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The Effect of Schooling Age on Fertility

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Sandra Schaffner and Andrea Siebert-Meyerhoff[1]

The Effect of Schooling Age on Fertility

Abstract

Fertility rates decline in most developed countries. This is especially true for Germany. Fertility is highly correlated with the skill level of women. The age at school enrolment and therefore the age at graduation depends on the month of birth. Children born before the cut-off date start school earlier than children born after the cut-off date. Therefore, there are also age differences at graduation. These differences can have an effect on the age at first birth and therefore the number of children. We analyze the effects of age at school enrolment on fertility in Germany. Our results suggest that women that are older at graduation are somewhat older at the age of first birth but do not have less children than younger women. Although, the effects on fertility are small we observe negative life-time earning effects of late enrolment for women in East-Germany.

JEL Classification: I21, J13

Keywords: Fertility; education; regression discontinuity

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1 Introduction

In the last decades, the fertility of women in Germany has declined sharply. It decreased from 2.4 children per women in 1960 to 1.5 children in 2015 (Statistisches Bundesamt, 2008; Statistisches Bundesamt, 2016). Additionally, the age of the women giving first birth increased (Gordo, 2009). Life expectancy has increased parallel to these changes in fertility. These developments result in demographic changes and population ageing. Therefore, fewer people are of working age. The share of those working is decreasing; that of those retired increasing. Finally, social security contributions are decreasing while pension costs increase.

The theoretical literature shows a relationship between the skill level of women and fertility: Higher education of women can be associated with both a decrease or an increase in fertility (e.g. Becker, 1960; Cigno and Ermisch, 1989) in theoretical models. High-skilled women earn higher wages that increase the household income. Higher household income can increase the number of children since there are less budget constraints. However, higher income also increases the possibility to invest more in each child (Becker, 1960) which results in a quantity-quality trade-off. Furthermore, higher wages increase the opportunity costs of women to leave the labor market for childbearing and childrearing.

Opportunity costs depend on a number of factors. Wage level and length of the work interruption influence opportunity costs of childbearing. The household income decreases when a women leaves the labor market for childcaring. The higher the actual wage rate, the higher is the decrease in income while being outside the labor market. Besides the direct income losses, there are additional costs of interruptions of the working career. Interruptions can result in less working experience, less human capital and finally lower wages (Mincer and Ofek, 1982). The length of work interruptions strongly depend on the possibility of external child care. Especially in West-Germany, the number of child care facilities for children below the age of three have been rather scarce.

Numerous empirical papers investigate the relationship between women's skill level and their fertility. In Germany, high-skilled women are most likely to be childless (Blossfeld and Huinink, 1991; Blossfeld and Jaeninchen, 1992; Kreyenfeld, 2004). The differences are smaller for older women and do not exist for women in East-Germany (Blossfeld and Huinink, 1991; Kreyenfeld, 2004). However, analyzing causal effects is challenging. The skill level of women can be endogenous since several factors influence both, education and fertility. These factors can be how they grew up, the number of siblings, success in school etc. Furthermore, women self-select themselves into different educational groups. Selection can be based on their preferences regarding work and family. Women with low preferences for children are more likely to invest in human capital. In contrast, women with high preferences for children probably invest less in education since they want to give birth earlier. These problems of endogeneity need to be solved by adequate empirical methods.

There exist few possibilities to account for the described endogeneity. Instruments for schooling years are mainly used. The number of schooling years is influenced by reforms and legal changes regarding compulsory schooling (Monstad, Propper and Salvanes, 2008; Black, Devereux and Salvanes, 2008). The introduction of more compulsory schooling years leads to differences between birth cohorts in the number of schooling years. Another possibility to account for heterogeneity is the use of cut-off dates for school enrollment (Black, Devereux and Salvanes, 2011; Kohler, Prskawetz and Skirbekk, 2004). Women born just before and after the respective cut-off date should not differ in their characteristics exept of the age at school entry. We use this difference for investigating the effect of the birth month at fertility and earnings of women. Especially, the effect at the probability of giving birth, the age at first birth, the number of children and earning points in the pension system is estimated.

The remainder of the paper is organized as follows. The next section gives an overview of the previous empirical findings. Section 3 describes the data and methodology applied. Section 4 presents results of the empirical analysis. Finally, section 5 concludes.

2 Previous findings

The most prominent theoretical view on the relationship between education and fertility comes from Becker (1960) who argues that education affects fertility through an income effect: Higher education mostly yields in higher income and high-income households can afford more children. On the other side, higher income increases the opportunity costs for better-educated women if they have to interrupt their career for child caring needs (Cigno and Ermisch, 1989). More recent theories argue that more educated women may work in jobs with more flexibility and better opportunities to reconcile work and family and hence, education should have a positive impact on fertility (Kravdal, 2007).

There is descriptive evidence that, in Germany, high skilled women are most likely either to be childless or have children at older ages (Blossfeld and Huinink, 1991; Blossfeld and Jaeninchen, 1992; Kreyenfeld, 2004). However, the differences become smaller for older women and do not exist for women in East-Germany (Blossfeld and Huinink, 1991; Kreyenfeld, 2004). A causal interpretation of the effect of education on fertility is problematic because education is endogenous and the effect may be biased due to reverse causality. Some more recent studies account for this endogeneity by using exogenous variation in compulsory schooling years due to policy interventions.

The results suggest for different countries that an expansion in schooling years reduces the likelihood of teenage pregnancies, what is usually defined as having the first child before the age of 20 (Black et al., 2008; Monstad et al., 2008; Silles, 2011; Grönqvist and Hall, 2013; Cygan-Rehm and Maeder, 2013; Duflo, Dupas and Kremer, 2015; Geruso, Clark and Royer, 2014; Kirdar, Meltem and Ismet, 2016). For Germany, Cygan-Rehm and Maeder (2013) explore the extension of compulsory schooling from 8 to 9 years and find that an increase in years of schooling reduces the incidence of teenage pregnancy by 6 percentage points but has no effect on fertility timing in older ages. There is also evidence that the effect of education is heterogeneous. For example, Grönqvist and Hall (2013) explore a reform that increases the length of the vocational track in upper secondary schooling from two to three years and find that one additional year in secondary schooling decreases teenage pregnancy by 4 percentage points. Effects are heterogeneous since they are more pronounced for women with high grades and those having parents with high education. They do not observe any effect for men.

While the effects on teenage pregnancies are quite established the long-lasting effects of education on fertility timing (Black et al., 2008; Monstad et al., 2008; Cygan-Rehm and Maeder, 2013; Kamhöfer and Westphal, 2017) and on the number of children are more ambiguous. For example, Cygan-Rehm and Maeder (2013) and Kamhöfer and Westphal (2017) for Germany, Leon (2014) and Brand and Davis (2011) for the US and Fort, Schneeweis and Winter-Ebmer (2016) for the UK find a negative effect of additional schooling on the number of children, whereas Monstad et al. (2008) for Norway and Clark et al. (2014) for the UK do not find a significant effect. Examining eight European countries, Fort, Schneeweis and Winter-Ebmer (2011) even find that more schooling results in more children. This result is supported by a follow up study for Continental Europe (Fort et al., 2016). They observe further that higher educated women are less likely to be childless. In contrast, Monstad et al. (2008) find no effect on childlessness, whereas Cygan-Rehm and Maeder (2013) and Kamhöfer and Westphal (2017) find a positive effect. Examining the interdependence between fertility timing and total fertility, Bratti and Tatsiramos (2012) show that high educated women who have their first birth later in life do catch up and even realize higher fertility rates.

One drawback of using policies that affect compulsory schooling years as an instrument is that they usually only estimate a local average treatment effect. Due to this the estimated effect of education on fertility is only representative for women who are affected by the reform, namely those who drop out of school at the end of compulsory schooling and hence, have the lowest educational level (see e.g. Monstad et al., 2008). To overcome this problem, Amin and Behrman (2014) apply a different approach by using within twins variation in schooling to estimate the average treatment effect of schooling on fertility. They show that there is a positive effect of schooling on fertility timing and a negative effect on the number of children but no effect on the likelihood to remain childless. However, only one third of all twin pairs differ in schooling and fertility can still be endogenous due to different preferences between the pairs. The authors argue that the estimated effect of education is rather an upper bound of the true causal effect.

Using a different approach, namely school entry policies that cause exogenous variation in school starting age, Black et al. (2011) for Norway show that women who are older when entering school are less likely to have the first child as a teenager. Kohler et al. (2004) for Sweden further find that an increase in school starting age increases age at motherhood by 5 months. They argue that this delay of motherhood can be explained by peer group effects: With regard to family decisions, women are more orientated towards women of the same school cohort than towards women of the same biological age.

By contrast, McCrary and Royer (2006) for the US (precisely California and Texas) barely find any affect of education neither on fertility timing nor on other fertility outcomes. They find that women who enter school at older ages have less schooling but do not differ in fertility from women who start school one year earlier. Building up on this study, Tan (2017) finds that those who were born after the cut-off, though having less schooling, also perform better in end-of-grade tests. So, adding test scores to the estimation, she finds that more schooling and better test scores have a negative effect on the probability of teenage pregnancies.

What may lead to these contradicting findings is the fact that school entry policies in the US affect compulsory schooling years because schooling is mandatory until students reach a certain age. In Norway and Sweden in contrast, students have to attend a school for a certain amount of years. Hence, the effect of school starting age in Norway and Sweden reflects the effect of age at graduation net of human capital accumulation (see Kohler et al., 2004) whereas the effect estimated by McCrary and Royer (2006) reflects the effect of human capital accumulation net of age at graduation. Using school entry age in contrast to policy reforms of compulsory schooling years differ in their way of analysis. In the analysis of schooling reforms it is not possible to distinguish between the effect of age at graduation and schooling years, since an increase in compulsory schooling affects both, age at graduation and human capital accumulation.

In Germany, compulsory schooling rules are similar to those in Sweden or Norway. The month of birth influences age at school entry and hence, age at graduation but not (directly) years of schooling. Thus, our approach resembles mostly the one by Kohler et al. (2004) and Black et al. (2011) and estimates the pure timing effect of education on fertility net of human capital accumulation. Another advantage of our approach is that the effect is representative for all women who comply with the existing school starting rules, so that an average treatment effect can be approximated (Black et al., 2011).

Black et al. (2011) additionally show that starting school at an older age negatively affects earnings up to an age of approximately 30 years. In their thirties they have catch up to women of the same age but who were enrolled in school earlier indicating to a concave age-earnings profile.

3 Data

To analyze the effects of schooling age on fertility we apply data on persons insured in the German pension insurance. The Sample of Active Pension Accounts (Versichertenkontenstichprobe, VSKT) is a one percent stratified random sample of the insurance accounts kept by the German statutory pension agencies. The sample is stratified by gender, nationality, type of insurance and birth year. In Germany, statutory pension insurance is mandatory for all employed persons in the private and public sector and who are not civil servants (Beamte). Some occupations like lawyers and doctors are exempted from the statutory pension scheme. The data covers all persons who were at least once insured in the statutory pension insurance. Those, who were not employed, self-employed, a civil servant or employed in one of the exempted occupations throughout their whole employment life are not included. Summed up, about 90 percent od the German population is included in the German federal Pension Scheme (Himmelreicher and Stegmann, 2008).

The scientific use file (SUF) is an additional 25 percentage random sample of the VSKT. Each year it covers the individual insurance records of workers aged between 30 and 57. The first SUF was drawn for the year 2002, the second for 2004. From 2004 onwards yearly waves are published as SUFs. The insurance records are retrospective data. It is therefore panel data from the age of fourteen up to the year of observation.

Every year, an additional 25 percentage sample is drawn from those aged between 30 and 57 in the VSKT. There does not exist a unique identifier so that it is not possible to identify the same person in two different waves. However the chances of being sampled several times is quite high. Therefore, the data are comparable to repeated cross-sectional data. For our analysis we want to observe as many cohorts as possible. Furthermore, we also want to observe women in older ages to have information on (completed) fertility and earnings. Therefore, we decided to combine several SUFs.

Combining the different scientific use files raises some problems. If the different datasets are only pooled together, some persons are observed several times in the data. We restrict the data to those individuals who are 57 in the waves 2004 to 2013. Furthermore, we add all observations of the 2014 wave: we base our analysis on the scientific use file for 2014 for the birth cohorts 1947 to 1984 and only add the birth cohort 1946 from the SUF 2013, the birth cohort 1945 from SUF 2012, ... and the birth cohort 1937 from SUF 2004. So, we end up with a 0.25 percent sample of the birth cohorts 1937-1984.

The data is administrative data that covers monthly information on the labour market status and child birth due to social security contributions. For each calender month starting at age 14 information is available. To fill gaps in individual accounts, insured persons are contacted in regular intervals. However, since the reporting is not mandatory, there are differences how good the spells apart from social security contributions and unemployment benefits are filled. Furthermore, there are only few additional variables included in the data: sex, age, residence, number and age of children, education, occupation, income. Unfortunately, neither household characteristics nor information on the partner are available.

As described above, the data sets for the years from 2004 to 2014 are combined. Additionally, we restrict our sample on women since fertility rates are analyzed. In the data, childbirth can only be observed for the mothers (with very few exceptions) and possible effects for men cannot be observed. For the women the month of birth as well as month of birth of their children is available. The age at birth (by month) can be derived.

4 Methodology

This study analyzes the effect of school entry age and therefore also school leaving age of women on their fertility and life-time income. In all German Federal States (Bundeslaender) exist cut-off dates for school entry. These cut-off dates differ between the Federal States. However, there was also a time period when it was the same throughout West-Germany and throughout East-Germany. Table A.1 gives an overview of the cut-off dates for school entry for the birth cohorts analyzed. The year of school enrolment depends on date of birth. That means that children who become six years old before the cut-off date enter school in the current year. Those with birthday at or after the cut-off date enter school in the following year. It has been possible to enter school earlier for those born in the first months after the cut-off dates. The rules for early enrolment differ between Federal States and over time. However, it is only a small share of parents that take chance of this possibility for early enrolment of their children especially in the decades of the preceding century when the women examined were born.

The exogenous cut-off dates for school entry have the effect that girls and women born right before the cut-off date are eleven months younger at graduation than those born in the month after the cut-off date but do not differ in skill level. Although there is some evidence that there is a relationship between month of birth and skills and that season of birth depends on socio-demographic characteristics of the mother (Buckles and Hungerman, 2008), we assume that there are no essential differences between those born directly before and after the cut-off date. Due to the age difference at graduation there can be differences in the age at first birth. Therefore, we compare women born just before the respective cut-off date to those born right after this threshold.

In a first step, we consider as equation for estimation:

$$y_i = late_i\alpha + state_i\theta + trend_i\vartheta + statetrend_i\nu + compyears_i\mu + x_i\beta + \varepsilon_i \quad (1)$$

the different outcomes analyzed are a function of being born after the cut-off date ($late_i$), the respective Federal State $state_i$, a cohort (time) trend $trend_i$, a state-specific cohort trend $statetrend_i$, the number of compulsory schooling years $compyears_i$ and a bundle of socioeconomic characteristics x_i, like the educational level. As dependent variable, we consider different fertility outcomes: First, we analyze the probability of giving birth by applying a probit model. The age at first birth - for all mothers- and the number of children are analyzed by applying simple OLS. Additionally, the number of children is analyzed by applying a poisson model, too.

However, it can be argued that the probability of giving birth, the age at first birth and the number of children are not independet from each other. Therefore, we estimate a duration model. The hazard function λ_i for the individual i estimates the time t_i until first birth starting at the age of 14 until the age of 44. More specifically, we allow for a more flexible form by applying a piece-wise constant hazard model. Furthermore, we include 5-year piece-wise constant effects for the treatment variable of whether individual i was born after the cut-off date. We include the same control variables as in the OLS/probit analysis.

Finally, the earnings of the women born before and after the cut-off date are compared. First, yearls earnings for each age and finally the sum of (lifetime) earnings are investigated by estimating OLS. The control variables are the same as in the fertility analyses. Additionally, the number of children is controlled for.

5 Results

In this section we first present some descriptives of the estimation sample with a special focus on the fertility of these women. Furthermore, we present the results of the analysis of giving birth, the age at first birth, the number of children and earnings.

Table 1 gives an overview of the estimation sample. We restrict our analysis to those women who were born within the two months before the cut-off date and the two months right after the cut-off date. We end up with 19,671 observations in West-Germany and 4,820 observations in East-Germany. 47% of the women in East-Germany and 37% of the women in West-Germany were born before 1963. There are differences between East- and West-Germany as well as between the cohorts. The share of mothers is the highest in East-Germany in the older cohort (90%), while the share is lower in the West (81%). The women in the younger cohorts are less likely to be mother (80% in East-Germany und 69% in West-Germany). However, some of these women were still in the fertile phase at the end of the observation period.

Table 1: Summary statistics

	all		**East 1940-1962**		**West 1940-1962**		**East 1963-1984**		**West 1963-1984**	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Mother	0.766	0.423	0.905	0.293	0.811	0.391	0.80	0.40	0.694	0.461
Age at first birth	25.64	5.151	22.731	3.513	24.72	4.906	25.09	4.793	27.46	5.209
No. of children	1.524	1.193	1.788	1.032	1.700	1.252	1.384	1.033	1.361	1.183
Earning points	13.29	11.88	24.55	13.08	16.10	13.28	11.81	9.559	9.283	8.488
Treatment group	0.272	0.445	0.280	0.449	0.307	0.461	0.270	0.444	0.244	0.430
Month of birth										
January	0.139	0.346	0.155	0.362	0.150	0.357	0.147	0.354	0.126	0.331
February	0.130	0.336	0.149	0.356	0.143	0.351	0.133	0.340	0.114	0.318
March	0.150	0.357	0.149	0.356	0.167	0.373	0.159	0.366	0.136	0.342
April	0.137	0.344	0.122	0.328	0.155	0.361	0.149	0.356	0.126	0.332
May	0.141	0.348	0.146	0.353	0.154	0.361	0.142	0.349	0.130	0.337
June	0.103	0.304	0.131	0.337	0.056	0.231	0.133	0.340	0.125	0.331
July	0.103	0.303	0.149	0.356	0.055	0.227	0.137	0.344	0.121	0.326
August	0.073	0.261	0	0	0.052	0.221	0	0	0.121	0.326
September	0.013	0.113	0	0	0.037	0.189	0	0	0.001	0.029
October	0.011	0.102	0	0	0.030	0.170	0	0	0.001	0.028
November	0.001	0.023	0	0	0.002	0.040	0	0	0	0
Year of birth	1963	12.28	1952	7.429	1952	7.135	1972	6.563	1973	6.522
No degree	0.364	0.481	0.352	0.478	0.336	0.472	0.459	0.498	0.369	0.482
Vocational degree	0.235	0.424	0.335	0.472	0.330	0.470	0.167	0.373	0.156	0.362

Highschool degree (Abitur)	0.178	0.382	0.142	0.349	0.122	0.328	0.181	0.385	0.226	0.418
University degree	0.138	0.345	0.116	0.321	0.086	0.281	0.145	0.352	0.18	0.384
Education unknown	0.085	0.279	0.054	0.227	0.125	0.331	0.049	0.216	0.07	0.254
Schleswig-Holstein	0.034	0.18	0	0	0.043	0.202	0	0	0.041	0.199
Hamburg	0.022	0.148	0	0	0.024	0.154	0	0	0.031	0.173
Lower Saxony	0.089	0.285	0	0	0.103	0.304	0	0	0.117	0.321
Bremen	0.006	0.08	0	0	0.007	0.086	0	0	0.008	0.091
North Rhine-Westphalia	0.189	0.392	0	0	0.21	0.407	0	0	0.255	0.436
Hesse	0.074	0.262	0	0	0.089	0.285	0	0	0.095	0.293
Rhineland-Palatinate	0.046	0.209	0	0	0.054	0.226	0	0	0.06	0.237
Baden-Wrttemberg	0.121	0.327	0	0	0.145	0.352	0	0	0.156	0.363
Bavaria	0.188	0.391	0	0	0.286	0.452	0	0	0.197	0.398
Saarland	0.008	0.09	0	0	0.013	0.113	0	0	0.008	0.089
Brandenburg	0.037	0.188	0.186	0.39	0	0	0.184	0.388	0	0
Mecklenburg-West Pomerania	0.024	0.152	0.119	0.324	0	0	0.122	0.327	0	0
Saxony	0.06	0.238	0.309	0.462	0	0	0.301	0.459	0	0
Saxony-Anhalt	0.035	0.184	0.193	0.395	0	0	0.161	0.367	0	0
Thuringia	0.027	0.161	0.129	0.335	0	0	0.143	0.35	0	0
West Berlin	0.024	0.154	0	0	0.026	0.16	0	0	0.033	0.179
East Berlin	0.015	0.121	0.063	0.243	0	0	0.089	0.284	0	0
8 yrs compulsory schooling	0.24	0.427	0.879	0.327	0.43	0.495	0	0	0	0
9 yrs compulsory schooling	0.655	0.475	0	0	0.570	0.495	0	0	1	0
10 yrs compulsory schooling	0.104	0.306	0.121	0.327	0	0	1	0	0	0
Birth cohort 1940-1962	0.448	0.497	1	0	1	0	0	0	0	0
Birth cohort 1963-1984	0.552	0.497	0	0	0	0	1	0	1	0
N	24,491		2,287		7,289		2,533		12,382	

The average age of giving birth is 26. However, the age of first birth differs between East- and West-Germany as well as between the cohorts: The age at first birth is the lowest in the East in the older cohort (23 years), while it is higher in the older cohort in the West (25 years). With 25 years at the first birth in the East and 27 years in the West, the women in the younger cohorts are older when giving first birth. In total, the average number of children per woman is 1.5. Whereas the number of children per woman in the older cohort is 1.8 in the East and 1.7 in the West, the number of children in the younger cohorts is 1.4 per woman in East-Germany as well as in West-Germany. The average number of earning points is 13. The number of earning points is the highest in the East in the older cohort (25 points), while it is lower in the younger cohort (12 points). In West-Germany, the number of earning points in the older cohort is 16, while it is 9 in the lower cohort. For a large share of women the educational level is unknown (9%). This number differs between the cohorts: The share of women with unknown educational level is the highest in West-Germany for the older cohort (13%), while it is lower for the older cohort in the East (5%). For the younger cohort, the level of education is unknown for 5% of the women in the East and for 7% of the women in West-Germany.

Figure 1: Share of women without children

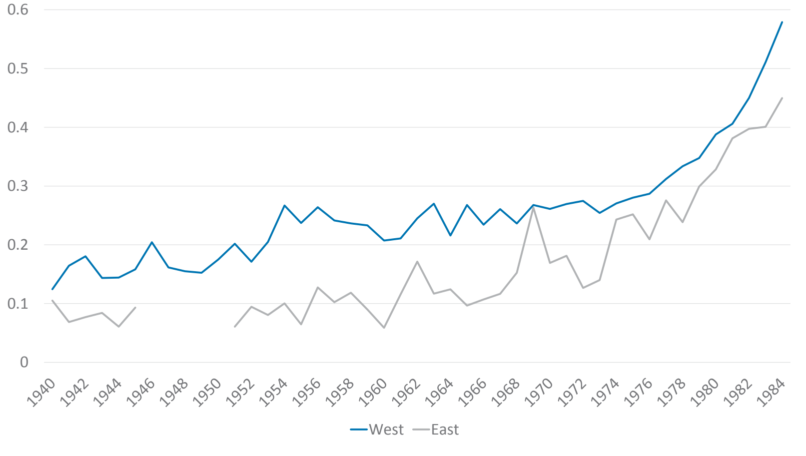
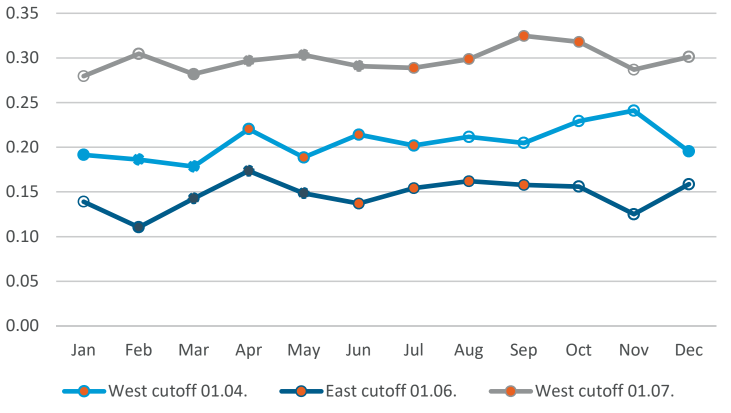


Figure 1 shows the share of women without children in different birth cohorts. The share of childless women increases by birth cohort. More than 80% (West-Germany) and 90% (East-Germany), respectively, of the women born before 1953 have at least one child while there are less than 70% and 80%, respectively, of those born after 1960. It becomes obvious that the share of women without children is much higher in West-Germany than in East-Germany. This is true for all cohorts. However,

Figure 2: Share of women without children by month of birth



the difference decreases for later birth cohorts. For the youngest cohorts 58%/44.5% of women are childless, however, it has to be taken into account that the youngest women are still in their fertile phase (age 30).

Figure 2 presents the share of childless women by month of birth for those cohorts in West-Germany with a cut-off date at the 1st of April and the 1st of July as well as women with a cut-off date at the first of June in the East. Due to small smaple sizes, all other groups are not displayed in the figure. The orange points are the months after the cut-off (treatment group) and the light points are the months before (control group) of the respective cohorts/region group facing different cut-off dates. It cannot be observed a clear pattern. However, it seems to be the case that women born in the four months after the respective cutoff (orange dots) are somewhat more likely of being childless in West-Germany.

Figure 3 displays the mean age at first birth. While women born before 1955 were about 23 years at first birth in East-Germany and 24 years in West-Germany, this number increased up to more than 28 years and more than 27 years, respectively for the youngest cohorts which have almost finished their fertile phase and some women have not given birth at all (birth cohort 1977). This number will be even higher for the most youngest cohorts (1984) because these women are still in their fertile years in 2014.

Figure 3: Mean age at first birth by birth cohort

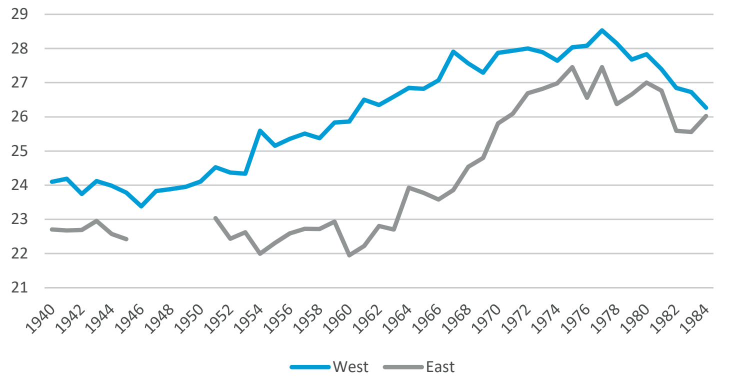


Figure 4: Mean age at first birth by birth month

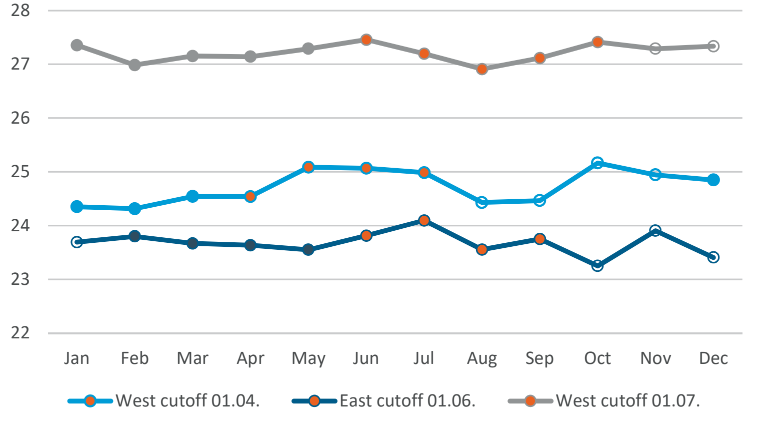
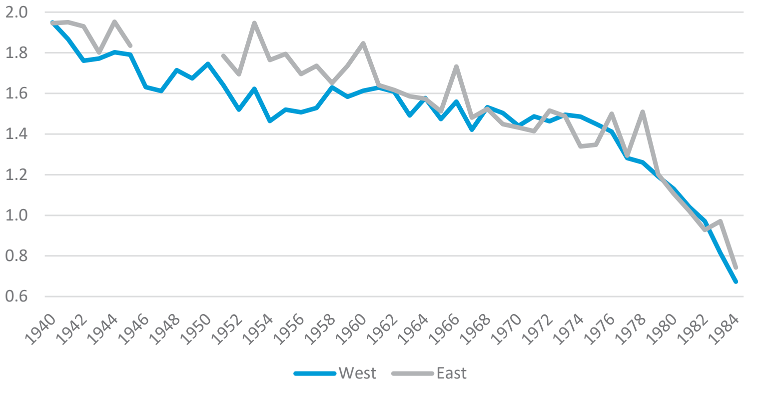


Figure 4 displays the mean age at first birth by month of birth. Women in the first months after the cut-off date are slightly older when first giving birth than women born before the cut-off date. This becomes obvious for East-Germany and for West-Germany with a cut-off date at the beginning of April.

Figure 5: Number of children by birth cohort

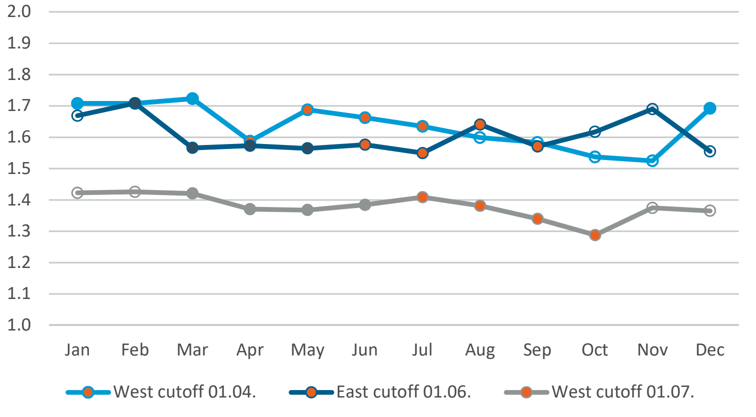


Regarding the number of children, Figure 5 shows a sharp decrease by birth cohort. Although there are significant differences in the share of childless women and the age at first birth, the completed fertility (the number of children) per woman is almost the same in West- and East- Germany. It decreased from 1.95 of women born in 1940 to 1.3 for women born in 1977. Regarding the differences between the women born before and after the respective cut-off date, Figure 6 does not provide any clear pattern.

First, the probability of being a mother is analyzed. Therefore, as described above, a probit model, with the probability of one child as dependent variable, is estimated. We compare those women born within the two months before the cut-off date to those born within the two months after the cut-off date (Table 2).

In both parts of Germany, there is no significant difference between those born before and after the cut-off date. Dividing the sample in the older and younger cohorts lead to different results for East-Germany. Women of the birth cohorts 1940-1962 born after the cut-off are more likely to give

Figure 6: Number of children by birth month



birth. That means that those who are older at school entry and therefore also at graduation are more likely to become a mother. This is against intuition. However, it can be observed that these women, when having any child are older at first birth. This result is as expected that the older ones at graduation are also older at their first pregnancy. This finding suggest that women in East-Germany postpone first birth dependent on the age at graduation. Although they are almost one year older than the women in the control group, their first birth is only half a year later. Therefore, the women seem to catch up some part of the age difference at graduation.

In West-Germany, some smaller effect for the older cohorts can be observed while the effect is the other way round for the younger cohorts. Women of the cohorts 1963-1984 born after the cut-off date are about 5 months younger at first birth than women of the birth cohorts 1963-1984 in the control group. Regarding the number of children, there are not any significant effects of late graduation of mothers on the number of children.

To account for the fact that the decision for children and the timing of birth are not independently from each other, a piece-wise hazard model is applied. The model is defined in that way that fertility is analyzed between the ages 14 and 43. Women without any children at the age of 43 are defined as right censored. Furthermore, the pieces with constant hazard rates are defined in 5-year intervals:

Table 2: The effect of born after the cut-off date on various fertility outcomes - OLS and probit estimates

	West Germany		East Germany	
	Coeff.	Std. Err.	Coeff.	Std. Err.
Probability of giving birth - probit				
All	-0.0132	0.0321	0.0746	0.0756
Cohorts				
1940-1962	-0.0702	0.0548	0.2551 **	0.1270
	(4,346)		*(1,274)*	
1963-1984	0.0280	0.0385	-0.0565	0.0923
	(6,270)		*(1,414)*	
Age at first birth - OLS				
All	-0.0035	0.1321	0.5389 **	0.2159
Cohorts				
1940-1962	0.3609 *	0.1920	0.4906 *	0.2809
	(3,558)		*(1,147)*	
1963-1984	-0.3980 **	0.1791	0.5875 *	0.3371
	(4,232)		*(1,080)*	
Number of children - OLS[1]				
All	-0.0115	0.0264	-0.0217	0.0472
Cohorts				
1940-1962	-0.0673	0.0421	0.0538	0.0700
	(4,346)		*(1,274)*	
1963-1984	0.0403	0.0329	-0.0908	0.0629
	(6,270)		*(1,414)*	

Notes: Number of observations in parentheses. [1]Poisson model produces similar results. The effect is shown for those born one or two months after the respective cut-off date. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Covariates: Year of birth, education level, federal state, number of compulsory schooling years. Source: VSKT, 2005-2014.

14-18, 19-23, 24-28, ... 39-43.

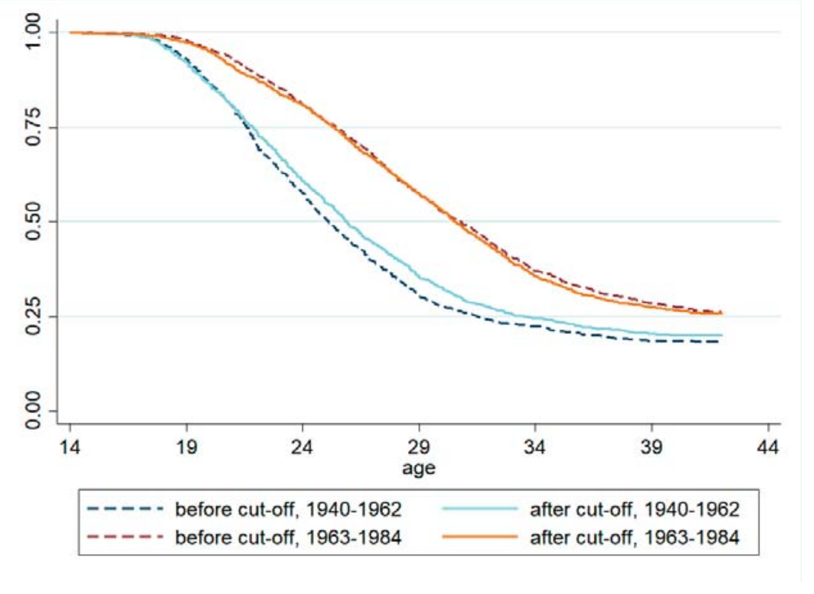
Figure 7 presents the survival functions for women in West-Germany with the "hazard" of first birth. It can be seen that the decrease of childless women is faster for the older cohort than for the younger cohort. 25% of those born after 1962 remain childless while it is about 20% for the older

Table 3: Age at first birth - Piece-wise hazard estimates

	West Germany		East Germany	
	Coeff.	Std. Err.	Coeff.	Std. Err.
All				
Age-specific effect				
14-18	0.1808 *	0.0971	-0.1612	0.1758
19-23	-0.0781 *	0.0451	-0.0403	0.0707
24-28	-0.0651	0.0467	0.0072	0.1097
29-33	0.0779	0.0635	0.1994	0.1755
34-38	-0.0171	0.1102	0.8081 **	0.3501
39-44	-0.4109	0.2670	0.8280	0.7863
	(37,401)		*(7,943)*	
Cohort 1940-1962				
Age-specific effect				
14-18	0.1402	0.1166	-0.1357	0.2060
19-23	-0.1511 **	0.0595	-0.0389	0.0926
24-28	-0.1756 **	0.0724	0.2890 *	0.1747
29-33	0.1568	0.1320	0.4876	0.3642
34-38	-0.0131	0.2045	1.2820 **	0.6533
39-44	-0.1509	0.5780	1.0465	1.2689
	(13,611)		*(3,289)*	
Cohort 1963-1984				
Age-specific effect				
14-18	0.2465	0.1721	-0.3069	0.3292
19-23	0.0161	0.0699	-0.0327	0.1130
24-28	0.0330	0.0599	-0.2403 *	0.1362
29-33	0.1006	0.0674	-0.0069	0.1921
34-38	0.0614	0.1249	0.4937	0.4042
39-44	-0.3348	0.2995	0.4915	0.9453
	(23,790)		*(4,654)*	

Notes: Number of observations in parentheses. The effect is shown for women born one or two months after the cut-off date. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Covariates: Year of birth, education level, federal state, number of compulsory schooling years. Source: VSKT, 2005-2014.

Figure 7: Kaplan-Meier Survival rate for West-Germany

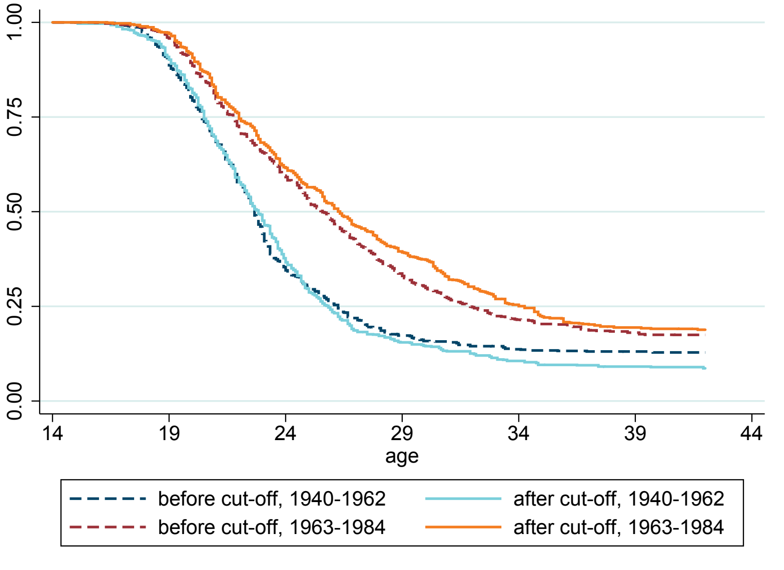


ones. Furthermore, it can be observed that there are hardly any differences between treatment and control group for the younger cohort. By contrast, differences between women born before and after the cut-off date become obvious for the cohort 1940-1962. The birth rate of West-German women in their twenties born before the cut-off date is higher than the one of those born after the cut-off date.

The regression results yield a positive coefficient for teenager women in West-Germany, which means that the relative risk of first birth increases by 18% for those who are older at graduation (Table 3). This effect is unexpected. However, for older ages (19-23) the expected effect of a decrease of the relative risk of birth and therefore an increase of the age at first birth can be observed. This finding is driven by the older birth cohorts. Women of the cohorts 1947-1962 born after the respective cut-off date are characterized by a longer time period until first birth if they are in their twenties as already expected from Figure 7. This is in line with the linear regression results (Table 2). The hazard model does not show any effects of graduation for the younger cohort in West-Germany. However, the age regression in Table 2 suggests that women born after the cut-off date are somewhat younger when giving birth. However, the age regression is only based on those women who gave birth while the hazard model implements both the decision of giving birth at all and the timing of birth. Furthermore, the estimated coefficient for teenagers is relatively high but insignificant. The observed differences seem to be the result of small differences in teenage pregnancies. However, the number of observations in the hazard model is too small in this time period to show any significant differences.

The results for East-Germany hardly show any significant effects. For the older cohorts positive effects in the age between 24 and 28 can be observed. Furthermore, a large and positive difference at the age period 34-38 can be observed. This difference also becomes obvious in Figure 8 that displays the survival rate for East-Germany. However, only very few women of these birth cohorts give first birth above the age of 34. Therefore, the results are based on very few observations and are reflected by the higher age at first birth as well as the lower probability of remaining childless in Table 2. The reliability of these results seems to be questionable since we cannot rule out that it is only driven by very few observations and relatively high weighting factors. The estimated coefficients of the hazard model for the younger cohort are first negative and become positive from the age of 34 on. However, only the coefficient for the age period between 24 and 28 is significant and reveals that childless women born after the cut-off date are less likely to become mother than their counterparts born before the cut-off date.

Figure 8: Kaplan-Meier Survival rate for East-Germany



If there are any effects of schooling age on the timing of birth and gaps in the employment history of women, than there can be effects on labour market income. The data only cover data on individual earning points. These earning points are based on earnings subject to the old-age pension-scheme (rentenversicherungspflichtig) and unemployment benefits but not regarding household income and other earnings or income.

Figure 9: Estimated coefficient yearly earning points - East-Germany

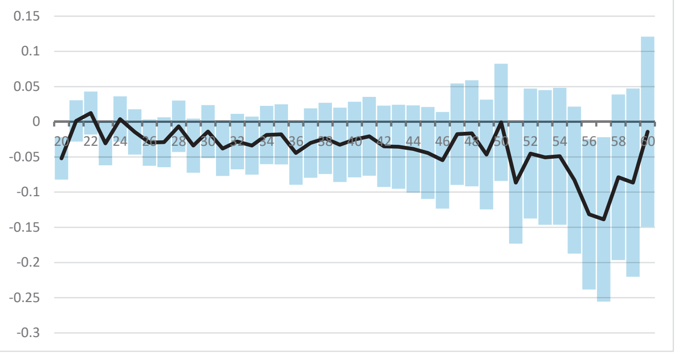


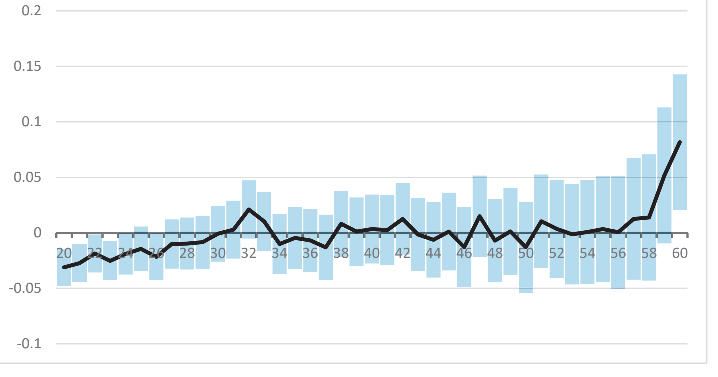
Figure 9 show the difference between those born before and after the cut-off date in East-Germany as well as the confidence intervals. The differences are the result of OLS earning regressions at each year between the age of 20 and 60 of the women in the estimation sample. Women born after the cut-off date start working earlier and hence, have more experience at each age than women who were born after the cut-off date. Since experience yields positive wage returns, we expect to oberve that women who graduate at an older age have less earning points at each year. Since many of the women in the sample were younger than 60 in 2014, the results for older ages are only for those cohorts that already reached the respective age-year. Therefore, the number of observations sharply reduced at the end of the observation period which can be seen by the increasing confidence intervals. The confidence intervals reflect the 5% significance level.

For almost all ages the differences in East-Germany are not significant although the coefficient is mainly negative and even increases as women age. In the mid-fifties the coefficients become strongly negative and significant different from zero. The results suggest that there are effects of age at school entry/graduation throughout the whole life cycle. Compared to similar regressions for men (see Figure

A.3 in the Appendix), it can be seen a similar pattern until the age of 50. Afterwards those men who were older at graduation catch up.

In West-Germany, differences for young ages can be observed (Figure 10). Those who were older at graduation have somewhat lower earnings until the age of 26 that can be explained by the differences in job tenure and experience. They are older at graduation and therefore less experienced at the same age. This difference vanishes for older ages. This fits to results found by Black et al. (2011) for the US who show that earning differences vanish about the age of 30. However, it has to be taken into account that there can be different channels leading to this effect. Interestingly, in comparison to men (see Figure A.2 in the Appendix) women catch up earlier than men who are almost their whole career below the level of those who entered school earlier. This difference between men and women can be a hint that the different timing of birth and career breaks of women reduces the differences set by age.

Figure 10: Estimated coefficient yearly earning points - West-Germany



The number of lifetime earning points and therefore the amount of the future pension do not differ between those born before and after the cut-off date in West-Germany although they have one year less to pay into the pension scheme (see Table 4). The eligibility for a pension mainly depends on the age of a person. Since those born after the cut-off date are almost one year older at graduation they theoretically sum up less earning points. However, the finding of no significant difference for West-Germany indicates that women of the treatment group catch up to women of the control group either due to higher earnings or a postponement of giving birth.

In East-Germany women who started school at older ages of the birth cohorts born before 1962

Table 4: Lifetime earning points - OLS estimates

	West Germany		East Germany	
	Coeff.	Std. Err.	Coeff.	Std. Err.
All	-0.1940	0.2191	-1.1488 **	0.4849
Cohorts				
1947-1962	0.0003	0.4284	-2.1888 ***	0.8007
	(6,691)		*(2,059)*	
1963-1984	-0.3354	0.2073	0.1459	0.5250
	(12,220)		*(2,493)*	

Notes: Number of observations in parentheses. The effect is shown for women born one or two months after the cut-off date. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Covariates: Year of birth, education level, federal state, number of compulsory schooling years. Source: VSKT, 2005-2014.

have two earnings point less. In 2017 this difference is equivalent to about 60 Euro less pension. One part of this difference can be explained by the somewhat shorter period of payments into the pension scheme. The eligibility for a pension mainly depends on the age of a person. Since those born after the cut-off date are almost one year older at graduation they sum up less earning points. However, one earning point reflects the yearly mean earning of those employed in Germany. Therefore, the difference equivalents to more than two years of contributions.

Robustness checks

We derive some robustness checks. First of all we vary the period before and after the respective cut-off date. Therefore, we first take only one month. However, sample size reduces too much. Furthermore, we take three or four months into account. The results are comparable to those of only two months. However, in most cases absolut size and significance level of the estimated coefficients reduce as expected. Based on these robustness checks, we assume that the results are not driven by the choice of the period before and after the cut-off.

The analysis of the number of children is also executed with a poisson model. Like the OLS results all estimated coefficients for the age at school entry are insignificant. Besides the piece-wise hazard model we also executed a simple hazard model as well as a competing risk model. The competing risks in this model are giving first birth and becoming 42. The results of this two models are quite similar. Furthermore, the estimated coefficient for being born directly after the cut-off date are comparable to the sum of the respective coefficients in the piece-wise hazard model.

The results of the different robustness checks are available on request by the authors.

6 Conclusion

Delaying motherhood and decreased fertility rates are problems of Western Societies, particular in Germany where population is ageing rapidly. There is evidence of strong correlations between the educational level of a woman and her fertility outcomes. However, evidence from natural experiments shows that this correlation is not always due to a causal effect of education. We contribute to this evidence by examining the effect of school entry age on the probability of having children, the number of children and timing of first birth. We make use of exogenous variation in school entry age which results out of the cut-off dates for school entering. We can therefore analyze the effect of being almost one year older at graduation on fertility. By tracking the women over the life cycle, we are also able to investigate life-time earnings of women.

For West-Germany we observe that starting school lately, slightly increases the likelihood of teenage motherhood. This finding in combination with existing papers that show that the likelihood of teenage motherhood decreases with an extension of compulsory schooling indicates that more education not age effects drive these findings. For the same cohort in West-Germany we also observe a postponing of giving first birth between the ages 19 and 28. However, we do not find any effects on completed fertility.

For East-German women we observe a higher risk of first birth between 24 and 28 which results in an increased age at first birth but also a lower probability of being childless.

Summed up the effects of late graduation on fertility timing seem to be relatively small which is in contrast to the finding by Kohler et al. (2004). For Germany, empirical evidence indicates a negative effect of an additional year of compulsory schooling (Cygan-Rehm and Maeder, 2013) and of an additional year of college education (Kamhöfer and Westphal, 2017) on completed fertility. These effects are comparable large in magnitude. In contrast, we show that completed fertility is not affected by age at graduation in West-Germany, indicating that the findings of the existing literature for Germany are mainly driven by the extension of education not by the age effect. However, it should be kept in mind that those studies estimate a LATE for women who increase their education due to the reform, namely those with low educational levels. These women probably differ from the women in our sample.

Besides the effects on fertility we analyze earning effects of being older at school entry and graduation. Our results indicate that women in West-Germany realize lower earnings in the beginning of their career compared to those who started school early. This result can be driven by the reduced experience. They catch up until the age of 30 and do not differ in their life-time earnings. This finding is in line with Black et al. (2011). By contrast, women in East-Germany who graduate at an older age do not catch up these earning differences and experience less life-time earnings until they retire. Retirement age depends in contrast to school entry on the absolute age. The loss in earnings results in a lower pension.

The effects of age at school entry and therefore age at graduation on fertility behaviour as well as on life-time earnings is stronger in East-Germany as compared to West-Germany and for the older East-German cohorts as compared to the younger East-German cohorts. In the group of the older East-German cohorts, the youngest women are born in 1962. Hence, they lived in the GDR the most time during their fertile phase. The finding of education affecting the fertility outcomes and earnings of these women is stronger than that of women mainly living in West-Germany during their twenties is somehow surprising in the light of better child care facilities and therefore lower (indirect) career costs of children in the GDR.

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Appendix A Appendix

Table A.1: Cut-off dates for school entry

	Birth cohort		
	1947-1950	1951-1961*	1962-1984**
Bavaria	Sep 30		June 30
Hesse	July 1	Apr 01	June 30
Berlin	Apr 01		June 30
Saarland	Oct 1	Apr 01	June 30
North Rhine-Westphalia	June 30	Apr 01	June 30
Rhineland-Palatine	Apr 01		June 30
Baden-Wurttemberg	Apr 01		June 30
Bremen	Apr 01		June 30
Schleswig-Holstein	Apr 01		June 30
Hamburg	Apr 01		June 30
Lower Saxony	Apr 01		June 30
Germand Democratic Republic	May 31		May 31

Note the following deviations: *Saarland: first birth cohort affected by March/April cut-off: 1953. NRW: 1955. **Bavaria: first birth cohort affected by June/Juy cut-off: 1963. Agreements: 1955 Düsseldorf Acoord, 1964 Hamburg Accord.

Figure A.1: Development of earning points - by cohort and region

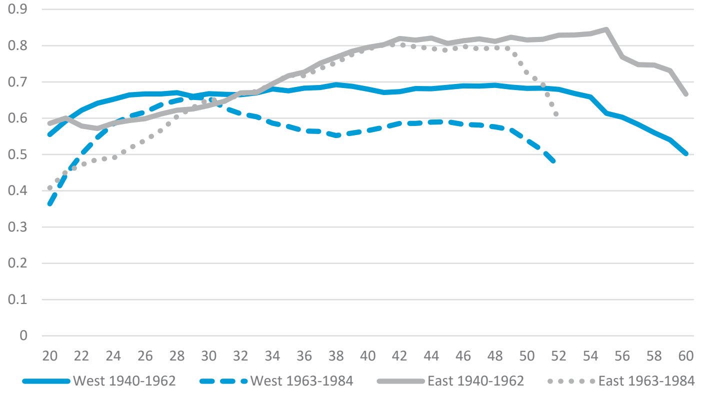

Table A.2: Start of school year and introduction of 9th grade

	Start of school year by birth cohorts		First cohort with 9 years
	1947-1961	1962-1984	of compulsory schooling*
Bavaria	Oct 01	Oct 01	1954/1955
Hesse	Apr 01	Aug 01	1952/1953
West Berlin	Apr 01	Aug 01	1952/1953
Saarland	Apr 01	Aug 01	1942/1943
North Rhine-Westphalia	Apr 01	Aug 01	1952/1953
Rhineland-Palatine	Apr 01	Aug 01	1952/1953
Baden-Wurttemberg	Apr 01	Aug 01	1952/1953
Bremen	Apr 01	Aug 01	1943/1944
Schleswig-Holstein	Apr 01	Aug 01	1931/1932
Hamburg	Apr 01	Aug 01	1930/1931
Lower Saxony	Apr 01	Aug 01	1946/1947
German Decmocratic Republic	Sep 01		1951

*In the GDR, compulsory schooling was increased from 8 to 10 years during a transition phase that accounted for 5 years. The transition was completed in 1957.

Figure A.2: Estimated coefficient yearly earning points - East-German men

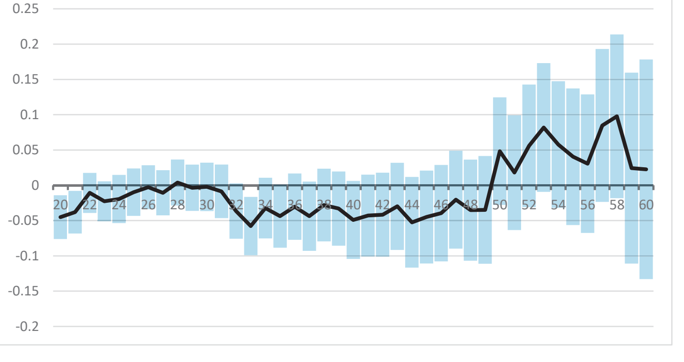

Figure A.3: Estimated coefficient yearly earning points - West-German men

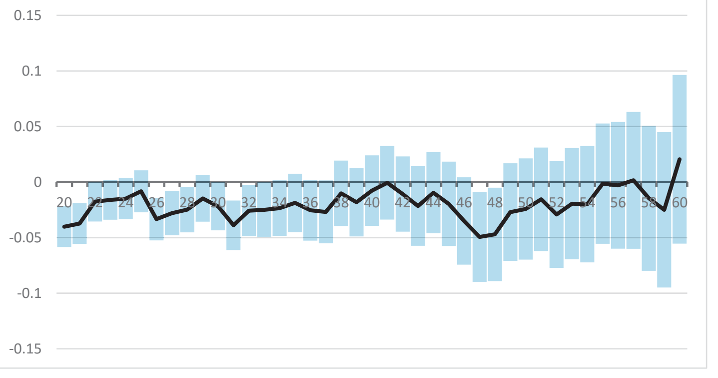

Table A.3: Lifetime earning points - OLS estimates men

	West-Germany		East-Germany	
	Coeff.	Std. Err.	Coeff.	Std. Err.
All	-0.8800**	0.346	-1.250	0.536
	(9,101)		*(2,260)*	
Cohorts				
1940-1962	-0.6841	0.650	-1.1932	0.934
	(3,599)		*(902)*	
1963-1984	-0.9218***	0.319	-1.3268	0.570
	(5,502)		*(1,358)*	

Number of observations in parentheses. The effect is shown for men born one or two months after the cut-off date. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Covariates: Year of birth, education level, federal state, number of compulsory schooling years. Source: VSKT, 2005-2014.

Table A.4: Regression results - West-Germany

	1940-1962			1963-1984		
	motherhood	Age	no. children	motherhood	Age	no. children
	Probit	OLS	OLS	Probit	OLS	OLS
Treatment	-0.0702	0.5520	-0.0864	0.0280	-0.4419	0.0256
group	(0.055)	(0.126)	(0.024)	(0.038)	(0.100)	(0.016)
Trend	-0.0066	0.0104	-0.0254	0.1294	0.9952	0.0874
	(0.021)	(0.052)	(0.009)	(0.033)	(0.091)	(0.014)
$Trend^2$	0.0009	0.0071	0.0014	-0.0034	-0.0198	-0.0023
	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)	(0.000)
Trend						
Schleswig-	-0.0541	0.0370	-0.0041	0.0017	-0.0020	-0.0035
Holstein	(0.026)	(0.061)	(0.012)	(0.023)	(0.062)	(0.009)
Hamburg	-0.0344	0.0388	-0.0078	-0.0035	0.0024	0.0101
	(0.032)	(0.083)	(0.012)	(0.025)	(0.075)	(0.010)
Lower	0.0010	0.0373	0.0179	0.0296	0.0331	0.0187
Saxony	(0.024)	(0.058)	(0.010)	(0.019)	(0.055)	(0.008)
Bremen	-0.0181	-0.1865	0.0558	-0.0110	-0.0739	0.0152
	(0.045)	(0.108)	(0.019)	(0.034)	(0.083)	(0.013)
North Rhine-	-0.0017	0.0709	0.0149	0.0149	-0.0463	0.0152
Westphalia	(0.023)	(0.056)	(0.009)	(0.018)	(0.053)	(0.007)
Hesse	0.0082	0.0625	0.0226	0.0223	0.0601	0.0259
	(0.026)	(0.059)	(0.010)	(0.019)	(0.056)	(0.008)
Rhineland-	0.0212	-0.0011	0.0186	0.0087	-0.0035	0.0034
Palatinate	(0.027)	(0.063)	(0.011)	(0.021)	(0.059)	(0.009)
Baden-	-0.0169	0.0541	0.0015	0.0130	-0.0064	0.0024
Wuerttemberg	(0.025)	(0.058)	(0.010)	(0.018)	(0.054)	(0.007)
Bavaria	0.0047	0.0754	0.0191	0.0205	0.0109	0.0145
	(0.023)	(0.056)	(0.009)	(0.018)	(0.053)	(0.007)
Saarland	-0.0515	0.2461	-0.0362	0.0369	-0.3584	0.0206
	(0.041)	(0.107)	(0.018)	(0.030)	(0.099)	(0.011)
Skill level						
Vocational	-0.1242	0.8410	-0.0748	-0.0830	0.4806	-0.0057
degree	(0.070)	(0.153)	(0.030)	(0.061)	(0.152)	(0.026)
highschool	-0.2205	1.9593	-0.0997	-0.1091	1.4790	0.0007
(Abitur)	(0.089)	(0.200)	(0.038)	(0.052)	(0.136)	(0.022)
University	-0.5416	3.6909	-0.3470	-0.4004	3.1516	-0.2102
degree	(0.103)	(0.267)	(0.042)	(0.054)	(0.141)	(0.022)
Education	-0.0349	-0.5865	0.2022	-0.1746	-1.3155	0.0440
unknown	(0.090)	(0.234)	(0.043)	(0.079)	(0.213)	(0.042)

Federal State						
Schleswig-Holstein						
Hamburg	-0.6638	2.0033	-0.5029	-0.0587	0.0463	-0.5958
	(0.236)	(0.645)	(0.098)	(0.681)	(1.881)	(0.285)
Lower Saxony	-0.3342	0.7230	-0.1919	-0.7602	-1.8258	-0.5747
	(0.182)	(0.354)	(0.078)	(0.503)	(1.114)	(0.215)
Bremen	-0.0343	1.3333	-0.3371	0.5494	0.7691	-0.5006
	(0.397)	(0.840)	(0.127)	(1.003)	(2.187)	(0.366)
North Rhine-Westphalia	-0.4364	1.3231	-0.2682	-0.4335	0.8630	-0.5945
	(0.185)	(0.370)	(0.078)	(0.460)	(1.049)	(0.190)
Hesse	-0.4783	0.4911	-0.3912	-0.6102	-1.5435	-0.8516
	(0.202)	(0.399)	(0.087)	(0.513)	(1.182)	(0.208)
Rhineland-Palatinate	-0.3149	1.0132	-0.1320	-0.0975	-0.2308	-0.1618
	(0.212)	(0.450)	(0.095)	(0.575)	(1.273)	(0.234)
Baden-Wuerttemberg	-0.1760	1.1932	-0.0347	-0.2912	0.4702	-0.1468
	(0.202)	(0.377)	(0.084)	(0.487)	(1.083)	(0.200)
Bavaria	-0.4116	1.1200	-0.2432	-0.5485	-0.3647	-0.4986
	(0.190)	(0.387)	(0.082)	(0.470)	(1.082)	(0.195)
Saarland	-0.2636	-0.0512	-0.0759	-0.7726	9.9802	-0.7425
	(0.335)	(0.745)	(0.168)	(0.806)	(2.570)	(0.290)
West-Berlin	-0.4950	1.9647	-0.4127	-0.2699	0.5616	-0.3355
	(0.211)	(0.471)	(0.089)	(0.642)	(1.743)	(0.262)
compulsory schooling						
9 years	-0.2578	0.4018	-0.2013			
	(0.120)	(0.279)	(0.052)			
constant	1.5659	23.2268	1.6980	-0.3003	16.8790	0.6316
	(0.193)	(0.398)	(0.084)	(0.566)	(1.319)	(0.236)
R^2		0.1105	0.0367		0.0945	0.0355
N	4 346	8 886	13 614	6 270	13 463	23 790

Table A.7: Regression Results - East-Germany

	1940-1962			1963-1984		
	motherhood	Age	no. children	motherhood	Age	no. children
	Probit	OLS	OLS	Probit	OLS	OLS
Treatment	0.2551	0.6843	0.1424	-0.0565	0.6826	-0.0714
group	(0.127)	(0.208)	(0.047)	(0.092)	(0.224)	(0.035)
Trend	0.0026	0.0620	-0.0008	-0.0418	1.7486	0.0577
	(0.027)	(0.078)	(0.010)	(0.075)	(0.141)	(0.025)
Trend^2	0.0010	-0.0044	0.0013	-0.0003	-0.0276	-0.0016
	(0.002)	(0.004)	(0.001)	(0.001)	(0.003)	(0.000)
Trend						
Brandenburg	-0.0138	-0.0564	-0.0155	0.0172	-0.1593	0.0027
	(0.030)	(0.083)	(0.011)	(0.026)	(0.046)	(0.010)
Mecklenburg-	0.0355	-0.0165	0.0007	-0.0076	-0.1657	-0.0007
West Pomerania	(0.037)	(0.091)	(0.012)	(0.028)	(0.052)	(0.011)
Saxony	-0.0160	-0.0591	-0.0099	0.0237	-0.2160	0.0238
	(0.030)	(0.080)	(0.010)	(0.025)	(0.045)	(0.009)
Saxony-	-0.0210	-0.1552	-0.0141	0.0231	-0.0518	0.0126
Anhalt	(0.032)	(0.082)	(0.012)	(0.031)	(0.046)	(0.011)
Thuringia	-0.0244	-0.0355	-0.0246	-0.0328	-0.2423	-0.0142
	(0.033)	(0.083)	(0.012)	(0.030)	(0.052)	(0.010)
Skill level						
Vocational	0.0493	0.3340	-0.0496	0.0885	0.6943	0.0698
degree	(0.163)	(0.267)	(0.059)	(0.133)	(0.309)	(0.052)
highschool	0.0155	0.6595	-0.0376	-0.1123	1.4703	0.0166
(Abitur)	(0.192)	(0.299)	(0.073)	(0.125)	(0.279)	(0.048)
University	-0.0715	2.2322	-0.0711	-0.5830	3.8334	-0.3341
degree	(0.222)	(0.357)	(0.073)	(0.131)	(0.413)	(0.044)
Education	-0.6895	0.8422	-0.3282	-0.4629	-3.9564	-0.0496
unknown	(0.220)	(0.696)	(0.107)	(0.192)	(0.359)	(0.118)

Federal State						
Mecklenburg-	0.0401	0.1171	0.2513	0.7790	0.6176	0.0603
West Pomerania	(0.258)	(0.408)	(0.101)	(0.671)	(1.441)	(0.255)
Saxony	-0.0147	0.7364	0.0545	-0.1528	2.0577	-0.5826
	(0.217)	(0.314)	(0.077)	(0.539)	(1.266)	(0.209)
Saxony-	-0.0722	0.2040	-0.0712	-0.0243	-2.8887	-0.2658
Anhalt	(0.253)	(0.376)	(0.091)	(0.778)	(1.259)	(0.259)
Thuringia	0.2247	-0.1181	0.2077	1.4573	1.9306	0.3487
	(0.267)	(0.326)	(0.091)	(0.763)	(1.404)	(0.232)
East-Berlin	-0.4644	3.3696	-0.3069	0.1479	-3.7231	-0.1972
	(0.276)	(0.747)	(0.101)	(0.765)	(1.271)	(0.315)
compulsory schooling						
10 years	-0.2154	1.8542	-0.2044			
	(0.301)	(0.539)	(0.108)			
constant	1.2104	22.7611	1.3484	1.8284	3.8537	0.8304
	(0.234)	(0.355)	(0.084)	(0.916)	(1.845)	(0.341)
R^2		0.1110	0.0369		0.1915	0.0613
N	1 274	2 527	3 289	1 414	2 975	4 654

Table A.10: Estimation result - Piecewise-constant hazard

	West-Germany				East-Germany			
	1940-1962		1963-1984		1940-1963		1963-1985	
Age-specific effect								
14-18	-0.0037		0.0785		0.0444		0.0592	
	(0.026)		(0.050)		(0.047)		(0.071)	
19-23	-0.0286		-0.0141		0.1001	***	-0.0362	
	(0.033)		(0.055)		(0.036)		(0.071)	
24-28	-0.0455		0.1523		0.0272		0.0247	
	(0.046)		(0.113)		(0.034)		(0.079)	
29-33	-0.0685		-0.1912		0.0160		-0.1853	
	(0.083)		(0.227)		(0.040)		(0.123)	
34-38	-0.0710		-0.1732		0.0934		0.2784	
	(0.127)		(0.578)		(0.081)		(0.230)	
39-43	0.1626		-1.2037	***	0.1374		0.8691	
	(0.477)		(0.355)		(0.233)		(1.275)	
Trend	-0.0132		-0.0133		0.0136		-0.0422	
	(0.020)		(0.011)		(0.020)		(0.036)	
Trend	-0.0008	***	-0.0006		0.0005	*	0.0007	
	(0.000)		(0.001)		(0.000)		(0.001)	
age-trend								
14-18	-0.6791	***	-1.3080	***				
	(0.099)		(0.415)					
19-23	-0.2077	**	-0.7464	*	0.3617	***	0.5777	***
	(0.101)		(0.413)		(0.039)		(0.073)	
24-28	-0.1040		-0.5081		0.4573	***	0.6717	***
	(0.102)		(0.422)		(0.039)		(0.081)	
29-33	0.0779		-0.4895		0.5654	***	0.8676	***
	(0.115)		(0.455)		(0.044)		(0.113)	
34-38					0.7179		0.8544	
					(0.062)		(0.178)	
39-44	-0.0041		0.5646		0.8010	***	-0.4168	
	(0.276)		(0.441)		(0.161)		(1.220)	
compulsory schooling								
9 years	0.0061		0.0673		-2.5528	***	-2.1017	***
	(0.052)		(0.054)		(0.056)		(0.046)	
Skill level								
no degree	-0.0589		-0.1740		0.0466		0.1218	
	(0.037)		(0.125)		(0.030)		(0.073)	
Vocational	-0.0567		-0.2095			##	0.0181	
degree	(0.038)		(0.126)				(0.087)	
highschool	-0.1534	***	-0.2889	**	-0.0172		0.1133	
(Abitur)	(0.046)		(0.133)		(0.033)		(0.085)	
University	-0.0673		-0.3245	**	-0.0462			
degree	(0.060)		(0.139)		(0.036)			
Education					0.1622		0.4745	
unknown					(0.049)		(0.136)	
state dummies	+		+		+		+	
state trend	+		+		+		+	
N	4343		1274		6270		1414	