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ABSTRACT

School Starting Age, Maternal Age at Birth, and Child Outcomes*

This paper analyses the effects of maternal school starting age and maternal age-at-birth on children's short and long-term outcomes using Finnish register data. We exploit a school-starting-age rule for identification. Mothers who are born after the school entry cut-off give birth at higher age, but total fertility and earnings are unaffected. Being born after the cut-off reduces gestation and, hence, child birth weight. The effects on birth weight and gestation are rather small, however, suggesting that the long-run impacts are limited. Accordingly, we find no impacts on longer-term child outcomes, such as educational attainment and adolescent crime rates. Overall, we interpret this evidence as saying that there are no favorable effects of maternal age at birth on child outcomes.

JEL Classification: J13, I21

Keywords: school starting age, fertility, maternal age, birth outcomes, education, crime

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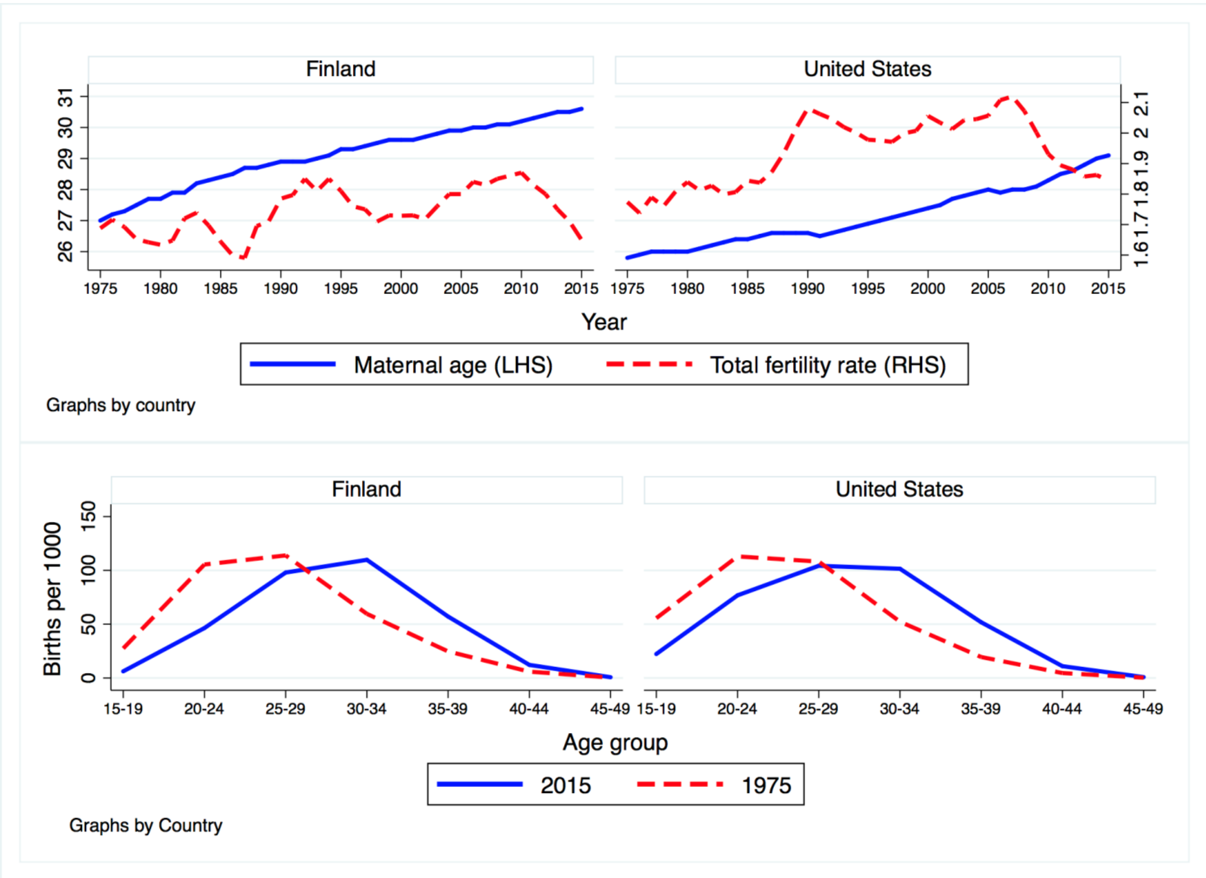
1. Introduction

Women in the developed world are increasingly postponing childbearing decisions until later in life. The upper panel of Figure 1 shows the evolution of maternal age and fertility for two countries, Finland and the United States, from 1975 to 2015. The development in these two countries is remarkably similar, with trend increases in maternal age at birth but no appreciable changes in fertility rates. This impression is reinforced by the lower panel, which shows that there is a uniform translation of the maternal age distribution towards higher ages, without a clear change in the fertility rate, between 1975 and 2015.

Figure 1: Fertility rates and maternal age in Finland and the United States, 1975-2015.

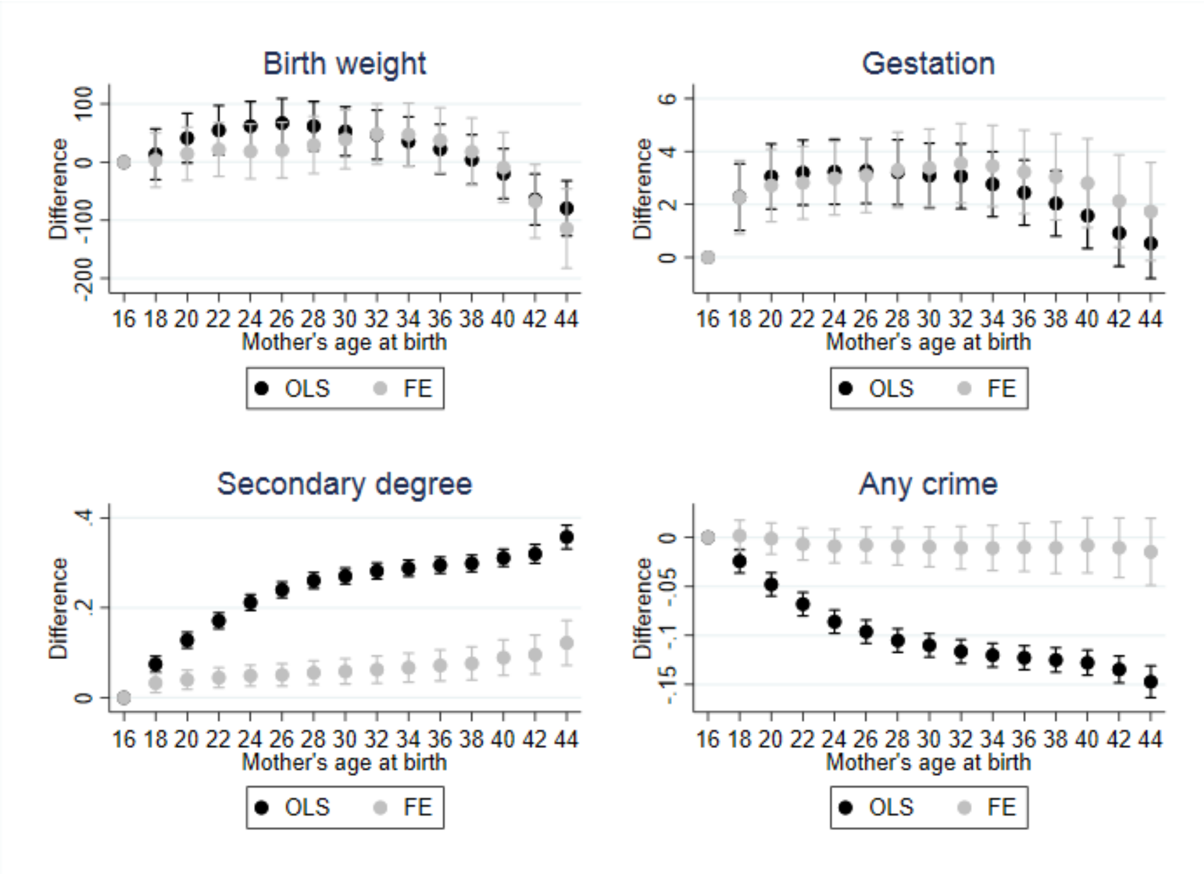


Source: OECD Family data base.

In this paper, we are primarily interested in the impact of maternal age at birth on children's outcome in the short and long run. Maternal age may affect the child through various channels. On the one hand, medical risk factors increase with mother's age (e.g., Sutcliffe et al., 2012); on the other hand, older women are wealthier and have access to more resources and more stable family environments.

A large (descriptive) literature has documented that children born to very young mothers, in particular, tend to have worse outcomes from birth to adulthood. Figure 2 reproduces these results using our data (from Finland). The black circles (reporting OLS-estimates) show that the higher maternal ages tend to be associated with better child outcomes than teen motherhood. Older mothers give birth to heavier children; their children are more likely to attain a secondary degree, and they commit less crime.

Figure 2: Mother's age at birth and child outcomes



Notes: The figures plot the coefficients on mother's birth age dummies in regressions that also includes child's birth year dummies. "FE" refers to a specification with mother fixed effects. Birth weight and gestation regressions include children whose mothers were born between 1960-1980 and had at least two children. Regressions with secondary degree and any crime as outcomes are for children whose mothers were born between 1945-1960.

The association between teen motherhood and worse outcomes is likely driven by teen mothers having unfavorable characteristics. The mother fixed effects estimates (the grey circles) represent a first attempt of dealing with such selection. When we compare children born to the same mother, the relationship between maternal age and child outcomes is more nuanced. Nevertheless, there is a positive relationship between having secondary schooling, as well as gestation, and age at motherhood.

The within-siblings comparison is an important step forwards in terms of establishing causality.[1] Nevertheless, the age difference between siblings is endogenous, as the health, development, and the circumstances around the birth of the older sibling may affect the decision of when (and whether) to

[1] This approach has been used by several papers in the literature, e.g., Myrskylä and Fenelon (2012), Myrskylä et al. (2013), Aizer et al. (2018), Duncan et al. (2018), and Favara and Perez (2019).

have another child. Thus, the mother fixed effects estimates are potentially contaminated by unobserved factors as well.

We use school starting age rules to shed light on the impact of maternal age on child outcomes in Finland. Women born after the school entry date (1st of January) start school almost a year older than those born just before the school cut-off date (31st of December). This creates a mechanical difference in age when individuals exit schooling, which can have an effect on fertility and maternal age, as women are less likely to have children while still enrolled in school.

School entry policies can affect fertility and child outcomes through other channels as well. A large literature has shown that children who start school at older ages tend to score higher on in-school tests, and also have higher educational attainment (e.g., Black et al., 2011, and Fredriksson and Öckert, 2014). Hence, school entry age may also postpone labor market entry by affecting the length of schooling. In turn, parental schooling can directly affect child outcomes by increasing the amount of resources available,[2] and by increasing the ability to process information regarding the effects of parental behavior (Aizer and Stroud, 2010).[3]

A prerequisite for our analysis is the availability Finnish register data that allow us to track women over their life-cycle and their children into early adulthood. The register data contain information on traditional birth outcomes, such as birth weight and gestation, but also on maternal behaviors, such as smoking. To the data we have also matched later child outcomes such as having a secondary degree, whether the child has committed any crime, and early career employment outcomes.

We show that the school entry rule affects the age at graduation from school. The school starting age also affect the age at family formation. Thus, the age at cohabitation and the age of giving birth both increase as a result of being born after the school entry cut-off. In particular, those born just after the school-entry cut-off have their first births when they are around half a year older than those born just before this cut-off. Completed fertility, however, is unaffected, and there is thus no effect on selection into motherhood. Somewhat surprisingly, perhaps, educational attainment is only weakly affected in the Finnish context. Moreover, the school entry cut-off does not affect earnings and the characteristics of the father.

Birth weight and gestation fall as a result of the mother being born after the school-entry cut-off. The birth weight effect is rather small, however: interpreted as the effect of being born to an older mother,

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[2] Highly educated parents also tend to have less children, meaning more resources available per child. Moreover, school starting age can also affect life time income, fertility and crime behavior, all of which can have an independent impact on child outcomes.

[3] Aizer and Stroud (2010) show that the first widely publicized report of the negative effects of smoking on health had very different impact on behavior of highly educated and low educated mothers. Immediately after the publication of the report, more educated mothers immediately reduced their smoking, while the less educated did not, and that the relative health of their newborns likewise increased.

the estimates suggest that an increase in the maternal age by 5 years (roughly a standard deviation increase in maternal age) lowers birth weight by around 7 percent relative to the mean. Also, being born after the school-entry cut-off only has a minor effect on the likelihood of extreme birthweight outcomes. And it does not affect the probability of smoking during pregnancy. We also show that the school starting age has no impact on children's long-run outcomes. This implies that inactivity rates (not in school, nor employed) are unrelated to maternal age, as are teenage crime rates.

Our paper adds to several strands of literature. First, we add to a large descriptive literature that has examined the association between maternal age and child outcomes. As illustrated by Figure 2, this literature is plagued by selection into different maternal ages. Contrary to this literature, our estimates imply that the impact of maternal age on birth weight is negative. Second, we add to the literature examining the causal effect of school entry age on fertility. Previous studies have focused on fertility in the years immediately following or during school enrolment (McCrary and Royer, 2011, Black et al., 2011). We analyze the effect of the school entry rule on fertility patterns throughout a woman's fertile ages and thus observe the effects on completed fertility. Third, we add to the literature on the relationship between the school entry age and offspring outcomes. To our knowledge, our paper is the first to examine the impact of maternal school entry rules on children's longer-term outcomes. The only previous study that has examined the impact of maternal school starting age on children outcomes, McCrary and Royer (2011), focused on infant health outcomes of children born to younger mothers.

The remainder of the paper is organized as follows. Section 2 describes the data. In Section 3, we first present the empirical set-up, and then move on to present our results on the relationship between school entry rules, maternal age at birth, and child outcomes. Section 4 concludes.

2. Data

We use administrative data from Finland, containing information on entire cohorts of women born between 1951-59 and 1971-78. The younger birth cohorts (i.e., those born 1971-78) are used to shed light on the relationship between maternal age and child outcomes at birth. The reason for focusing on these cohorts is that the Medical birth registry is available during 1987-2018. Given this restriction, the earliest cohort we can do the analysis for consists of women born in 1971 (who were 16 in 1987). We also want to cover the upper-range of the fertile age range; this puts an upper limit on those born in 1978 who are 40 years-of-age in 2018. The older cohorts (those born 1951-59) are used to shed light on maternal age at birth and longer-run education and crime outcomes for their children. Information on demographics, education and labor market outcomes for both parents and their children are obtained from the Finnish

Longitudinal Employer–Employee Data (FLEED) and is available for 1988-2016. The crime information comes from sentence records that cover 1987-2015.[4]

Table 1 shows descriptive statistics for mothers and their children.

Table 1: Descriptive statistics

	Mother characteristics	Birth outcomes	Long-run child outcomes
Mothers born	1971-78	1971-78	1951-59
	(1)	(2)	(3)
Mother's age at 1st birth	27.95 (5.27)		
Mother's age at birth		29.84 (5.31)	27.59 (5.24)
Years of schooling	14.34 (2.78)		
Earnings (before 1st birth)	20976.19 (16873.97)		
# Children	2.34 (1.27)		
Have a spouse	0.98		
Spousal years of schooling	13.44 (2.90)		
Spousal earnings (before 1st birth)	27947.75 (23852.60)		
Maternal secondary ed.	0.64		
Paternal secondary ed.	0.61		
Birthweight (grams)		3510.29 (571.87)	
Gestation (days)		277.82 (13.27)	
Induction		0.17	
C-section		0.10	
Mother smokes		0.14	
Child secondary ed.			0.82
Child inactive			0.18
Any crime age 18-20			0.07
#observations	187,464	439,582	616,044

Notes: The table reports means and standard deviations (within parentheses). Inactivity is defined as not being employed, nor being enrolled in education at age 21 (or the first year a child can be found in the FLEED data). Column (1) is representative of mothers born 1971-78. Column (2) is representative of all children to mothers born 1971-78. Column (3) is representative of all children to mothers born 1951-59

Mothers were almost 28 years old when they gave birth to their first child; see column (1). Their children weighed on average 3.5 kg., 10 percent of the babies were delivered by C-section, and 14 percent of mothers smoked during pregnancy; see column (2). The final column shows longer-run child outcomes (available for children of mothers born 1951-59). It shows, for instance, that 18 percent of the children were "inactive" (i.e., not in employment or education) at age 21 and 7 percent of children committed a crime when they were aged 18-20.[5]

[4] In supplementary analysis, we also use population data (available 1987-2018) on when the individuals graduated from school (the FOLK-degree data set).

[5] Note that the crime data include all forms of crime.

3. The school entry cut-off, maternal age at birth, and child outcomes

3.1 Specification

We are mainly interested in how the maternal age at birth (MAB) affects child outcomes (y)

$$y_{ic} = \alpha_c + \beta MAB_{ic} + f(DoB_{ic}) + \varepsilon_{ic} \quad (1)$$

where DoB denotes day of birth (of the mother), α_c is a cohort (c) fixed effect, and y_{ic} is the outcome for a child born to a mother from cohort c. A cohort is defined as running from July to June.

Since maternal age at birth is endogenous, we use variation coming from the school-starting-age legislation. With DoB normalized to zero at the school entry cut-off (1st of January), the instrument is defined as $Z_{ic} = \mathbf{1}\{DoB_{ic} \geq 0\}$.

The reduced form corresponding to equation (1) then is

$$y_{ic} = \theta_c + \pi Z_{ic} + g(DoB_{ic}) + \epsilon_{ic}, \quad (2)$$

where $g(DoB_{ic})$ is a control function in the assignment variable (day of birth).

Since the school entry cut-off may affect other maternal outcomes (e.g., educational attainment and earnings) which may have a direct effect on child outcomes, we focus on the reduced form. Below we show that education, earnings, and the characteristics of the partner, are generally unaffected by the cut-off. We therefore think maternal age at birth is the main mechanism, even though we cannot strictly rule out other mechanisms. We mostly estimate equation (2) using a 2nd order parametric control function in day-of-birth on a window that roughly corresponds to the optimal bandwidth (in the Calonico et al. 2014 sense, given the 2nd order control function). We have also estimated all outcome equations via local linear regression with bandwidths chosen so as to minimize mean-squared error; these results are reported in the Appendix, and the results do not change appreciably.

We first examine a wide range of outcomes for potential mothers, that is, their years of schooling, earnings, and the probability to give birth at a given age using the specification in (2). We then examine the effects of maternal school starting age on the outcomes of children born to these mothers, both at birth and in the longer run. Note that compliance with the school starting age legislation is very high in Finland. Only 5.9 percent of students leave compulsory school outside their normal age range.[6]

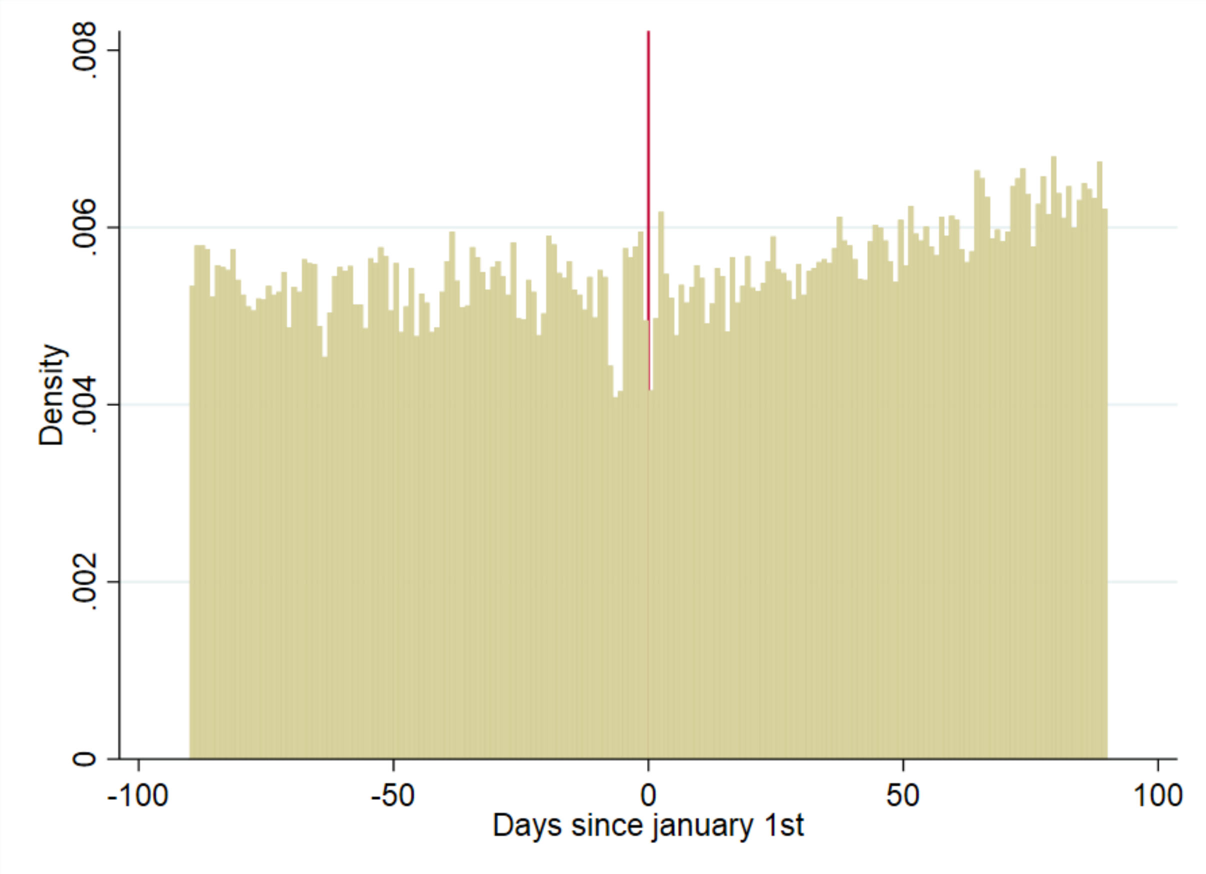
[6] This number comes from the cohorts of mothers born 1975-78. Unfortunately, we do not observe the school starting age in our data. But since grade retention is rarely practiced in Finnish schools (in 2016, 0.3 % of compulsory school students repeat a grade) we infer that 95 percent is a ballpark estimate of the compliance with the school starting age legislation.

3.2 Validity of the research design

A fundamental assumption in the regression discontinuity design is that individuals cannot exactly manipulate the assignment variable, which implies that they are as good as randomly assigned relative to the school-entry cut-off. If so, there should be no shifts in the distribution of birth dates around this threshold;[7] analogously, pre-determined covariates should be balanced at the cut-off.

The assignment variable in the RD-design is the day of birth of mothers. Figure 3 shows the distribution of birth dates among mothers born 1971-78. There is a dearth of births around Christmas which has to do with C-sections not being planned then.[8] Other than that, the number of births evolve smoothly through the cut-off. Consequently, the McCrary test for manipulation of mother's birth dates around the threshold could not be rejected.[9]

Figure 3: Distribution of birth dates



Notes: Mothers born in 1971-1978 (90 days before and after the cutoff date, January 1st) in Finland.

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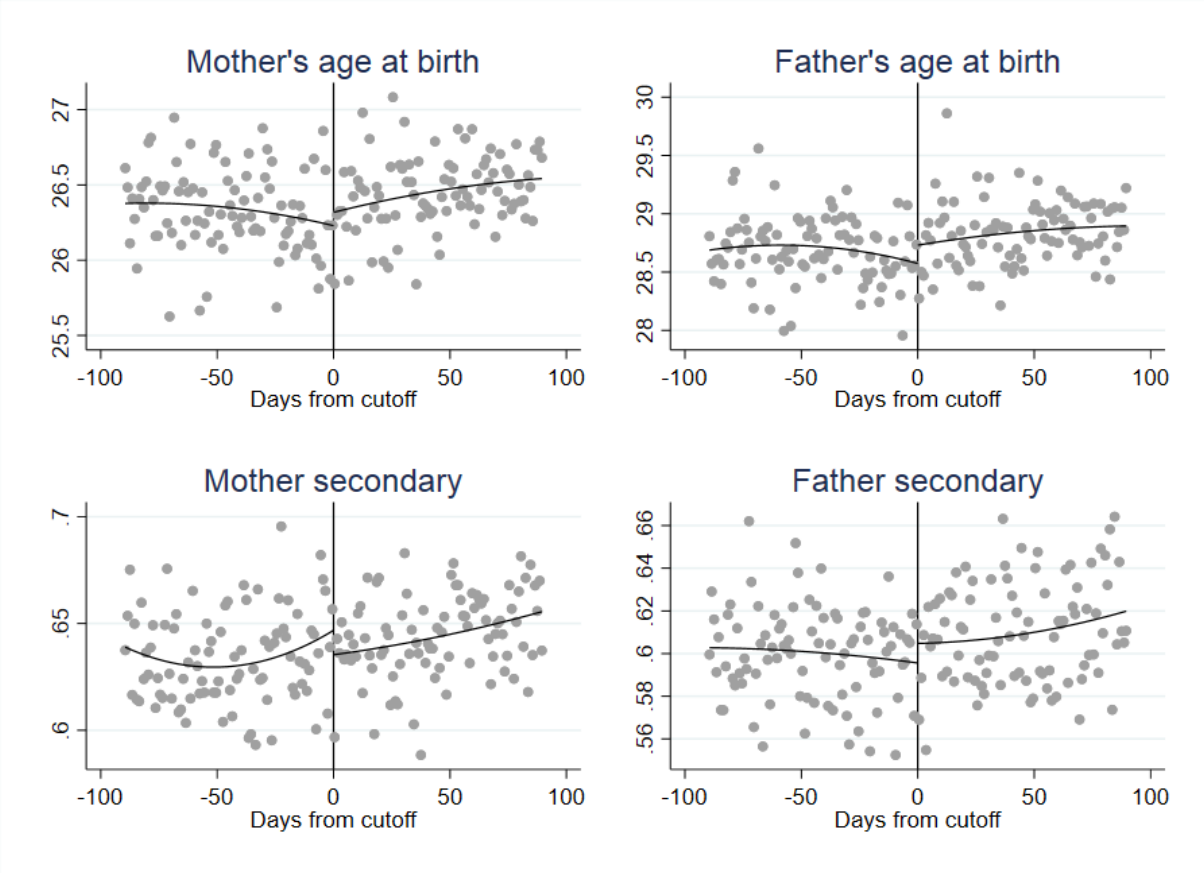
[7] Huang et al. (2020) show that Chinese mothers systematically time births relative to the school entry cut-off.

[8] Jacobson et al. (2020) document a similar pattern using Californian data.

[9] The McCrary test (2008) for a discontinuity in the density indicates no manipulation at the threshold; the discontinuity estimate is -0.020 (standard error: 0.021). Accounting for the fact that the assignment variable is discrete, does not alter this conclusion. Frandsen (2017) shows that the McCrary test tends over-reject a true null hypothesis when the assignment variable is discrete. This over-rejection problem is likely small in the current context, as day-of-birth is a finely grained assignment variable.

Another way to check the validity of the research design is to investigate whether the background characteristics of women change at the threshold. Figure 4 examines whether there is a discontinuity in parental characteristics at the school entry cut-off for all mothers born between 1971-1978. It shows that there are no differences in the age of birth of the parents of the mothers; the same conclusion applies to their education levels.[10]

Figure 4: Mother's birth dates and pre-determined characteristics



Notes: The sample includes all mothers born 90 days before and after January 1st in 1971-1978 in Finland. The figure plots the sample averages of the characteristics of the parents of the mothers in our sample by day of birth. The solid lines represent a second order polynomial regression.

Table 2 provides a slightly more detailed analysis of whether baseline covariates are balanced for the mothers born 1971-78.[11] The first two columns examine whether the parents are present in the data; a non-present parent is basically equivalent to the parent not being alive. As the first two columns show, there are no jumps at the cut-off. The next two columns look at parental age at birth – age at birth is also balanced at the threshold. The final two columns examine whether parental education is balanced.

[10] Analogous analyses for *all women* (rather than *all mothers*) born 1971-78 show that there are no discontinuities in the number of births and baseline characteristics around the school entry threshold.
[11] Table A6 reports on balancing in the sample of mothers born in the 1950s.

Education for the maternal parents is the same on both sides of the school entry cutoff. Taken together, there is no evidence of any systematic differences for mothers around the threshold.

Table 2: Balance of pre-determined characteristics at cut-off

	Parent observed in data		Parental age at birth		Parent has secondary ed.	
	Mother	Father	Mother	Father	Mother	Father
Born after cut-off	0.002	0.005	0.101	0.168	-0.011	0.010
	(0.002)	(0.003)	(0.105)	(0.118)	(0.010)	(0.010)
Mean dep. var.	0.987	0.970	26.335	28.692	0.634	0.600
# observations	89,876	89,876	88,756	87,248	87,890	84,291

Notes: Sample includes mothers who were born in 1971-1978. Estimates were obtained using a second-order polynomial in the assignment variable (day of birth) and observations 90 days before and after cutoff date. Regressions include cohort fixed effects (July/June). Table A1 in appendix report the analogous table for the local linear specification.

3.3 Effects of being born after the school entry cut-off on outcomes for mothers

How does the school entry legislation affect maternal outcomes? We begin by examining whether it affects the age of school completion, the age of cohabitation, and the age of motherhood.

Figure 5 examines how being born after the school entry cut-off affects the age of school completion.[12] The left-hand panel shows that being born after the cut-off lowers the probability of leaving school at younger ages, in particular at age 16 (when compulsory school ends) and age 19 (when upper-secondary school ends); by age 30 there are no differences left. The right-hand panel illustrates that those who are born after the cut-off – who start school when they are one year older – leave school when they are 0.68 years older; the average school-leaving age increases from around 24.3 to almost 25 years-of-age.

Since differences in the school-entry age translate into differences in the school-leaving age, it is likely that the entry age affects partnership and family formation. Figure 6 examines the impact on when the first cohabiting relationship is formed. The left-hand side shows how the probability of cohabiting by age is affected by the school-entry cut-off, while the right-hand side shows the mean impact on age at first cohabitation. The left-hand panel illustrates a stronger impact at younger ages, but in the longer run there is no differential selection into partnerships. Being born after the school entry cut-off thus only affects the timing of partnership formation, and individuals form there first cohabiting relationship at 23.8 years of age rather than at 23.2 years-of-age, as shown in the right-hand panel.

[12] The outcome is constructed using information on when the individuals obtained their highest post-compulsory educational degree. For those with no post-compulsory degrees, the time of graduation is the expected time of graduation from compulsory school (June in the year when turning 16).

Figure 5: Age at graduation and school entry age cutoff

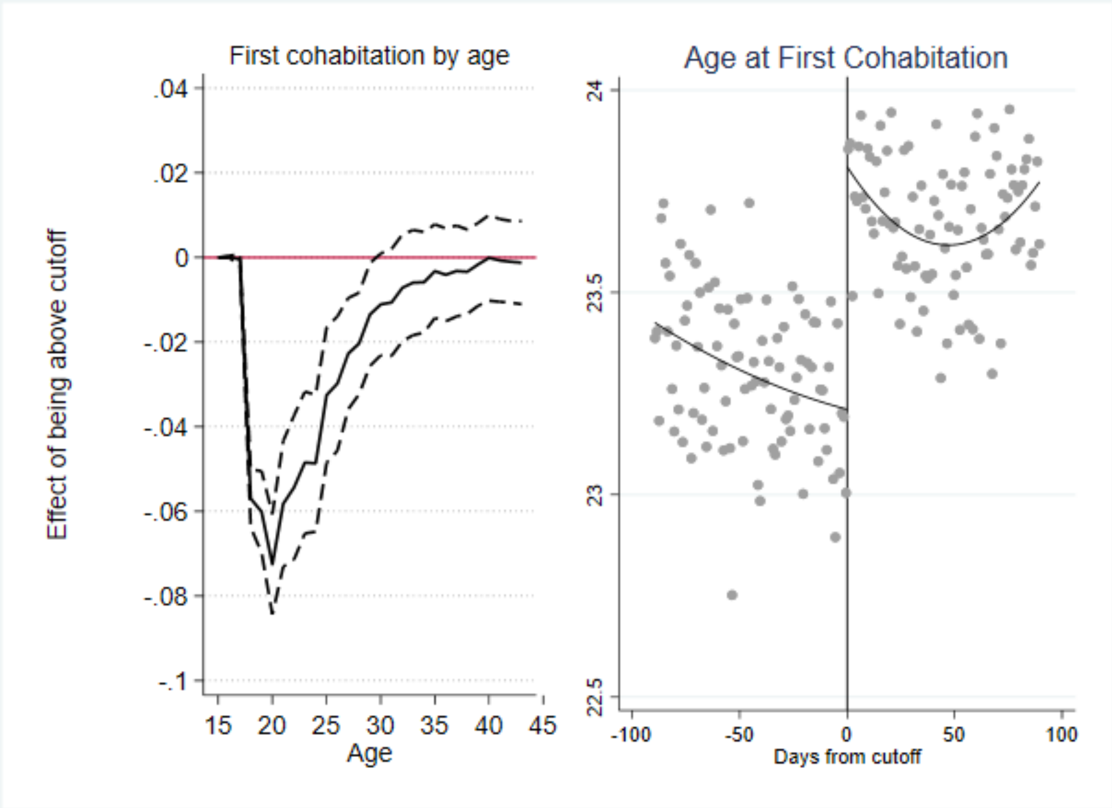
Notes: The left-hand panel plots the estimated effects of being born after cutoff on the probability to graduate from school by age that were obtained from separate polynomial regressions. The specification only includes births 90 days before and after the school starting age cut off (January 1st). The right-hand panel plots mean age at graduation by day of birth, with a fit (solid line) obtained from fitting a 2nd order polynomial separately on data from each side of the threshold. The RD-estimate of being born after the cut-off is 0.680 (standard error: 0.136).

Figure 7 turns to age at motherhood. The left-hand-side shows how the distribution of maternal ages at first birth changes at the school-entry cut-off. It illustrates that there is no effect for young females (below age 20), and that that the effect dissipates by age 40. The latter result implies that the school starting age does not affect the selection into motherhood.

The right-hand-side of Figure 7 examines how maternal age at birth is affected by the school starting age.[13] It illustrates a clear jump in maternal age at birth at the school entry cut-off. Just to the right side of the cut-off, age at birth is 0.42 years higher than just to the left.

[13] Since fertility is unaffected we include all births at this stage.

Figure 6: Age at first cohabitation and school entry age cutoff



Notes: The left-hand panel plots the estimated effects of being born after cutoff on the probability to cohabitate by age that were obtained from separate polynomial regressions. The specification only includes births 90 days before and after the school starting age cut off (January 1st). The right-hand panel plots mean age at cohabitation by day of birth, with a fit (solid line) obtained from fitting a 2nd order polynomial separately on data from each side of the threshold. The RD-estimate of being born after cut-off is 0.616 (standard error: 0.082).

Table 3 examines how a set of maternal outcomes are related to the school entry cut-off. Columns (1) and (2) show that age at first birth and average age at birth increases by 0.46 years and 0.42 years, respectively.[14] Age at birth is the only outcome which is affected in the Finnish context, however. In particular, there is no effect on birth spacing or total fertility, as shown by columns (3) and (4). Moreover, and in contrast to many other countries, there is no statistically significant effect on years of schooling for the cohorts of mothers born 1971-78. Similarly, the level of earnings is unrelated to the school-starting age; the estimated impact is small (-0.36% relative to the mean) and far from being statistically significant. Columns (7)-(10) illustrate that spousal characteristics are unrelated to the school entry age, which reinforces the conclusion that the school-entry age legislation only affects maternal age at birth in the Finnish context.

[14] The effect of the school entry cut-off on average age at birth is slightly lower than the effect on average age at first birth since there is a small reduction in birth-spacing for those born after the cut-off. In particular, the parametric estimates show that: the effect on average age at birth (0.42) = the effect on age at first birth (0.46) – the effect on birth spacing (0.04).

Figure 7: Fertility, age at birth, and school entry age cutoff

Notes: The left-hand panel plots the estimated effects of being born after cutoff on the probability to give birth by age that were obtained from separate polynomial regressions. The specification only includes births 90 days before and after the school starting age cut off (January 1st). The corresponding figure using local linear regression is reported in appendix (Figure A1). The right-hand panel plots mean age at birth by day of birth, with a fit (solid line) obtained from fitting a 2nd order polynomial separately on data from each side of the threshold.

Table 3: Effect of being born after school entry on outcomes for mothers

Variable	(1) Age at 1st birth	(2) Age at birth (all births)	(3) Spacing	(4) # Children	(5) Years of schooling
Born after cut-off	0.459***	0.419***	-0.040	-0.002	0.077
	(0.108)	(0.071)	(0.054)	(0.026)	(0.057)
Mean	27.778	29.691	3.236	1.793	14.207
# observations	89,876	210,712	71,034	89,876	89,876
	(6) Earnings before 1st birth	(7) Have spouse	(8) Age of spouse	(9) Spousal yrs. of schooling	(10) Spouse earnings before 1st birth
Born after cut-off	-74.804	0.000	-0.051	0.058	119.933
	(347.429)	(0.003)	(0.128)	(0.060)	(499.518)
Mean	20709.817	0.904	30.273	13.358	30337.304
# observations	89,095	89,876	87,319	87,319	85,720

Notes: Sample includes women who were born in 1971-1978. Estimates were obtained using a second order polynomial in the assignment variable (day of birth) and observations 90 days before and after cutoff date. Regressions include cohort fixed effects (July/June). Table A2 in appendix reports the analogous table for the local linear specification.

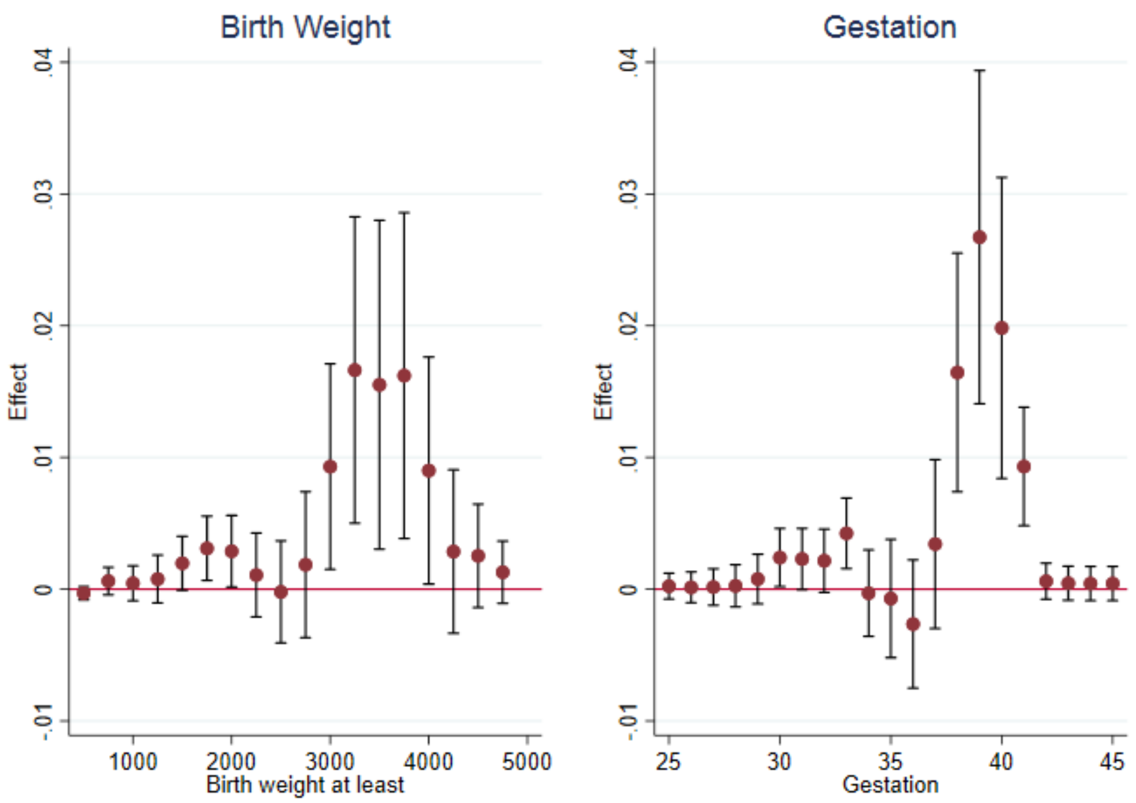
3.4 School entry cut-off, maternal age at birth, and child birth outcomes

Now, let us turn to birth outcomes. Figure 8 shows how the distribution of birth weights and gestation, respectively, is affected by the school entry rule. Regarding birthweight, there is a shift in the number of births from around 4000 grams to 3500 grams. Similarly, the school-entry cut-off reduces gestation, but the effects are concentrated around full-term (40 weeks).

Table 4 goes on to show how a wider set of birth outcomes depends on whether the mother is born after the school entry cut-off.[15] As already noted, birthweight and gestation fall as a result of the mother being born after the school entry cut-off. The table also shows that the probability of the birth being induced or the result of a C-section is unaffected by the cut-off; there is, thus, nothing to suggest that gestation periods are cut shorter, using C-sections or inductions, for older mothers. Moreover, birth-weight by gestation is unaffected; see column headed "BW-ratio", which suggests that the decrease in birthweight is driven by the reduction in gestation, and that fetal growth is unaffected by maternal age at birth. The final column of Table 4 suggests that health behaviors, measured here using an indicator of whether the mother smokes during pregnancy, is unaffected by being born after the cut-off.

[15] The results do not change if we focus on first-born children.

Figure 8: Effect of the school-entry rule on the probability to give birth by birth weight and gestation interval



Notes: The figure plots the point estimates from separate parametric second order polynomial regressions that estimates the probability to have birth weight of at least the amount on the x axis (left-hand-side figure) or gestation (weeks) of at least the amount on the x axis (right-hand-side figure). Sample includes all women born 90 days before or after school entry cutoff in the years 1971-1978. Figure A2 in appendix reports the analogous figure for the local linear specification.

Our preferred interpretation of the results in Table 4 is that an increase in the maternal age at birth causes a reduction in birthweight. A standard deviation increase in age (5.3 years) causes a reduction in birthweight by 7.7 percent (-270 grams). Could such a reduction in birthweight matter for outcomes in the longer run? If we take the estimates in Black et al. (2007) literally, a reduction in birthweight by 7.7 percent would: (i) reduce IQ by 2.4 percent of a standard deviation; and (ii) reduce high-school completion rates by 0.69 percentage points.[16] Thus, the reduction in birthweight induced by maternal age could matter in the longer-run, but it is unlikely that the long-run effects are large. In the next sub-section, we directly examine if the long-run outcomes for children are affected by maternal age at birth.

[16] We use the estimates reported in Table III in Black et al. (2007). They report that the effect of an increase of birth weight by 1% on the stanine of IQ is 0.0062. Since the stanine has a standard deviation of 2, the effect of the increase we consider is (0.0062/2)*7.7=0.024 of the standard deviation of IQ.

Table 4: Effect of mother being born after school entry cutoff on the child's birth outcomes

	Mother's age at birth	Birthweight	Gestation (days)	BW-ratio	Induction	C-section	Mother smokes
Born after cut-off	0.419***	-21.015***	-0.515***	-0.003	-0.004	0.001	-0.004
	(0.071)	(7.683)	(0.179)	(0.002)	(0.005)	(0.004)	(0.005)
Mean	29.691	3512.219	277.886	0.998	0.169	0.100	0.143
# observations	210,712	210,473	210,019	209,966	204,443	210,712	2107,12

Notes: Sample includes all children to women born in 1971-78. Estimates were obtained using a second-order polynomial in the assignment variable (day of birth) and observations 90 days before and after cutoff date. The regressions include cohort fixed effects (July/June). BW-ratio is defined as observed birth weight divided by the median birth weight for gestational age (see, e.g., Voskamp et al. 2014). Table A3 in appendix reports the analogous table for the local linear specification.

3.5 School entry cut-off, paternal age at birth, and child birth outcomes

We showed above that women born after school starting age cut-off give birth at older ages and have children with lower birth weight and gestation than women are born before the cut-off date. Next, we ask whether we find similar results for fathers. Do fathers born after the school entry cut-off postpone fertility, and does this spill over onto birth outcomes for their children?[17]

Table 5 examines whether the school entry cut-off has an effect on the father's age at parenthood and birth outcomes. The results in column one indicates that being born after the school cut-off increases father's age at birth. The increase in father's age at birth (0.158) is about one third of the effect reported for mothers in Table 3. The effects on birthweight and gestation are negative but insignificant. Taking the weaker effects of being born after the cut off on father's age at birth into account, the implied effects of age at birth on child outcomes are of the same magnitude for both fathers and mothers: 50 (40) grams lower birthweight and 1.2 (1.7) days shorter gestation for mothers (fathers).

Table 5: Effect of father being born after school entry cutoff on the child's birth outcomes

	Father's age at birth	Birthweight	Gestation (days)	BW-ratio
Father born after cut-off	0.158**	-6.241	-0.274	0.000
	(0.079)	(7.642)	(0.177)	(0.002)
Mean	32.151	3509.886	277.745	0.998
Observations	207,495	207,250	206,787	206,732

Notes: Sample includes the children of fathers whose spouses were born between 1971-1978 and gave birth between 1987-2018. Estimates are parametric estimates using a second-order polynomial in the assignment variable (day of birth of father) and observations 90 days before and after the cutoff date. Table A4 in appendix reports the analogous table for the local linear specification.

[17] The medical literature tends to find that advanced paternal age is associated with worse birth outcomes, such as lower birth weight and higher risk of stillbirths (Nybo Andersen and Urhoj, 2019, and Khandwala et al. 2018).

3.6 School-entry cut-off, maternal age at birth, and child longer-run outcomes

Is there an effect of maternal age at birth on the longer run outcomes for children? To address this question, we now focus on mothers born earlier, i.e., during 1951-59.[18] For children of these mothers we can obtain information on their outcomes at ages 18-20. Column (1) of Table 6 shows that maternal age at birth increases by 0.21 years as a consequence of the mother being born after the school-entry cut-off.[19]

Table 6: Effect of mother being born after school entry cutoff on child's long-term outcomes

	Mother's age at birth	Secondary degree	Inactivity	Any crime
Born after cut-off	0.211***	-0.000	-0.007	-0.002
	(0.056)	(0.004)	(0.004)	(0.003)
Mean dep. var.	27.514	0.821	0.188	0.069
# observations	325,751	325,751	325,751	325,751

Notes: The sample includes women who were born in 1951-1959 and their children. Estimates were obtained using a second-order polynomial in the assignment variable (day of birth). All regressions include cohort fixed effects (July/June). Inactivity is defined as not being employed, nor being enrolled in education. Secondary degree and inactivity are measured when the child is 21 (or older if not observed at age 21). Crime is any crime committed between ages 18-20. Table A5 in appendix reports the analogous table for the local linear specification.

Remaining columns of Table 6 shows that there are no long-run implications for children of having their mothers being born after the school entry cut-off. Given the moderate size of the effect of maternal age on birth weight, it would be surprising if we would have found large longer run effects. Also, as discussed before, advanced maternal age may be associated with higher income around child birth, and the school starting age may also have an effect on mother's outcomes. Table A6 in appendix reports the balance test results for the 1951-59 cohorts, as well as the effects of being born after the cut-off date on mother's own outcomes. As previously, we find no discontinuity of the background characteristics of these mothers. Neither do we see any direct effect of being born after school cut off on fertility. However, unlike the cohorts born in the 1970s, being born after the school starting cut-off date increases educational level of these mothers.[20] Thus, for these cohorts the school entry cut-off can affect child

[18] Since the reduced-form effects of the school entry cut-off on birth-weight and gestation are much more imprecise for fathers than for mothers, we choose to ignore fathers at this stage.

[19] The reduction in the effect on maternal age has to do with educational attainment being lower in older cohorts. If females complete schooling before the onset of the fertile ages we would not expect the school starting age to matter much.

[20] Panel B) in Table A6 shows that the effect of being born after the school entry cut-off for the mother's own schooling is 0.129 years (standard error: 0.029). This is a substantially larger effect than the 0.077 years (standard error: 0.057) we observe for the cohorts born 1971-78. The likely reason for the reduction in the effect of the school entry age on education is that the younger cohorts went to school in a less-selective education system. Fredriksson and Öckert (2014) show that the effect of the school entry age fell from 0.21 years to 0.11 years as a result of a reform pushing ability tracking from age 11 (or 13) to age 16. Finland implemented a similar reform starting with the cohorts born 1961; see Pekkala et al. (2009). The 1951-59

outcomes both through maternal age at birth and through maternal education. Since we expect mother's education to improve child outcomes, the results in table 5 reinforces the view that there are no favorable effects of maternal age at birth on child long-run outcomes.

4. Conclusions

Is it beneficial for the child if birth is postponed to stages of the life-cycle when the mother has more education and resources available? To study this question, we exploit the school starting age rule in Finland and analyse its impact on fertility patterns and offspring outcomes.

We show that women who are born after the school-entry cut-off are older when they give birth. The effect of being born after the cut-off is to increase maternal age at birth by 0.4-0.5 years for the cohort of mothers born in the 1970s. Completed fertility, however, is unaffected; there is thus no effect on selection into motherhood.

Birth weight and gestation fall as a result of being born after the school-entry cut-off. The birth weight effect must be considered small, however: interpreted as the effect of being born to an older mother, the estimates suggests that an increase in the maternal age by 5 years (almost a standard deviation increase in maternal age) lowers birth weight by around 7 percent relative to the mean. Moreover, we detect only minor effects on the likelihood of extreme birthweight outcomes. We also show that there are no impacts on children's long-run outcomes. Inactivity rates (not in school nor employed) are unrelated to the school entry cut-off, as are teenage crime rates.

Comparing our estimates to OLS-estimates and sibling fixed effects estimates of the effects of the maternal age at birth, we find that the latter two approaches yield the misleading impression that giving birth at a higher age has a favorable impact on child outcomes. For instance, the within siblings estimates suggest a positive association between the probability of having a secondary degree and maternal age. Our estimates, on the other hand, suggest that the relationship is negative, albeit not significant. Hence, it seems that the conclusion that higher maternal ages yield favourable outcomes is based on a spurious correlation.

cohorts were thus affected by the more selective system while 1971-78 cohorts pursued their education in a system where tracking was implemented at age 16 rather than age 11.

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Appendix

Table A1: Balance of pre-determined characteristics at cut-off (local linear specification)

	Parent observed in data		Parental age at birth		Parent has secondary ed.	
	Mother	Father	Mother	Father	Mother	Father
Panel a)						
Born after cut-off	0.001	0.004	0.092	0.138	-0.006	0.007
	(0.002)	(0.003)	(0.087)	(0.093)	(0.009)	(0.008)
Mean dep. var. [a)]	0.987	0.970	26.317	28.693	0.635	0.600
# observations	47,594	65,842	66,792	72,932	49,434	64,350
Bandwidth left/right	50/50	69/69	71/71	79/79	53/53	72/72

Notes: Sample includes mothers who were born in 1971-1978. Estimates were obtained using local regression with a 1st order polynomial in the assignment variable (day of birth). Bandwidths are determined by minimizing mean squared error following Calonico et al. (2014). Regression include cohort fixed effects (July/June). [a)] Mean below cut off within optimal bandwidth.

Table A2: Effect of being born after school entry on outcomes for mothers (local linear)

Variable	(1) Age at 1st birth	(2) Age at birth (all births)	(3) Spacing	(4) # Children	(5) Years of schooling
Born after cut-off	0.540***	0.471***	-0.041	0.000	0.083
	(0.116)	(0.078)	(0.042)	(0.020)	(0.058)
Mean[a)]	27.716	29.634	3.257	1.786	14.217
# observations	39,338	87,462	57,084	74,290	44,804
BW left/right	41/41	39/39	76/76	78/78	47/47
	(6) Earnings before 1st birth	(7) Have spouse	(8) Age of spouse (1st birth)	(9) Spousal yrs. of schooling	(10) Spouse earnings before 1st birth
Born after cut-off	-58.763	-0.000	-0.024	0.077	408.725
	(359.872)	(0.002)	(0.126)	(0.063)	(498.510)
Mean[a)]	20,826.668	0.904	30.312	13.336	30,213.328
# observations	41,656	72,446	45,308	40,832	39,176
BW left/right	44/44	76/76	49/49	44/44	43/43

Notes: Sample includes mothers who were born in 1971-1978. Estimates were obtained using local regression with a 1st order polynomial in the assignment variable (day of birth). Bandwidths are determined by minimizing mean squared error following Calonico et al. (2014). Regression include cohort fixed effects (July/June). [a)] Mean below cut off within optimal bandwidth.

Table A3: Effect of mother being born after school entry cutoff on the child's birth outcomes (local linear)

	Mother's age at birth	Birthweight	Gestation (days)	BW-ratio	Induction	C-section	Mother smokes
Born after cut-off	0.471***	-14.828**	-0.378**	-0.002	-0.002	0.004	-0.006
	(0.078)	(7.160)	(0.154)	(0.002)	(0.004)	(0.004)	(0.005)
Mean dep. var. [a)]	29.634	3513.856	277.920	0.998	0.169	0.101	0.145
# observations	87,462	123,380	144,524	113,496	167,178	94,260	92,218
Bandwidth left/right	39/39	55/55	65/65	51/51	77/77	42/42	41/41

Notes: Sample includes all children to women born in 1971-78. Estimates were obtained using local regression with a 1st order polynomial in the assignment variable (day of birth). Bandwidths are determined by minimizing mean squared error (following Calonico et al. 2014). Regression include cohort fixed effects (July/June). BW-ratio is defined as observed birth weight divided by the median birth weight for gestational age (see, e.g., Voskamp et al. 2014). [a)] Mean below cut off within optimal bandwidth.

Table A4: Effect of father being born after school entry cutoff on the child's birth outcomes (local linear)

	Father's age at birth	Birthweight	Gestation (days)	BW-ratio
Father Born after cut-off	0.236***	-5.982	-0.395**	-0.000
	(0.078)	(6.917)	(0.198)	(0.001)
Mean dep. var. [a)]	32.183	3507.641	277.679	0.998
# observations	116,020	129,268	88,146	152,784
Bandwidth left/right	53/53	59/59	40/40	70/70

Notes: Sample includes the children of fathers whose spouses were born between 1971-1978 and gave birth between 1987-2018. Estimates were obtained using local regression with a 1st order polynomial in the assignment variable (father's day of birth). Bandwidths are determined by minimizing mean squared error (following Calonico et al. 2014). Regression include father's cohort fixed effects (July/June). [a)] Mean below cut off within optimal bandwidth.

Table A5: Effect of mother being born after school entry cutoff on child's long-term outcomes (local linear)

	Mother's age at birth	Secondary degree	Inactivity	Any crime
Born after cut-off	0.173***	-0.002	-0.002	-0.003
	(0.056)	(0.004)	(0.004)	(0.002)
Mean dep. var. [a)]	27.525	0.821	0.184	0.069
# observations	170,688	177,106	177,106	235,092
Bandwidth left/right	54/54	56/56	56/56	75/75

Notes: Sample includes women who were born in 1951-1959 and their children. Estimates were obtained using local regression with a 1st order polynomial in the assignment variable (day of birth). Bandwidths are determined by minimizing mean squared error. All regressions include cohort fixed effects (July/June). Inactivity is defined as not being employed, nor being enrolled in education. Secondary degree and inactivity are measured at age 21 (or older if not observed at age 21). Crime is any crime child committed between ages 18-20. [a)] Mean below cut off within optimal bandwidth.

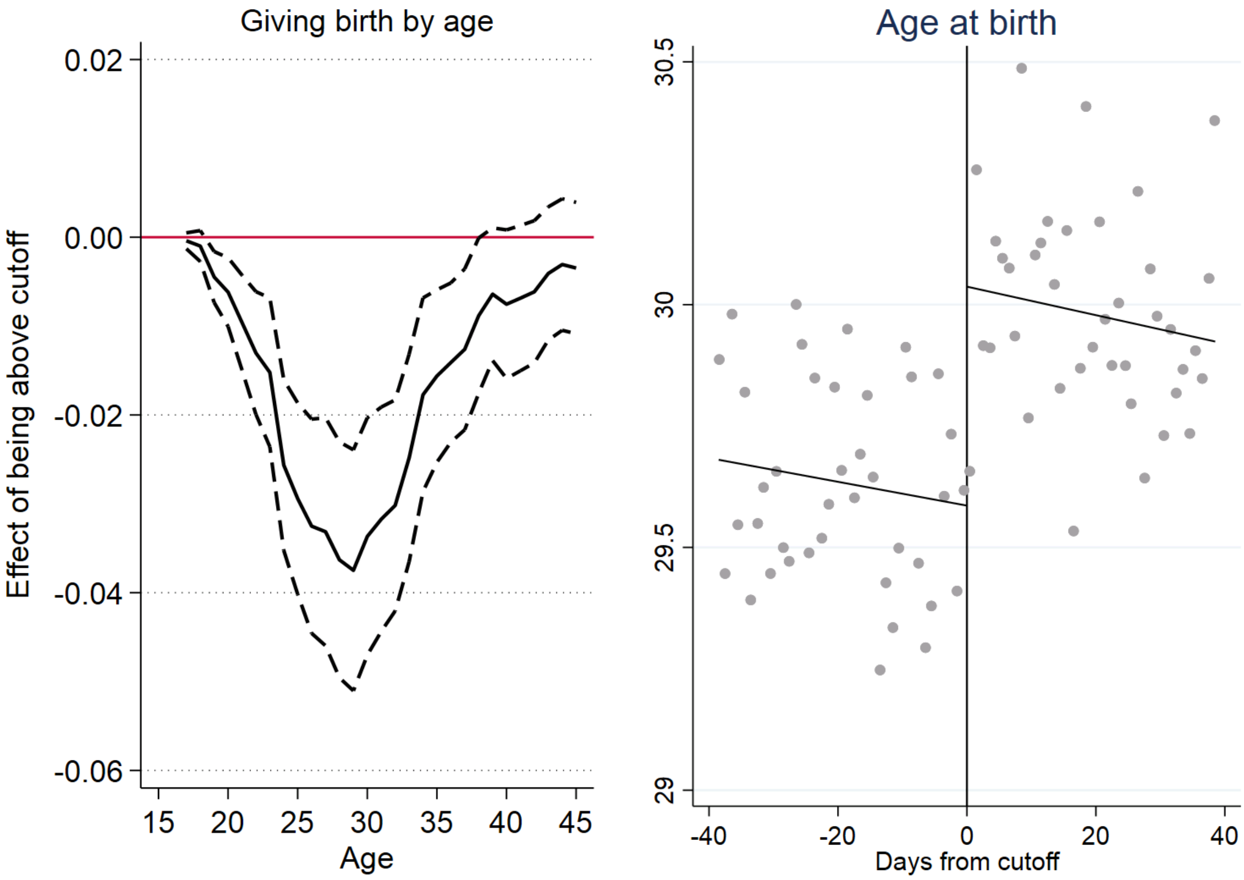
Table A6: Being born after school entry, balance of predetermined covariates, and outcomes for mothers, 1951-59 cohorts

Panel A) Local linear	Balance			Outcomes	
	Maternal mother observed	Maternal father observed	Mother's years of schooling	Number of children	Years of schooling
Born after cut-off	0.004	0.006	0.039	-0.022	0.091***
	(0.003)	(0.004)	(0.030)	(0.014)	(0.029)
Mean dep. var. [a)]	0.902	0.844	9.839	2.671	12.648
# observations	127,392	139,116	75,486	167,392	145,472
Bandwidth left/right	40/40	44/44	39/39	53/53	46/46

Panel B) Parametric	Balance			Outcomes	
	Maternal mother observed	Maternal father observed	Mother's years of schooling	Number of children	Years of schooling
Born after cut-off	0.001	0.007*	0.033	-0.009	0.129***
	(0.003)	(0.004)	(0.026)	(0.015)	(0.029)
Mean dep. var.	0.901	0.845	9.830	2.664	12.625
# observations	292,148	292,148	178,776	291,805	292,148

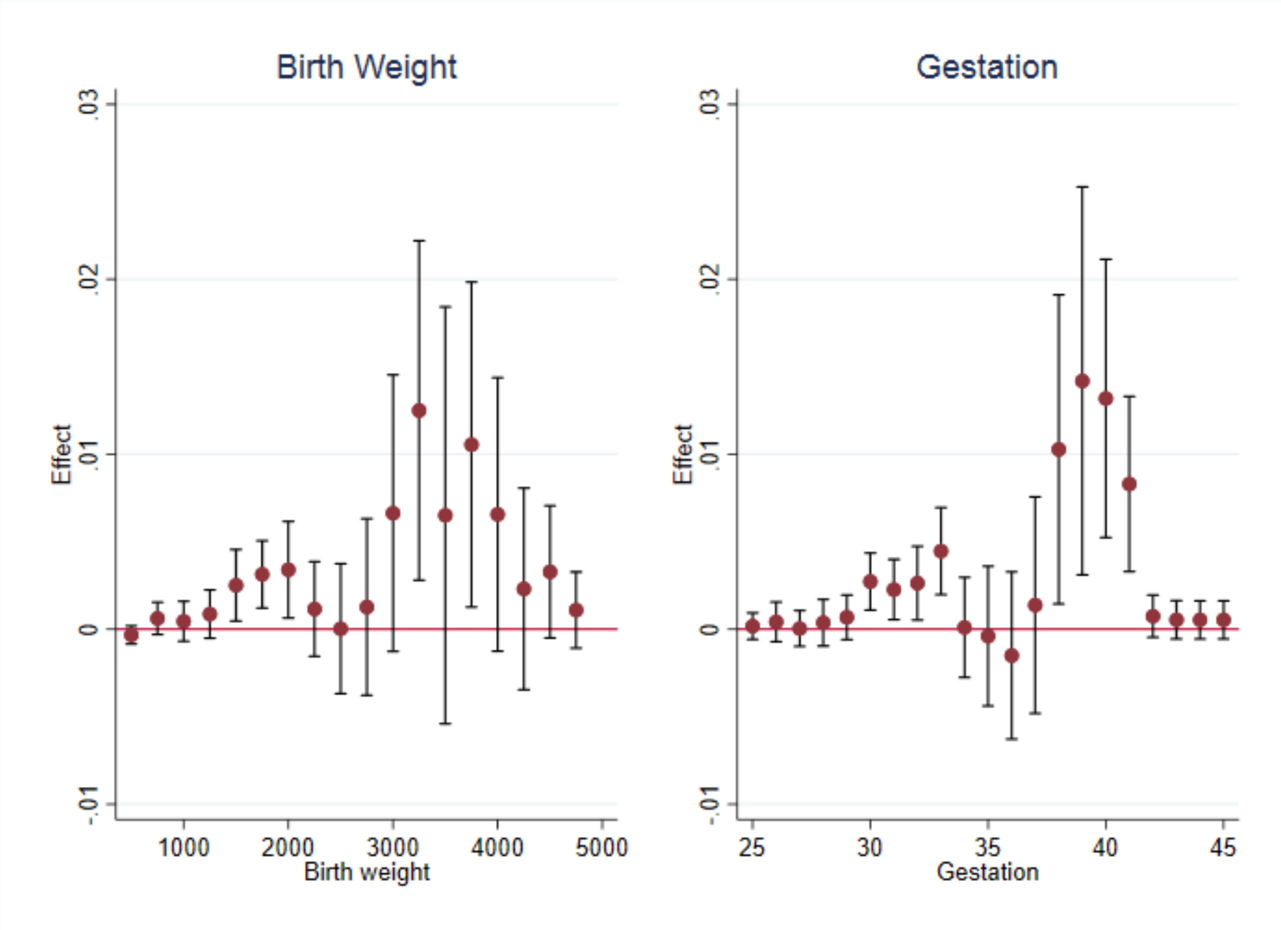
Notes: Sample includes women who were born in 1951-1959 and their children. Estimates in Panel A) were obtained using local regression with a 1st order polynomial in the assignment variable (day of birth). Bandwidths are determined by minimizing mean squared error. Estimates in panel B) are parametric estimates using a second-order polynomial and observations 90 days before and after cutoff date. All regressions include cohort fixed effects (July/June). [a)] Mean below cut off within optimal bandwidth.

Figure A1: Fertility, age at birth, and school entry age cutoff (local linear)



Notes: Left-hand side figure plots the point estimates from separate local linear regression that estimates the effect on being above school entry cutoff; see notes to Figure 7.

Figure A2: Effect of the school-entry rule on the probability to give birth by birth weight and gestation interval (local linear)



Notes: The figure plots the point estimates from separate local linear regressions that estimates the probability to have birth weight at least the amount pointed in the x axis (left hand side figure) or gestation at least the amount in weeks pointed in the x axis (right hand side figure).