicate this relation (Klesment and Van Bavel, 2017).

school. Admission was based on teacher recommendations, an entrance exam, and primary school grades. Those admitted continued their education in a general secondary school for five more years, and at age 16 were eligible to attend an upper secondary school (for two years) and, later, university. Those who were not admitted, or did not apply, stayed in primary school for two more years. By the beginning of the 1970s, most primary schools offered continuation classes (civic schools), which offered a more practically-oriented education, such that virtually all students remained in school until age 16 (Pekkarinen, 2008). After civic school, students could finish their education or continue with vocational training, but could not attend upper secondary schools.

With the implementation of the reform, the former primary, general secondary and civic schools disappeared and were replaced by comprehensive schools. Comprehensive schools offered the same educational content to all students for nine years, from age 7 to 16. After this compulsory education, students could choose to either apply to an upper secondary school, apply to a vocational school,[10] or stop studying.

The reform thus implied several changes. First, it delayed the choice of academic or vocational track from age 11 to age 16. Second, it meant that all students would now be together in the same facilities and exposed to the same national curriculum for nine (instead of four) years. However, it did not, in practice, extend compulsory schooling, as most students were already enrolled in school for nine years before the reform (Pekkarinen, 2008).

The adoption of the reform was approved by parliament and legislated in the 1968 School Systems Act (467/1968). The reform was mandated to be implemented gradually from 1972 to 1977, with the order of adoption being determined geographically. It started with the northern municipalities, which had lower levels of educational attainment. The plan of adoption is described in Figure 1. The transition was overseen by regional school boards (Pekkarinen et al., 2009). In the year of implementation of the reform in a given municipality, all students in the first five grades were enrolled directly in the comprehensive school, while those in the sixth grade and above continued their education in the pre-reform system.

[10] Admission to either track was based on comprehensive school grades only.

Figure 1: Year of adoption of the reform by municipality

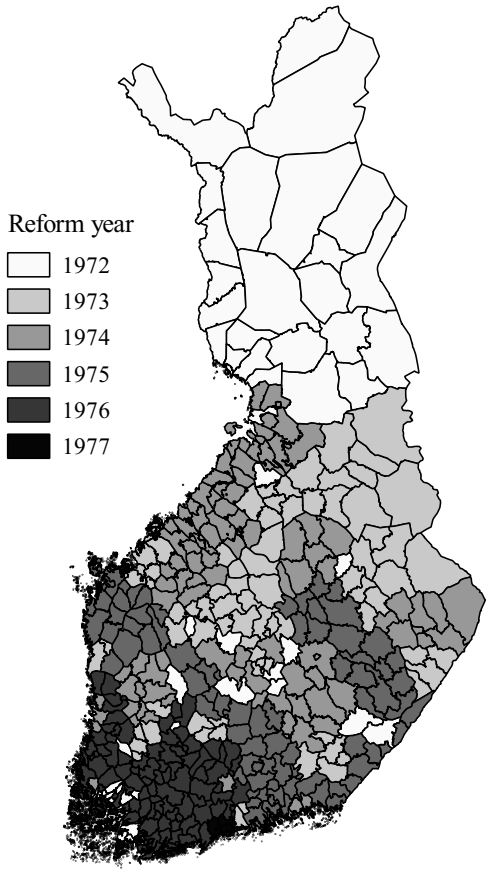


Table 1: Cohorts exposed to the new school system by reform year of municipality

	Reform year					
Year of birth	1972	1973	1974	1975	1976	1977
<=1960						
1961	X					
1962	X	X				
1963	X	X	X			
1964	X	X	X	X		
1965	X	X	X	X	X	
>=1966	X	X	X	X	X	X

3 Identification strategy

3.1 Direct exposure to the reform

The gradual adoption of the comprehensive school system, as described in section 2, generated variation in exposure to the new system across municipalities within cohorts, and across cohorts within municipalities. This variation is illustrated in Table 1. All students turning 11 in the year of adoption of the reform (who would start their fifth grade in that academic year) and all the younger ones were enrolled in the new system, while those turning 12 or more were never exposed. For instance, among students living in municipalities that implemented the reform in 1972, all those born in 1960 and before were never in the new system, while all those born in 1961 and afterwards were exposed to it.[11]

I will leverage this variation to first identify the impact of the reform on individual educational attainment and the gender gap in education, using a differences-in-differences strategy:[12]

[11] All of them were exposed to the change in the tracking age from age 11 to 16. The years of exposure to the new curriculum depended on their age at the time of the reform. For instance, those that were in fifth grade when the reform was implemented were exposed to the new curriculum for four years, those in fourth grade were exposed to it for five years, and so on. This information is summarized in Table A1.

[12] Similar specifications have been used by papers studying the effects of the Finnish comprehensive school reform (Kerr and Pekkarinen, 2013; Pekkarinen, 2008; Pekkarinen et al., 2009) and other similar reforms in other Nordic countries (e.g. Meghir and Palme, 2005; Meghir et al., 2018; Monstad et al., 2008).

$$y_{imrc} = \beta_0 + \beta_1 OwnExposure_{mc} + \mu_c + \gamma_r \times t + (\beta_2 + \beta_3 OwnExposure_{mc} + \nu_c + \lambda_r \times t) \times F_i + \delta_m + \epsilon_{imrc} \tag{1}$$

where y_{imrc} is an indicator of educational attainment of individual i, born in municipality m (located in region r) in cohort c; $OwnExposure_{mc}$ takes value 1 if cohort c from municipality m was affected by the school reform; μ_c are cohort fixed effects; $\gamma_r \times t$ are region-specific linear trends (in cohort year); F_i is an indicator for female gender, and δ_m are municipality of birth fixed effects. Standard errors are clustered at the municipality of birth level. I will present results on the direct impact of the reform separately on men and women, and on the gender gap in education (which will be captured by $\hat{\beta}_3$). In section 6.2 I also discuss and show results with alternative specifications, such as including municipality-specific trends instead, or partialling out region-specific linear pre-trends.

One necessary condition for the causal interpretation of these results is that the timing of the adoption of the reform for different municipalities was unrelated to trends in educational attainment. To study whether this assumption is likely to hold, I perform an event study exercise in which I estimate changes in educational attainment by cohort, with cohorts normalized with respect to the first exposure to the reform in each municipality. For example, in municipalities implementing the reform in 1972, the 1960 cohort would have value -1, as it was the last cohort not exposed to the reform; the 1961 cohort would have value 0, the 1962 cohort would have value 1, and so on. I run the following regression:

$$y_{imc} = \sum_{t \neq -1} \gamma_t + \mu_c + \delta_m + \epsilon_{imc} \tag{2}$$

where y_{imc} is an indicator of educational attainment, γ_t are coefficients on indicators for number of cohorts relative to first exposure to the reform, and t runs from -10 to 4. The indicator for $t = -1$ is excluded, such that coefficients represent changes in educational attainment with respect to the last non-affected cohort in a municipality. μ_c and δ_m are cohort and municipality

of birth fixed effects, respectively. The results of this exercise are shown in section 5.1.[13]

There are some potential caveats when using the variation generated from the adoption of the comprehensive school system in a differences-in-differences setting (Pekkarinen, 2008). First, as shown in Figure 1, there were some municipalities in southern parts of the country which were assigned to implement the reform earlier than the rest of municipalities surrounding them. This choice was probably not random. Second, in the Helsinki region, which was assigned to implement the reform in 1977, some municipality-run general secondary schools deviated from the existing selective system by taking in whole cohorts of students already some years before the official creation of comprehensive schools. As a result, in this region the reform might have been redundant. This would potentially lead to underestimation of the effects of the reform, given that 'treated' units will serve as controls. To assess the impact these two features have on the results, in section 6.2 I perform robustness checks in which I exclude individuals from Helsinki region and from these 'outlier' municipalities that implemented the reform before their surrounding localities did.

Recent work on differences-in-differences methods by Goodman-Bacon (2018) highlights other potential concerns with this type of estimators. He shows that, in models with variation in treatment timing, the diff-in-diff estimator can be seen as a weighted average of all two-way fixed effects diff-in-diffs that compare timing groups to each other (and to always-treated and never-treated units, if these exist). When treatment effects vary over time, relying on comparisons that use earlier-treated units as controls might bias the estimator. In order to assess whether, in my setting, this is likely to affect the estimates, I perform the Goodman-Bacon (2018) decomposition, which allows one to see what type of comparisons have the most weight for the aggregate estimator.[14] The results show that 84% of the weight comes from comparisons that use earlier-treated units as treatment and later-treated units as controls. Moreover, comparisons with earlier-treated units as controls, which account for the remaining 16% weight, give almost identical point estimates. In consequence, time-varying effects are unlikely to be a source of bias in my specification.

[13] Figure A2 further shows that municipalities that adopted the reform earlier (in years 1972-74) and those that adopted it later (in 1975-1977) where following similar marriage and fertility trends in pre-reform cohorts.

[14] The decomposition was performed using the `bacondecomp` Stata package (Goodman-Bacon et al., 2019).

3.2 Marriage market exposure

The reform could affect family outcomes through two main channels. First, being exposed to the reform could affect an individual's fertility or marriage outcomes through changes in their own level of education. Second, it could also affect these outcomes through changes in the educational composition of their marriage market, and in particular through changes in the gender gap. In order to separate these two channels, I will exploit the fact that marriage markets do not coincide fully with municipality-cohort groups. This is because individuals do not marry only within cohorts—in particular, men tend to marry slightly younger women, while women tend to marry slightly older men—and because marriage patterns are broader than municipalities in geographical terms. For instance, among those who marry from pre-reform cohorts, only around 24% of people marry someone born in the same municipality, while 53% of them marry someone born in the same region; less than 12% are married to someone from the same cohort, while more than 50% are in couples where the husband is from 0 to 3 years older than the wife.[15]

The gradual implementation of the reform, together with these standard features of the marriage market, generate variation in the degree to which someone's marriage market is exposed to the reform, conditional on that person's individual exposure. To see this, consider for instance the case of men born in 1960. These men were not exposed to the reform in any part of Finland. However, in municipalities that implemented the reform in 1972, women born in 1961 and younger ones were enrolled in the new system. Hence, the marriage market of 1960 men was substantially exposed to the reform. This exposure was lower in municipalities that adopted the reform later. For example, in municipalities that implemented the reform in 1977, the marriage market of the 1960 cohort of men was barely affected by the reform. Moreover, the fact that not all contiguous municipalities implemented the reform in the same year gives rise to additional variation in marriage market exposure. Figure A4 shows how even within regions (with borders marked in thicker lines) there is variation in reform timing.

This variation allows for identification of the impact of marriage market exposure on family outcomes while accounting for the direct effects of exposure to the reform. I will run the following

[15]The distribution of the age difference within couples, calculated as husband's minus wife's age, for men and women in pre-reform cohorts is shown in Figure A3.

type of regressions:

$$y^g_{imrc} = \alpha_0 + \alpha_1 MarriageMarketExposure^g_{rc} + \alpha_2 OwnExposure_{mc} + \mu_c + \delta_m + \gamma_r \times t + \upsilon^g_{imrc}$$

where y^g_{imrc} is the outcome of individual i, of gender g, born in municipality m of region r in cohort c; $MarriageMarketExposure^g_{rc}$ indicates the proportion of men (women) in a woman's (man's) marriage market who were exposed to the new school system; $OwnExposure_{mc}$ takes value 1 if cohort c from municipality m was affected by the school reform; μ_c are cohort fixed effects; δ_m are municipality of birth fixed effects; $\gamma_r \times t$ are region-specific linear time (cohort) trends, and standard errors are clustered at the municipality of birth level. These regressions are run separately for men and women.

I measure marriage market exposure in different ways. In my preferred measure, I consider individuals born in the same region as belonging to the same marriage market.[16] I then use the distribution of the age difference between couples in pre-reform cohorts, separately for men and women (see Figure A3), to impute the probability that person j belongs to person i's marriage market based on the age gap between the two. These probabilities are used as the weight that person j has on i's marriage market.[17] Specifically, marriage market exposure for individuals of gender g, born in region r in cohort c, is calculated as a weighted average of exposure to the reform in their marriage market, as follows:

$$MarriageMarketExposure^g_{rc} = \sum_{m' \in r} \sum_{c'} (\omega^{g'}_{c',c} \times w^{Pop}_{m'c'}) OwnExposure_{m'c'} \tag{3}$$

where $\omega^{g'}_{c',c}$ is the probability that an individual of gender g' and from cohort c' belongs to the marriage market of individuals of gender g from cohort c, based on the age difference between

[16] There are currently 19 regions in Finland, with the number of municipalities per region varying from 9 to 57 (median of 27). Figure A4 shows the map of Finland with the delimitation of regions and municipalities, together with the reform implementation year.

[17] Figure A5 shows, as an example, the resulting weights that men have for 1960 women's marriage market (in panel a) and that women have for 1960 men's marriage market (panel b) based on their year of birth.

the two (and their gender); $w^{Pop}_{m'c'}$ are weights for the population size of cohort c' in municipality m', and $OwnExposure_{m'c'}$ is an indicator equal to 1 if individuals from cohort c' and municipality m' in region r were exposed to the reform (where c' can be equal to c, and m' can be equal to m). Figure 2 shows the distribution of marriage market exposure separately for those exposed and not exposed to the reform themselves.

Alternative definitions of the marriage market include: a) considering only individuals born in the same region and with an age difference of 0 to 3 years in favor of the man; b) using the weights based on the age difference as in the baseline definition, and also weights based on the distance between municipalities of birth;[18] c) using weights based on age difference (as in baseline definition), together with weights for the surrounding municipalities of birth based on the frequency of marriage of people from those municipalities in pre-reform cohorts. In section 6.1 I discuss how results vary with these different measures of exposure.

4 Data and descriptive statistics

4.1 Data

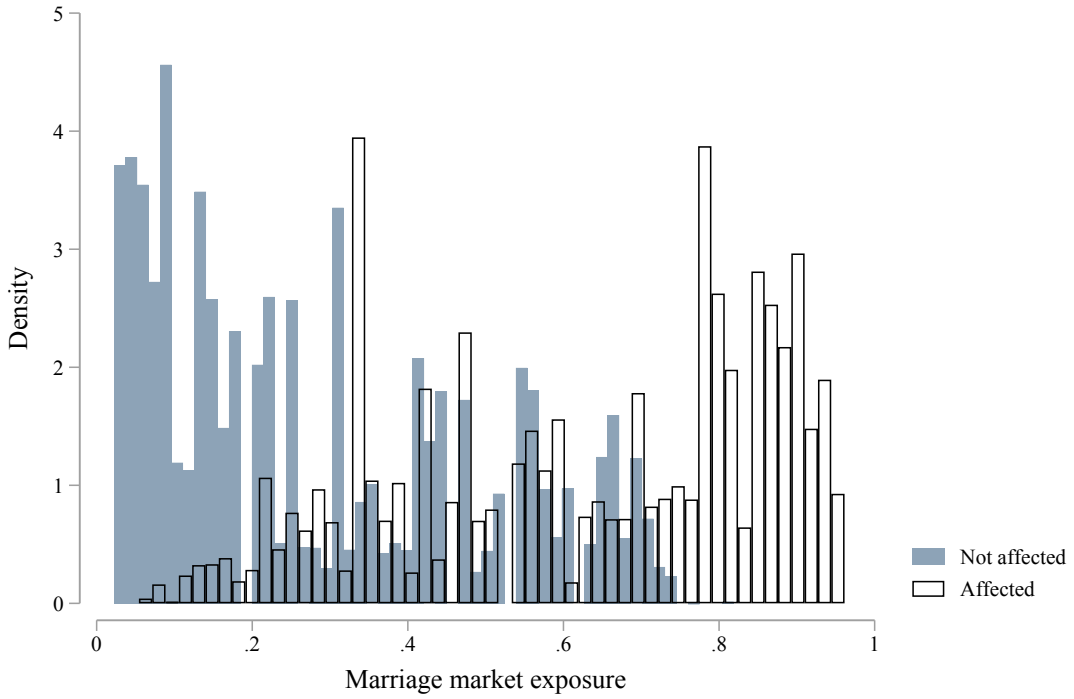
The main data source for the analysis is the FLEED-FOLK (Finnish Longitudinal Employer–Employee Data) dataset provided by Statistics Finland. It contains rich information about all individuals permanently living in Finland at the end of a given year. For the main part of the analysis, I use the files for years 1988-2006 and select all individuals born in Finland and aged 40 in each year. Hence, my sample consists of all Finnish-born individuals from cohorts 1948-1966 who are still living in Finland by age 40.[19] The region of Åland islands is excluded from the sample due to lack of information about the year of adoption of the reform. As a result, my sample consists of 1,460,448 individuals from 430 municipalities in 18 different regions.

The database contains basic information about the year, municipality and region of birth, as

[18] In particular, I calculate the probability that a person from municipality m' belongs to the marriage market of a person from municipality m as the (normalized) inverse of the distance between the two municipalities. Figure A6 shows, as an example, the weight that individuals from each municipality have in the marriage market of people from Tampere depending on the distance.

[19] I use information for cohorts up to 1970 for descriptive statistics.

Figure 2: Variation in the proportion of an individual's marriage market exposed to the reform for individuals affected and not affected by the reform themselves



well as the following variables regarding each statistical year: municipality of residence, civil status and family structure, educational attainment, and labor market status, among others. Besides the basic file, I use the supplementary marriage and family modules, which contain more detail about the history of marriages and divorces (including the spouse identifier), and about children (including their year of birth and identifiers). I supplement the information about children using the Finnish Medical Birth register, which contains information about all births taking place in Finland from 1987.

I combine the information about the year and municipality of birth with the year of adoption of the reform by municipality (as depicted in Figure 1) to construct a binary variable indicating if individuals were exposed to the new school system or not. Since I only know the municipality of birth, rather than the municipality where children were living at school age, estimates of this exposure variable could be affected by measurement error, likely leading to underestimation

of the effects. For each person, I then construct a measure of exposure to the reform of their marriage market as a weighted average of the individual exposure indicators of those people in their marriage market, as explained in section 3.2.

In order to study the impact of the reform on educational attainment, I construct an indicator variable for having more than secondary education, and an indicator for having at least a bachelor's degree or equivalent level.[20] In terms of marriage outcomes, I use the history of marriages to construct indicators for having married and for having divorced by age 40, to construct an indicator for being married or cohabiting by this age, to calculate the age at first marriage, and to get the identifier of the first spouse. Using the spouse identifier I collect information about their year and place of birth, educational attainment, and labor market outcomes. This allows me to construct indicators for whether a person is equally, more, or less educated than their spouse, and for the age difference between them. The analysis focuses on heterosexual couples, given that there are virtually no same-sex couples in the data for the cohorts of the sample.[21] Finally, I examine the following fertility-related variables: the number of children a person has by age 40, an indicator for childlessness at this age, and the age of first birth (for women).[22]

4.2 Descriptive statistics

Figure A7 presents the aggregate trends in education and family structure in Finland from 1948 to 1970. While at the beginning of this period there were more men than women with university degrees, the gender gap in university education closed with the cohorts born around 1960, and for cohorts born by 1965 there was already a female advantage, which continued to grow thereafter. At the same time, there were substantial changes to family structure. Marriage rates declined over this period: the percentage of men who ever married by age 40 declined by 14%, while there was a 8% decrease for women. The average number of children per woman, which

[20] The available variables for educational attainment are left-censored, and only distinguish among education levels starting from the upper secondary level. As a result, for lower levels, one can only know that a person did not achieve upper secondary education, but one cannot tell whether they finished compulsory schooling or dropped out.

[21] Registered partnerships for same-sex couples were introduced in Finland in 2002, and same-sex marriage was not legalized until 2017.

[22] Information on biological children is only available in the register from 1989 onwards. In the analysis of fertility outcomes I thus focus on cohorts from 1949 to 1966.

was increasing until the 1960 cohort, plateaued and then started to decrease for younger cohorts. Finally, we see an increase in the proportion of women who do not have any children by age 40 over the whole period.

Figure A8 shows the distribution of educational attainment for men and women just before (cohorts 1956-60) and just after the reform (cohorts 1966-70). It plots the percentage of men and women in each cohort group with three levels of education: basic (with at most upper secondary education), medium (more than secondary education, but less than university degree), and high (university degree or higher). In the pre-reform cohorts, there were substantially more men than women with low level of education, but also slightly more men than women with university degree. Post-reform cohorts had in general higher educational attainment, with decreases in the percentage of men and women with low education and increasing prevalence of university degrees. This increase was larger for women: the gender gap in having low educational attainment increased from 9.8 to 16.3 percentage points, and the gap in university education was reversed, such that in post-reform cohorts there is a 4 percentage point female advantage.

Finally, Figure A9 shows the frequency of different types of couples, by relative level of education, in the same pre- and post-reform cohorts. Couples are classified into four groups: couples where none has university education (L-L), couples were both have university education (H-H), couples where only the husband has university education, and couples where only the wife has university education. The most remarkable changes from the pre-to the post-reform cohorts are the decrease in the frequency of low-educated couples, and the increased prevalence of couples where both have university education, and of couples where the wife is more educated than her husband.

5 Results

5.1 Impact of the reform on the gender gap in education

The estimates of the impact of the reform on educational attainment for women and men and on the resulting gender gap, using the specification of equation (1), are shown in Table 2. The first three columns show the results for the probability of having more than secondary education, while the last three columns have an indicator for having at least university education as dependent variable.

The results show that the reform had a positive effect on women's educational attainment, but virtually no impact on men's education. Women exposed to the reform had a 1.4 pp higher probability of having more than secondary schooling, a 3.6% increase with respect to the pre-reform average, and 0.9 pp higher probability of having university education (a 6% increase). As a result, the female advantage in having more than secondary education increased by 1.7 pp (a 19% increase). The former gender gap in university education in favor of men (1 pp) was reversed, as the female advantage increased by 1.1 pp.

Table 2: Reform impact on gender gap in education

	Post-secondary			University		
	Women	Men	Female adv.	Women	Men	Female adv.
Own exposure	0.014***	-0.002	0.017***	0.009***	-0.002	0.011***
	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)
Observations	1460448	1460448	1460448	1460448	1460448	1460448
Adjusted R^2	0.034	0.034	0.034	0.016	0.016	0.016
Pre-reform mean	0.39	0.30	0.09	0.14	0.15	-0.01

This table shows estimates for the impact of direct exposure to the reform on the educational attainment of women and men, and on the female advantage in education. The first three columns have as dependent variable an indicator for more than secondary education, and the last three columns an indicator for university degree. Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. Own exposure takes value 1 for cohorts and municipalities affected by the reform. Pre-reform means refers to average of the dependent variable in the sample of each column for cohorts born in 1956-1960. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

These findings are consistent with previous results by Pekkarinen (2008) showing that the reform increased the female advantage in choosing the academic track and in entering into tertiary

education. He discusses that this differential effect on boys and girls is likely related to gender differences in the timing of puberty, with girls entering into adolescence before boys. While up to age 11 boys and girls have on average developed at the same pace, around this age their trajectories temporarily diverge, and by age 16 the gender gap in maturity might exacerbate the gender differences in academic performance and educational choices. This is consistent with studies showing that late pubertal development is associated with worse academic performance at age 16 and lower total educational attainment (Koerselman and Pekkarinen, 2018).

As discussed in section 3, to evaluate the extent to which the timing of the adoption of the reform for different municipalities was unrelated to trends in educational attainment, I perform an event study exercise. In particular, I estimate changes in female educational attainment by cohort, with cohorts normalized with respect to the first exposure to the reform in each municipality.[23]

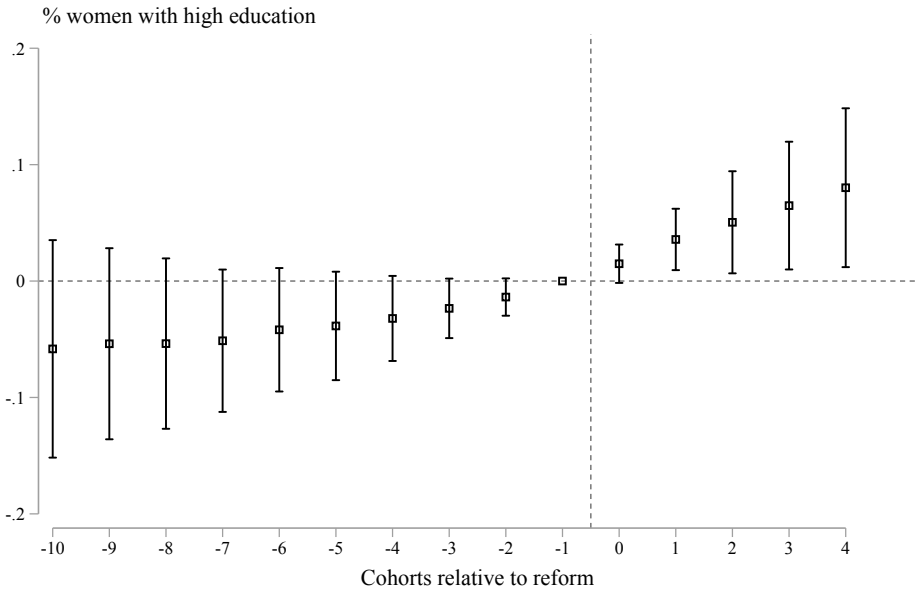
The results of this exercise are shown in Figure 3. Panel (a) presents the results for the whole sample. While none of the pre-trend coefficients are significant, there seems to be an upward trend in female education before the reform took place. This finding could be related to the fact that schools in the Helsinki region, in spite of being scheduled to be among the last to implement the reform, had in practice already started to adopt it some years before. To check if this explains the observed pre-trends, in panel (b) I repeat this exercise excluding observations from the Helsinki region. In this case one cannot see any clear patterns for the cohorts preceding exposure to the reform, and the increases in female education start clearly only after its implementation. This suggests that an important robustness check will be to test the sensitivity of the results to excluding the capital region.

5.2 Impact of marriage market exposure to the reform on marriage and fertility

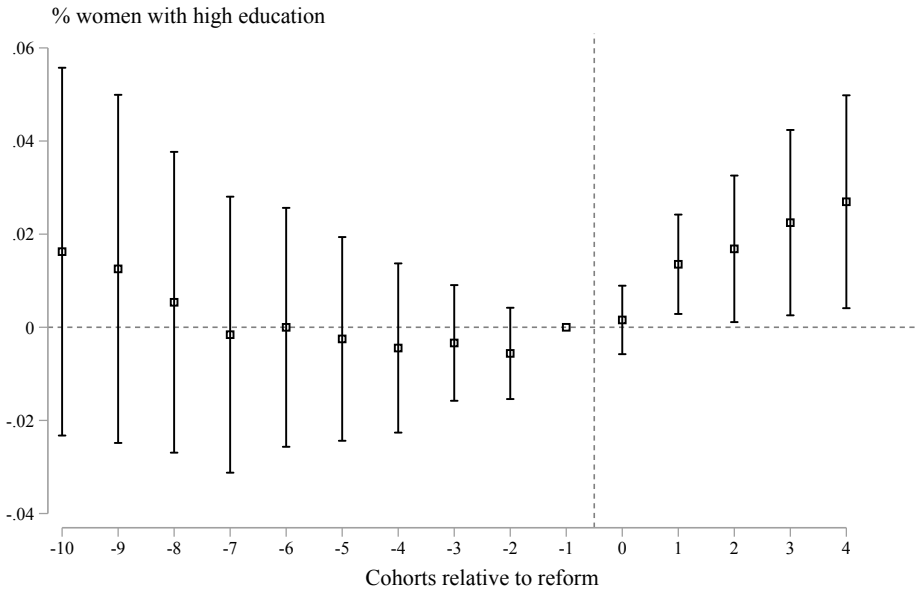
This section presents the main results for the impact of marriage market exposure to the reform on family outcomes, conditional on own exposure. I first show that marriage market exposure to the reform, conditional on individual exposure, does not itself affect a person's own level of

[23] Cohorts up to 1970 are used in order to have a balanced sample.

Figure 3: Percentage of women with high education by cohorts relative to first exposure to the reform



(a) Full sample



(b) Without Helsinki region

Notes: These figures plot the coefficients of a regression of women with high (post-secondary) education on indicators for number of cohorts relative to the one first exposed to the reform in a municipality, following the specification in (2). The coefficient on $t = -1$ is omitted, such that coefficients represent changes with respect to the last non-exposed cohort. Panel (a) shows results for the full sample, while in panel (b) the Helsinki region is excluded.

education. The results are shown in Table A2: the coefficient of own exposure is not affected by the inclusion of marriage market exposure in the regression, and marriage market exposure does not have any significant impact on men's and women's level of education. The results in this section can thus be interpreted as the effect of changes in the educational composition of the marriage market, separate from changes in own level of education.

The first three columns in Table 3 show the estimates of the effect of marriage market exposure on women's marriage outcomes: on the probability of having ever married by age 40 (column 1); on the probability of being in a couple, either married or cohabiting, by age 40 (column 2), and on the age at first marriage (columns 3).

The results suggest that marriage market exposure to the reform did not have significant effects on the probability of marriage or on the probability of being in a couple by age 40, although the coefficients are negative for both outcomes. Women whose marriage market was more exposed to the reform, however, saw a significant delay at the age of first marriage: a one standard deviation increase in marriage market exposure delays age of marriage by 0.18 years. Own exposure to the reform, on the other hand, does not seem to have affected these outcomes. This is consistent with previous findings that increased female education does not have important effects on the probability of marriage in developed countries (e.g. Anderberg and Zhu, 2014; Lefgren et al., 2006).

The last three columns of Table 3 show results for the impact of marriage market exposure on the probability of not having had any children by age 40, on the number of children by this age, and on the age at first birth. Women whose marriage market was more affected by the reform had a significantly higher probability of not having any children: a one standard deviation increase in marriage market exposure leads to a 0.9 pp higher probability of childlessness. While the coefficient on the total number of children suggests also a negative relationship, it is not significant. Finally, even among women who had at least one children, a one standard deviation increase in marriage market exposure leads to a 0.36 years delay in the age of first birth. Own exposure to the reform, in turn, seems to have, if anything, a positive effect on fertility, albeit not significant by most measures. This is again consistent with previous evidence that increases in

women's education have small effects on completed fertility in industrialized countries, which are even positive in some cases (Fort et al., 2016).[24]

In order to put the magnitude of these effects in context, I compare the effect sizes with the observed change in each variable during the period of study. Among women born in 1950, 10.78% did not have any children by age 40. This number increased to 12.8% for the cohort of women born in 1970. A one standard deviation increase in marriage market exposure thus accounts for almost 45% of the observed increase in female childlessness during this period. Similarly, a one standard deviation increase in marriage market exposure to the reform accounts for 13% of the increase in the age of first birth and for 6% of the increase in the age at first marriage from the 1950 to the 1970 cohorts, which were 5 pp and 8 pp, respectively.

Table 3: Marriage market exposure impact on women's marriage and fertility by age 40

	Marriage			Fertility		
	Ever married	In couple	Age marriage	Childless	Num children	Age childbirth
Marriage market exposure (sd)	-0.004	-0.004	0.182***	0.009***	-0.008	0.355***
	(0.004)	(0.005)	(0.060)	(0.002)	(0.010)	(0.086)
Own exposure	0.002	0.005*	0.004	-0.001	0.017*	-0.062
	(0.003)	(0.003)	(0.048)	(0.002)	(0.009)	(0.043)
Observations	716537	716537	524814	633193	633193	594132
Adjusted R^2	0.007	0.009	0.035	0.012	0.019	0.035
Pre-reform mean	0.74	0.74	25.10	0.12	2.05	25.77

Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. Marriage market exposure (in standard deviations) indicates the proportion of people in someone's marriage market affected by the reform. Own exposure takes value 1 for cohorts and municipalities affected by the reform. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.3 Interpretation of results

The results from the last subsection show that, on average, higher marriage market exposure to the reform leads to a higher probability of female childlessness and delays at the age of marriage and childbearing. In order to shed light on the drivers of these effects, this section first provides evidence on heterogeneous effects by level of education. If in more affected marriage markets there was a larger mismatch between the educational distributions of men and women,

[24] Table A3 in the Appendix shows that conclusions are similar if I instead examine men's outcomes.

we would expect larger declines in marriage and fertility for high-educated women and low-educated men. Because the reform had a direct effect on educational attainment, conditioning on level of education for the whole sample would lead to biased estimates. I will therefore focus on cohorts not exposed to the reform themselves, and exploit variation in degree of exposure in their marriage market only.

Table 4 shows, separately for high- and low-educated men and women, respectively, the effect of higher marriage market exposure on the probability of having ever married, on the probability of being married or cohabiting by age 40, on childlessness and on the number of children. The sample is restricted to those who where never exposed to the new school system. Individuals from Helsinki region are also excluded given that, as discussed in section 3, some were exposed to the new system before the date assigned in the adoption plan. Low-educated individuals are defined as those with at most secondary education, while the rest are classified as highly educated. Results defining high educated individuals as those with university degree yield similar results, and are shown in Table A4.

The results suggest that, among those not directly exposed to the reform, higher marriage market exposure leads to decreases in the probability of having ever married among women with high level of education, but not among the low-educated ones. Results are similar, although a bit smaller, for the probability of being married or cohabiting by age 40. For men, higher marriage market exposure leads to a (non-significantly) higher probability of having married for those with high level of education, but to a slightly lower probability for low-educated ones. Similarly, we see a small decrease in the probability of being married or cohabiting by 40, which is larger for those with low education. Consistent with this, albeit not always significant, the estimates for fertility outcomes suggest that both increases in childlessness and decreases in the number of children are concentrated in women with high level of education and men with low level of education.

All in all, this evidence is consistent with high-exposure marriage markets having a larger mismatch among the educational distributions of men and women, such that there are 'excess' numbers of high-educated women and low-educated men who are unable to find a suitable

match.[25]

Table 4: Heterogeneous effects of marriage market exposure by level of education – sample not directly exposed

	Women		Men	
	Low	High	Low	High
A. Marriage outcomes				
Ever married by 40	0.000	-0.012*	-0.002	0.008
	(0.004)	(0.006)	(0.009)	(0.012)
Mean of Y	0.73	0.78	0.62	0.78
Married/cohabiting by 40	0.001	-0.007	-0.010	-0.004
	(0.004)	(0.006)	(0.007)	(0.012)
Mean of Y	0.74	0.78	0.69	0.81
N	329638	166352	374126	139927
B. Fertility outcomes				
Childless	-0.000	0.001	0.015*	-0.004
	(0.003)	(0.005)	(0.008)	(0.014)
Mean of Y	0.11	0.12	0.22	0.16
Number of children	0.007	0.004	-0.007	-0.000
	(0.014)	(0.018)	(0.029)	(0.042)
Mean of Y	2.11	1.99	1.77	1.93
N	287439	146516	314773	122854

This table shows the coefficients of marriage market exposure in separate regressions where the dependent variable is the one indicated in each row. Sample is restricted to individuals not directly exposed to the reform, and divided into men and women with low (at most secondary education) and high (more than secondary education) education level. Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In order to explore if the results are thus purely driven by an increase in educational mismatch, I explore heterogeneity by the change in the gender gap in education induced by the reform at the marriage market level. The male-female gap in (university) education before the reform varied across regions: while in some regions men had a large advantage, in others women had already caught up to a great extent. As a result, the increase in women's education induced by

[25]This is despite the fact that a match between high-educated women and low-educated men would give rise to large specialization gains, to the extent that education predicts market productivity (Becker, 1973).

the reform led, in absolute terms, to decreases in the educational mismatch in some markets, to increases in others, and to little change in some (but to a reverse of the gap). I classify regions into two groups: regions in which the gender educational mismatch increased in absolute terms after the reform, and regions in which it did not change or it decreased.[26]

If the increase in educational mismatch was the only force driving the results, we would not expect to see negative effects on marriage or fertility in marriage markets where the mismatch did not increase. In those markets, the only change induced by the reform was making women more educated than men. The presence of negative effects in those regions would suggest that not only the size of the gender gap, but also its sign, matter, consistent with the importance of gender identity norms.[27]

The results are shown in Table 5. The first column displays the estimates for regions in which the gender gap in education did not increase in absolute terms, while the last column shows results for those in which it increased. Each row presents estimates of the effect of marriage market exposure from separate regressions with the different dependent variables. In general, we see that the effects are stronger in marriage markets where the reform led to an increase in educational mismatch: higher marriage exposure leads in these regions to declines in the probability of having ever married, and to lower probability of being in a couple by age 40. However, even in regions where the reform did not lead to an increase in mismatch, higher marriage market exposure has negative effects. In particular, we see that the increase in female childlessness is the same in both groups of regions.

The results from this exercise suggest that, even though increases in educational mismatch seem to be an important driving force, they are not enough to explain the main findings. The fact that higher exposure to the reform in the marriage market has a negative impact on fertility, even where mismatch did not increase, suggests that gender identity norms might also play a role.

[26] Specifically, I define the change in the gender gap as the difference between the gender gap in absolute value after the reform, and the gender gap in absolute value before the reform. To do so I estimate the impact of the reform on the gender gap in university education separately for each region.

[27] Akin to the social norms about relative earnings discussed by Bertrand et al. (2015), there might be a resistance to a situation in which the wife has higher education than her husband.

Table 5: Heterogeneous effects of marriage market exposure by change in educational mismatch

	No increase (1)	Increase (2)
A. Marriage outcomes		
Ever married by 40	-0.003	-0.009**
	(0.006)	(0.004)
Mean of Y	0.74	0.75
Married/cohabiting by 40	-0.000	-0.011*
	(0.006)	(0.006)
Mean of Y	0.74	0.74
N	364908	351629
B. Fertility outcomes		
Childless	0.010***	0.009**
	(0.003)	(0.004)
Mean of Y	0.12	0.12
Number of children	-0.012	-0.001
	(0.015)	(0.014)
Mean of Y	2.01	2.08
N	322464	310729

This table shows the coefficients of marriage market exposure in separate regressions where the dependent variable is the one indicated in each row. The sample in the first two columns consists of regions where the gender gap in university education decreased or did not change as a result of the reform, while the last two columns show results for regions where it increased. Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.4 Impact of marriage market exposure on other outcomes

Higher marriage market exposure to the reform might also affect other family-related outcomes, such as assortative mating or the probability of marital dissolution. However, the causal pathway to these outcomes is mediated by the impact of marriage market exposure on the probability of marriage itself. Similarly, exposure to the reform at the marriage market level might have an impact on labor outcomes, but the current specification makes it difficult to disentangle the extent to which this comes from changes in the probability of marriage or from changes in the relative supply of individuals with different educational levels in the labor market. With these caveats in mind, in this section I provide some suggestive evidence about the relationship between marriage market exposure and assortative mating, marital dissolution, and the probability of being employed.

The first three columns of Table A5 present estimates of the impact of marriage market exposure on the relative level of education within married couples. Higher marriage market exposure is related to an increased probability for women of having a spouse with the same level of education. This is likely driven by couples where both are highly educated. Women who were directly exposed to the reform, who had higher education, are in turn more likely to be more educated than their spouse.

The last three columns of Table A5 show results for the age difference within couples, for the probability of having divorced by age 40, and for the probability of being employed at this age. The age difference is expressed as husband's minus wife's age, such that it is on average positive. The estimates suggest that higher marriage market exposure does not affect this dimension of assortative mating for women. Direct exposure to the reform does not seem to have any effect on the age difference within couples either, on average. Regarding marital dissolution, higher marriage market exposure is related to a lower probability of being divorced for women. This is consistent with both the (non-significant) decrease in the probability of marriage, the delay in the age at first marriage—which might be related to a longer and more informed search, as in Becker et al. (1977)—and the higher probability of being with a spouse with the same level of education. Finally, higher marriage market exposure is related to a higher probability of em-

ployment for women. This could be partially driven by the relative increase in the frequency of women with high education level. It could also be related with the delay in the age of marriage or the increased probability of being with an equally-educated partner. At the same time, changes in the probability of working might themselves also affect these marriage outcomes.

6 Supplementary analyses

6.1 Measuring marriage market exposure

As discussed in section 3, in my baseline estimation the definition of marriage market exposure consists of a weighted average of individuals' exposure to the reform in someone's marriage market, geographically defined as their region of birth. The weight that different individuals have for someone's marriage market depends on the age difference between them (and gender), based on the distribution of the age gap within couples in pre-reform cohorts.

In this section I discuss how the main results differ when alternative specifications of the marriage market are used. In particular, I consider the following alternatives: 1) focusing only on individuals born in the same region and within the most common age gap, that is, 0-3 years in favor of the man; 2) using weights for the probability that j belongs to i's marriage market based on their age difference (as in the baseline) and their municipality of birth, using the frequency of marriages across different municipalities in pre-reform cohorts; and 3) using weights for the probability that j belongs to i's marriage market based on their age difference (as in the baseline) and the inverse distance of their municipalities of birth.

Results for the different family outcomes using the baseline (column 1) and these alternatives definitions of marriage market exposure are compared in Table 6. The main results are robust to changing the definition of marriage market. The measure of exposure that yields the most different results is the one that uses the age distribution from pre-reform cohorts (as in the baseline) and the normalized inverse distance between municipalities of birth as weights. The estimates using this measure are in all specifications substantially larger than the baseline estimates. On the contrary, the definition that restricts the marriage market to those born in the

same region and within an age gap of 0-3 years gives consistent, yet slightly smaller estimates. Part of this difference could be explained by the rigidity of this definition, which captures effects only for a part of the marriage market. This is likely to introduce measurement error that biases the estimates downwards. Overall, however, using one or another definition of marriage market does not affect the qualitative conclusions.

Table 6: Marriage market exposure coefficient with alternative marriage market definitions – women's outcomes

	Baseline	Region & 0-3 years	Age dist. & freq. marriage	Age dist. & inv. distance
	(1)	(2)	(3)	(4)
A. Marriage outcomes				
Ever married by 40	-0.004	-0.002	0.003	-0.008*
N=716537	(0.004)	(0.002)	(0.004)	(0.004)
Married/cohabiting by 40	-0.004	-0.002	-0.000	-0.009*
N=716537	(0.005)	(0.002)	(0.005)	(0.005)
Age at first marriage	0.182**	0.100**	0.112	0.355***
N=524814	(0.060)	(0.032)	(0.078)	(0.074)
B. Fertility outcomes				
Childless	0.009***	0.005***	0.006*	0.016***
N=633193	(0.002)	(0.001)	(0.003)	(0.002)
Number of children	-0.008	-0.002	-0.008	-0.014
N=633193	(0.010)	(0.006)	(0.015)	(0.010)
Age at first birth	0.355***	0.167***	0.330***	0.508***
N=594132	(0.086)	(0.041)	(0.100)	(0.104)

This table shows the coefficients of marriage market exposure in separate regressions where the dependent variable is the one indicated in each row. Different columns use different definitions of the marriage market, as indicated by column titles. Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6.2 Robustness tests

In this section I check the sensitivity of the main results to alternative control strategies and sample choices. Table 7 compares the coefficient of marriage market exposure (expressed in standard deviations) in the baseline specification (column 1) with several alternatives. Each row

shows results from separate regressions with different dependent variables. The first column also shows the Romano-Wolf stepdown adjusted p-values to correct for multiple hypothesis testing in the baseline specification. All main results survive this adjustment.

Table 7: Robustness of marriage market exposure impact on women's family outcomes

	Baseline	Municipality trends	Region pre-trends	W/o Helsinki	W/o outliers
	(1)	(2)	(3)	(4)	(5)
A. Marriage outcomes					
Ever married by 40	-0.004	-0.004	-0.003	-0.001	-0.004
RW p-value=0.485	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)
N	716537	716537	716537	602086	684723
Married/cohabiting by 40	-0.004	-0.005	-0.005	0.000	-0.004
RW p-value=0.643	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
N	716537	716537	716537	602086	684723
Age at first marriage	0.182**	0.197**	0.166**	0.077	0.200**
RW p-value=0.009	(0.060)	(0.068)	(0.051)	(0.063)	(0.061)
N	524814	524814	524814	445879	501265
B. Fertility outcomes					
Childless	0.009***	0.009***	0.009***	0.007**	0.009***
RW p-value=0.009	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
N	633193	633193	633193	532720	604979
Number of children	-0.008	-0.006	-0.012	-0.007	-0.007
RW p-value=0.644	(0.010)	(0.010)	(0.010)	(0.014)	(0.010)
N	633193	633193	633193	532720	604979
Age at first birth	0.355***	0.368***	0.326***	0.234***	0.370***
RW p-value=0.000	(0.086)	(0.092)	(0.078)	(0.057)	(0.088)
N	594132	594132	594132	502479	567346

This table shows the coefficients of marriage market exposure in separate regressions where the dependent variable is the one indicated in each row. Standard errors (in parentheses) are clustered at the municipality of birth level, and bootstrapped in column (3). RW p-value refers to the Romano-Wolf stepdown adjusted p-value to correct for multiple hypothesis testing in the baseline specification. All specifications include cohort and municipality of birth F.E., and additional controls as indicated in column titles. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In column 2 region-specific linear trends are substituted by municipality-specific linear trends. The results remain unaltered, although estimates become slightly more imprecise. In column 3, instead of including linear trends, I instead de-trend the dependent variable of region-specific

linear pre-trends. To do so, I follow Goodman-Bacon (2018) and estimate pre-trends by regressing the dependent variable on region-specific linear trends for cohorts up to 1960. These trends are then substracted from the full panel. The specification then includes only municipality and cohort of birth fixed effects. Standard errors are bootstrapped to account for the two-step estimation. Using this method has virtually no effect on the results.

In the last two columns I show results using the baseline specification but restricting the sample in different ways. First, as discussed in section 5.1, municipalities in Helsinki region had started to implement the reform before they were supposed to according to the adoption plan. To check whether this affects the results, in column 4 I exclude individuals from this region. The estimates remain consistent, albeit a bit smaller, suggesting that the potentially different trends of the capital region are not driving the results. Finally, some municipalities were assigned to adopt the reform earlier than most of their surrounding localities (see section 3). As discussed by Pekkarinen (2008), the choice of these municipalities is unlikely to have been random. In column 5 I drop individuals from these municipalities and find that results are unaffected. This indicates that the combination of municipality fixed effects and region-specific trends effectively controls for any potential differences in levels or trends.

7 Conclusion

This paper provides evidence on the effects of the female educational advantage on marriage and fertility outcomes. Exploiting changes in the gender gap in education in the marriage market induced by the Finnish comprehensive school reform, I show that higher female advantage delays marriage and childbearing, and leads to an increased probability of remaining childless by age 40. The size of these effects is substantial. A one standard deviation increase in marriage market exposure, leading to a 0.3 pp increase in female educational advantage, accounts for around 40% of the increase in female childlessness and for 13% of the increase in the age at first birth during this period in Finland.

These estimates can also be compared to those from related studies analyzing the impact of

changes in the gender gap in earnings on family formation. For instance, compared to the results by Bertrand et al. (2015), I find that the effect on the share of married males of a one standard deviation increase in marriage market exposure to the reform would be roughly equivalent to the effect of a 3 pp increase in the probability that a woman earns more than a man in the marriage market. In relation to the findings by Autor et al. (2019), the effect of this increase in marriage market exposure on the proportion of women without children is around 30% larger than that of a unit trade shock (an increase in manufacturing import pressure). Since they find that a unit trade shock decreases the male-female earnings gap by 2 points at the median, the effect on childlessness in my setting is equivalent to that of a decrease in the gender gap in earnings of 2.6 pp.[28]

My findings suggest that an important driver of the effects is the increasing mismatch between the distributions of educational attainment of men and women resulting from the reform. As such, the effects are stronger for low-educated men and high-educated women. However, my analysis also highlights that the sign of the gender gap in education, and not only its size, matter, consistent with the importance of gender identity norms. In particular, there are negative effects on family outcomes even in marriage markets where the absolute size of the educational mismatch did not increase.

Overall, these results are consistent with the sociological hypothesis that changes in the economic roles of men and women have profound implications for family structure (Goldscheider et al., 2015), and with previous evidence showing that relative advances by women can generate frictions in marriage markets (Bertrand et al., 2015). The question remains as to whether these effects will persist in the future, as social norms evolve towards more egalitarian gender attitudes.

[28]The definitions of the outcome variables differ slightly in these papers compared to mine. In Bertrand et al. (2015), the share of married males refers to the proportion of males who are currently married in each marriage market, which is defined for broad age groups (e.g. men aged 24-33). In my analysis, in turn, this estimate refers to the probability for men of being in a couple (married or cohabiting) by age 40. In Autor et al. (2019), they estimate the impact of a trade shock on the share of women aged 18-39 with children in the household (biological or otherwise), while I estimate effects on the probability for women of not having had biological children by age 40.

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Appendix

Table A1: Years of exposure to new curriculum by year of birth and reform year of municipality

	Reform year					
Year of birth	1972	1973	1974	1975	1976	1977
<=1960						
1961	5					
1962	6	5				
1963	7	6	5			
1964	8	7	6	5		
1965	9	8	7	6	5	
1966	9	9	8	7	6	5

Table A2: Own vs. Marriage market exposure: impact on high level of education

	Women		Men	
	(1)	(2)	(3)	(4)
Own exposure	0.012**	0.012**	0.000	0.002
	(0.004)	(0.004)	(0.004)	(0.004)
Marriage market exposure (sd)		-0.000		-0.004
		(0.002)		(0.003)
Observations	716537	716537	743911	743911
Adjusted R^2	0.038	0.038	0.016	0.016
Pre-reform mean	0.39		0.30	

Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. Marriage market exposure (in standard deviations) indicates the proportion of people in someone's marriage market affected by the reform. Own exposure takes value 1 for cohorts and municipalities affected by the reform. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Marriage market exposure impact on men's marriage and fertility by age 40

	Marriage			Fertility	
	Ever married	In couple	Age marriage	Childless	Num children
Marriage market exposure (sd)	-0.003	-0.010**	-0.059	0.004	-0.031**
	(0.006)	(0.005)	(0.059)	(0.004)	(0.014)
Own exposure	0.004	0.000	0.092*	-0.002	0.003
	(0.004)	(0.003)	(0.048)	(0.003)	(0.010)
Observations	743911	743911	494239	638569	638569
Adjusted R^2	0.010	0.008	0.038	0.011	0.015
Pre-reform mean	0.66	0.72	27.18	0.20	1.81

Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. Marriage market exposure (in standard deviations) indicates the proportion of people in someone's marriage market affected by the reform. Own exposure takes value 1 for cohorts and municipalities affected by the reform. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Heterogeneous effects of marriage market exposure by level of education – sample not directly exposed

	Women		Men	
	Low	Uni	Low	Uni
A. Marriage outcomes				
Ever married by 40	-0.001	-0.015	0.003	0.009
	(0.004)	(0.010)	(0.009)	(0.016)
Mean of Y	0.75	0.77	0.64	0.80
Married/cohabiting by 40	-0.001	-0.002	-0.009	0.008
	(0.004)	(0.011)	(0.006)	(0.018)
Mean of Y	0.75	0.77	0.71	0.82
N	434851	61139	442937	71116
B. Fertility outcomes				
Childless	-0.000	0.005	0.010	0.005
	(0.003)	(0.010)	(0.008)	(0.019)
Mean of Y	0.11	0.14	0.21	0.15
Number of children	0.008	-0.018	-0.002	-0.001
	(0.012)	(0.034)	(0.026)	(0.059)
Mean of Y	2.08	1.96	1.79	1.96
N	381327	52628	375334	62293

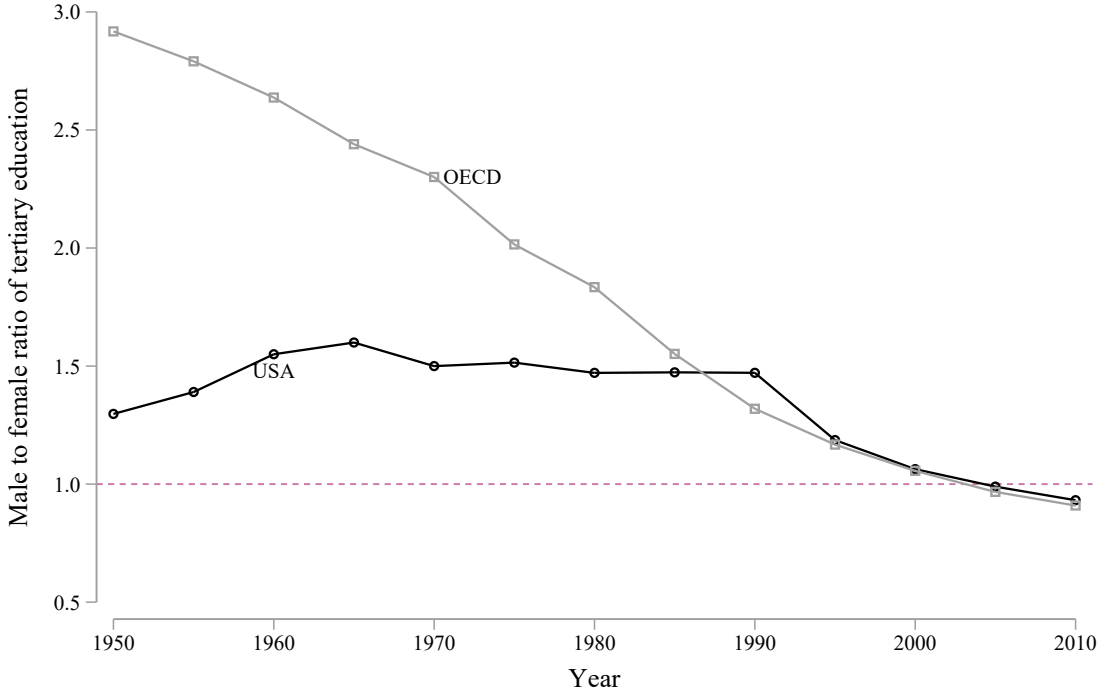
This table shows the coefficients of marriage market exposure in separate regressions where the dependent variable is the one indicated in each row. Sample is restricted to individuals not directly exposed to the reform, and divided into men and women with low level of education (less than university degree) and those with university education. Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Marriage market exposure impact on assortative mating, women's divorce and employment by age 40

	Relative level of education			Age difference	Divorced	Employed
	Equal	More	Less	with spouse	by 40	at 40
Marriage market exposure (sd)	0.011**	-0.009***	-0.004*	0.013	-0.010**	0.011***
	(0.005)	(0.003)	(0.003)	(0.055)	(0.003)	(0.003)
Own exposure	-0.008**	0.009**	-0.000	-0.011	0.000	-0.003
	(0.004)	(0.003)	(0.002)	(0.032)	(0.003)	(0.003)
Observations	716537	716537	716537	583016	716537	716537
Adjusted R^2	0.008	0.013	0.002	0.005	0.016	0.011
Pre-reform mean	0.50	0.14	0.08	2.39	0.17	0.79

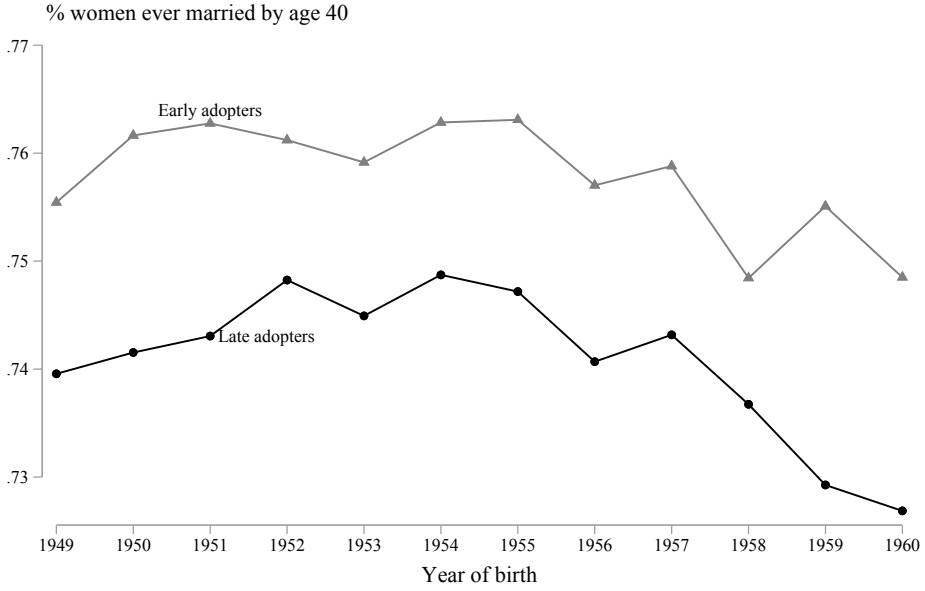
Standard errors (in parentheses) are clustered at the municipality of birth level. The specification includes cohort and municipality of birth F.E., as well as region-specific linear trends. Marriage market exposure (in standard deviations) indicates the proportion of people in someone's marriage market affected by the reform. Own exposure takes value 1 for cohorts and municipalities affected by the reform. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure A1: Ratio of percentage of men to percentage of women (ages 20-64) with tertiary education in the US and on average in the OECD

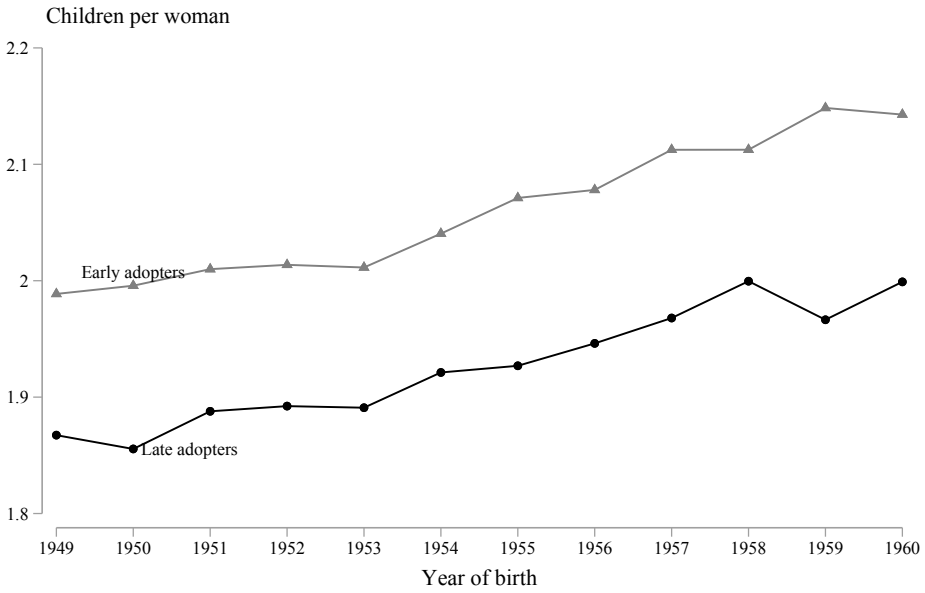


Notes: This figure shows the evolution of the ratio of the percentage of men to the percentage of women with tertiary education among the population aged 20-64 in the US (black line) and on average for OECD countries (gray line). Data from Barro and Lee (2013).

Figure A2: Trends in family outcomes in pre-reform cohorts – early vs. late reform municipalities



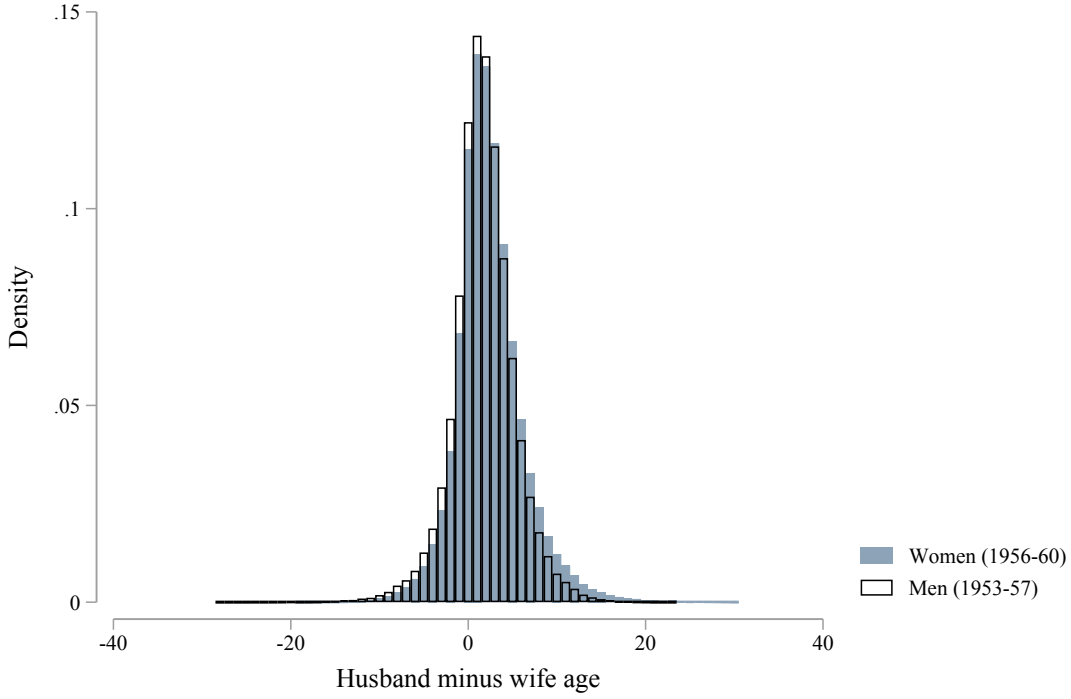
(a) Percentage of women ever married



(b) Average number of children per woman

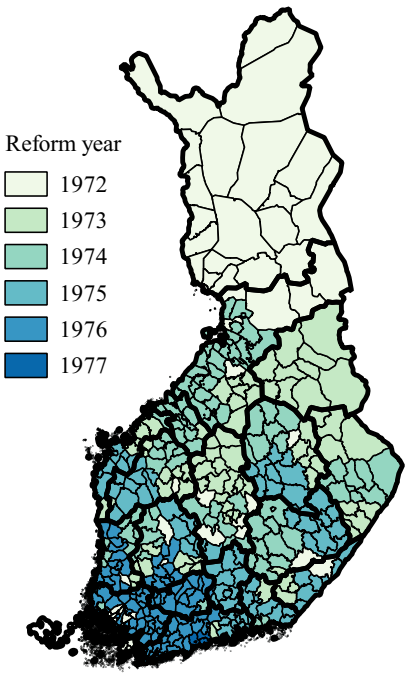
Notes: This figure presents the evolution of trends in fertility and marriage outcomes in early-adopter municipalities (those that implemented the reform in 1972-1974) and in late-adopter municipalities (those that implemented it in 1975-1977). Panel (a) shows the the percentage of women who were ever married by age 40 by cohort, and panel (b) shows the average number of children per woman by cohort.

Figure A3: Distribution of age difference between husband and wife in pre-reform cohorts



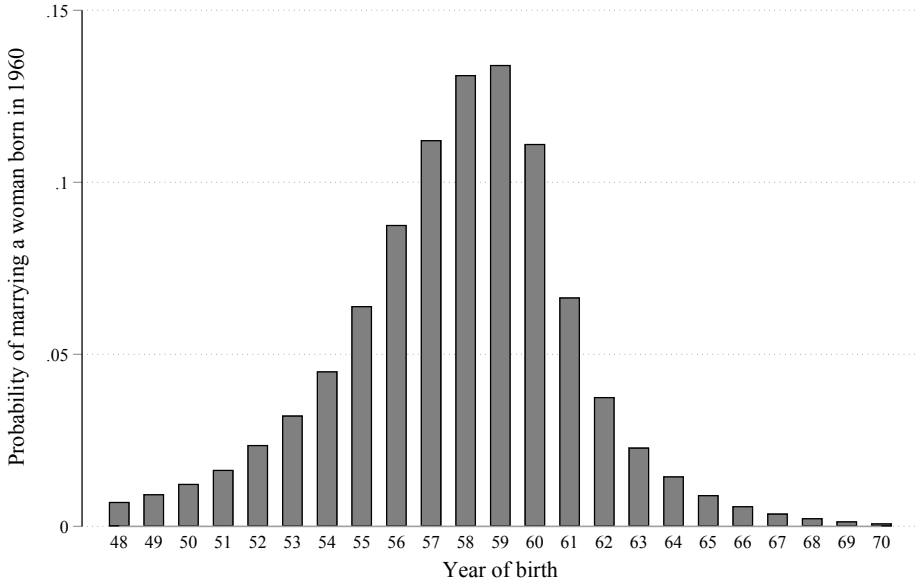
Notes: This figure shows the distribution of the age difference within married couples in pre-reform cohorts (1956-60 for women and 1953-57 for men).

Figure A4: Variation in year of reform implementation by municipality and region

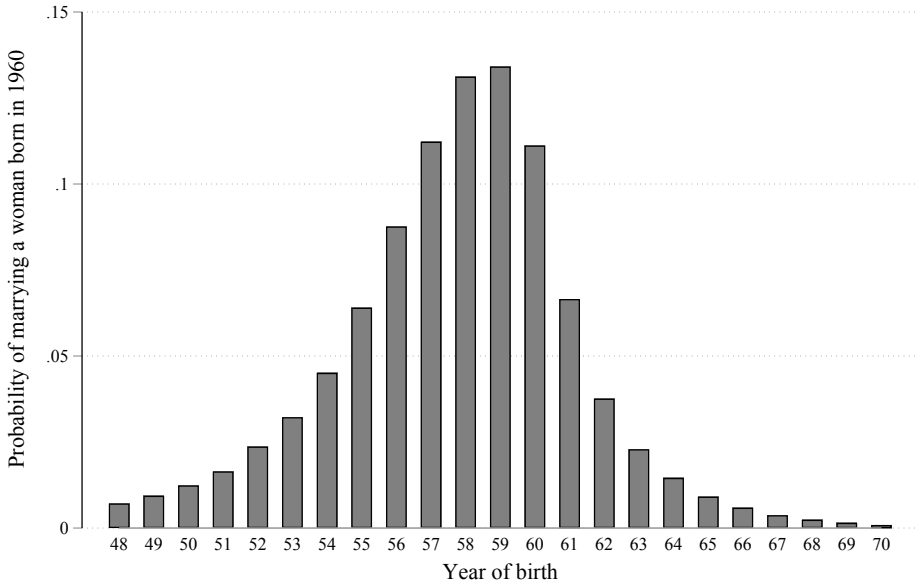


Notes: This map shows the year of adoption of the reform by municipality. Thicker lines indicate region boundaries.

Figure A5: Example of imputed probability of belonging to the marriage market – 1960 cohort



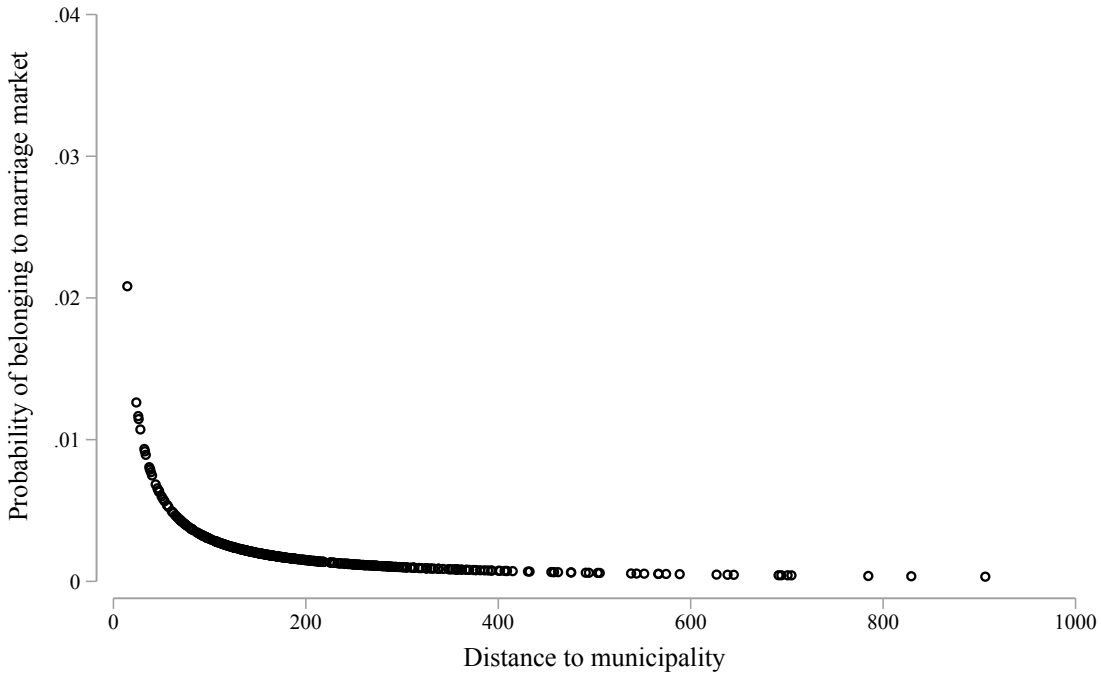
(a) Probability of belonging to the marriage market of a woman born in 1960



(b) Probability of belonging to the marriage market of a man born in 1960

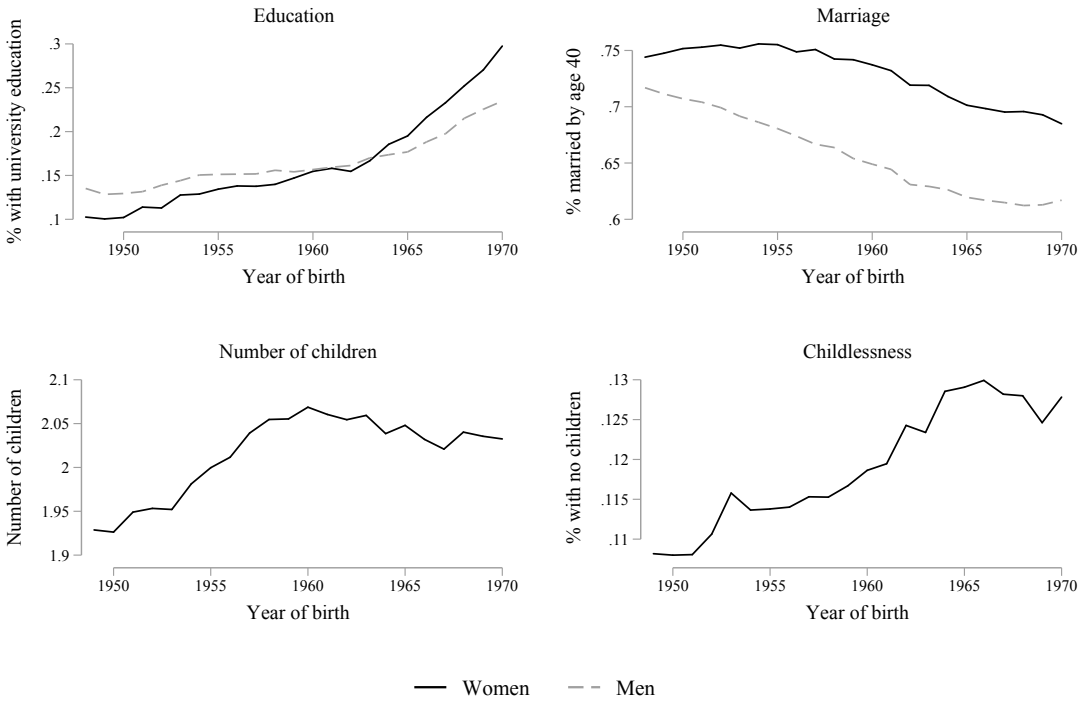
Notes: This figure represents the weight given to men and women of each cohort for constructing the marriage market of 1960 women in panel (a), and of 1960 men in panel (b). The calculation is based on the distribution of the age difference within couples in pre-reform cohorts (1956-60 for women and 1953-57 for men), which is shown in Figure A3.

Figure A6: Probability of belonging to marriage market by distance between municipalities: Tampere (example)



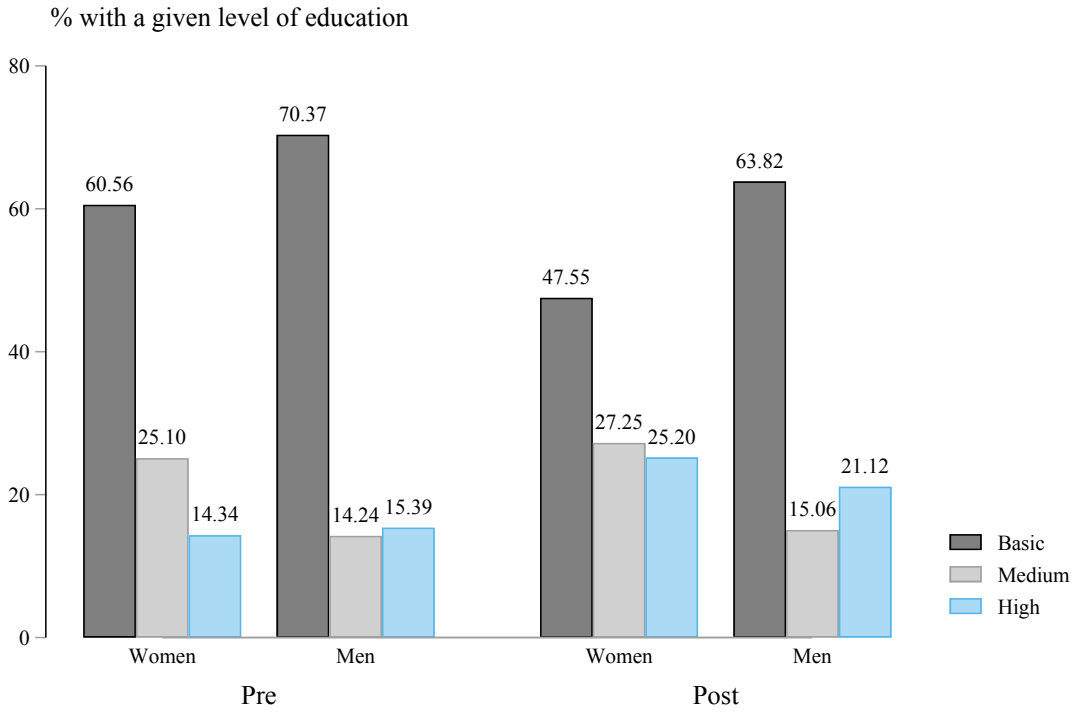
Notes: This figure plots the imputed probability for people in each municipality of belonging to the marriage market of individuals from Tampere (as an example). This probability is based on the inverse of the distance between each municipality and Tampere. Inverse distance probabilities are rescaled such that they add up to 1.

Figure A7: Aggregate education and family trends in Finland



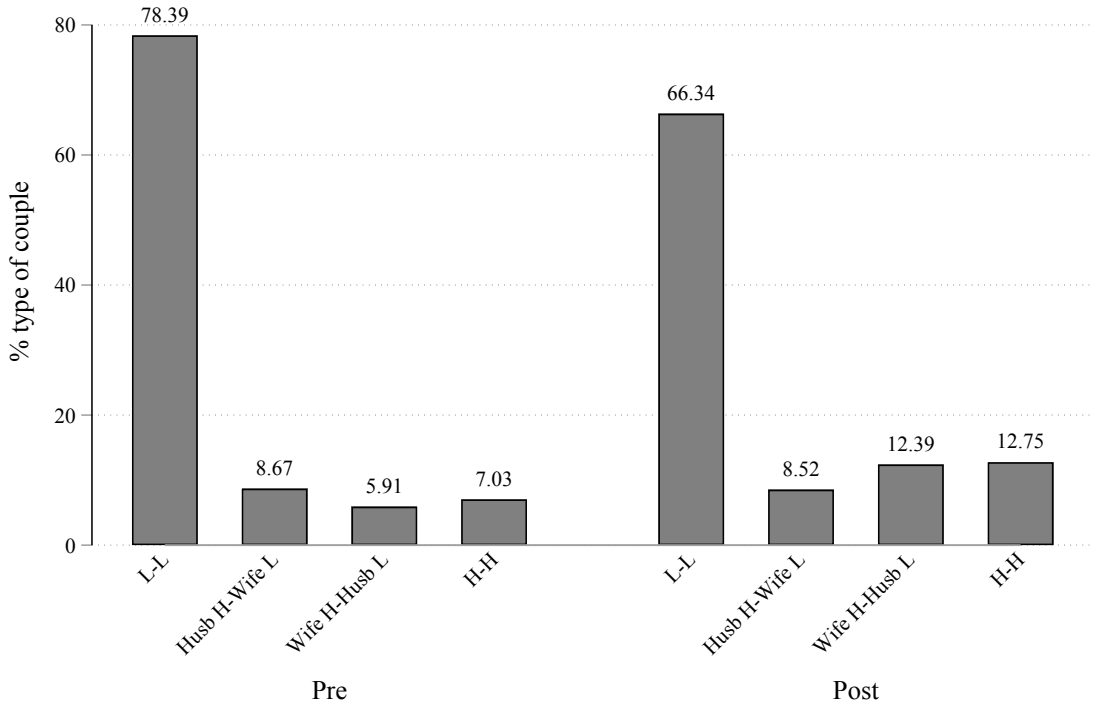
Notes: This figure plots the percentage of men and women with university education, the percentage of men and women who were ever married by age 40, the average number of biological children per woman, and the percentage of women who do not have any children by age 40 in Finland by year of birth.

Figure A8: Distribution of educational attainment by gender and cohorts



Notes: This figure plots the percentage of men and women with basic, medium, and high level of education in pre-reform (1956-60) and post reform (1966-70) cohorts. Basic education is defined as upper secondary education at most; medium education is defined as more than secondary, but less than university education, and high education refers to university degree or higher.

Figure A9: Frequency of different types of couples by relative education – pre- and post-reform cohorts



Notes: This figure plots the frequency of different types of couples, by relative level of education, in pre-reform (1956-60) and post reform (1966-70) cohorts. Couples are classified into four groups: couples where none of the spouses have a university degree (L-L), those in which both spouses have a university degree (H-H), couples where the husband has a university degree and the wife does not (Husb H-Wife L), and couples where the wife has a university degree and the husband does not (Wife H-Husb L).