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The impact of education on fertility during the Chinese Reform Era

Pau Baizan* and Wanli Nie**

*Institució Catalana de Recerca i Estudis Avançats (ICREA) and Universitat Pompeu Fabra.
Address: 25 Ramon Trias Fargas street, 08005 Barcelona, Spain.
E-mail: pau.baizan@upf.edu
ORCID: https://orcid.org/0000-0003-0117-8794

** Centre de recherche en démographie (DEMO), Université Catholique de Louvain
Address: 1 Place Montesquieu, 1348 Louvain-la-Neuve, Belgium.
E-mail: wanli.nie@uclouvain.be
ORCID: https://orcid.org/0000-0002-7163-7960.

Corresponding author: Pau Baizan. ICREA and Universitat Pompeu Fabra. 25 Ramon Trias Fargas street, 08005 Barcelona, Spain. E-mail: pau.baizan@upf.edu

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Data availability statement

The data that support the findings of this study are openly available in at "China Family Panel Studies (CFPS)" at https://doi.org/10.18170/DVN/45LCSO by Institute of Social Science Survey, Peking University, 2015.

Abstract

We examined the influence of education on fertility decisions in contemporary China, drawing upon theoretical insights that emphasise the role of social institutions, gender relations, and life course dynamics in shaping family behaviour. This led us to propose a set of hypotheses that explain the differential effect of education on each parity.

We used information on female cohorts born between 1960 and 1989, coming from the China Family Panel Studies for 2010–2018. We applied event history models with both independent and simultaneous equations models to account for selection and endogeneity effects. Consistent with our hypotheses, our results show little educational differentials in the probability of bearing a first child, while the better educated postpone first births. Woman's educational attainment is strongly negatively associated to the hazard of bearing a second or third child. Male partner's educational attainment also has a negative effect on the hazard of transition to a second or third birth, yet with a weaker intensity. We also found that the negative effect of education on second birth rates significantly declines across birth-cohorts. Moreover, the effect of birth-control policies gradually increases with the level of education.

Keywords: Fertility, education, China, social institutions, life course, event history analysis.

1. Introduction

China's road to below replacement fertility was accomplished in an astoundingly short period of time. Most of the decline was completed during the 1970s, from a total fertility rate of 5.8 in 1970 to 2.7 in 1979. During the 1980s, fertility levels fluctuated slightly above 2 children per woman and dropped to below replacement from the early 1990s. There is a consensus among different sources in estimating a TFR of around 1.5 children per woman since the mid-1990s (Feng 2015). Several scholars have highlighted the role of massive socio-economic changes in explaining this decline and the diminishing role of birth-control policies (Cai 2010; Feng 2015; Zhao and Zhang 2018). Indeed, the end of the one-child policy in 2016 did not substantially alter the fertility levels (Gietel-Basten 2019)[1].

Parallel to these fertility trends, there has been substantial changes in the Chinese institutional context. The institutional configuration of society, including family policies, has been linked to the fertility levels by an expanding theoretical literature (Esping-Andersen 1999; Huinink, Kohli, and Ehrhardt 2015; McDonald 2000; McNicoll 1994; Rindfuss and Choe 2016; Thévenon and Neyer 2014). These authors highlight how the state, market and families interact to provide welfare for individuals and families, with broadly predictable consequences for fertility levels. Key dimensions of the institutional environment are the gender system and the social mobility system (Goldscheider et al. 2015; Greenhalgh 1988). Our framework also emphasises the presence of cultural influences in family behaviour,

[1] The most recent census of 2020 shows a current total fertility rate of 1.3 and an ideal number of children of 1.8 among women of reproductive ages (Chinese National Bureau of Statistics 2021). Press conference about main results from the seventh population census in China.

http://www.stats.gov.cn/tjsj/zxfb/202105/t20210511_1817274.html

including both long-term continuities such as the importance of kinship and intergenerational relationships, as well as innovations such as the strength of dual-breadwinner couples and the rise of the "quality child" (Greenhalgh and Winckler 2005; Pfau-Effinger 2005).

One way to assess institutional influences is through their differential effects by socio-economic position of individuals, and more specifically their educational level, which can be seen as a proxy for socio-economic status. Individuals and families with different educational levels are subject to differing constraints and incentives for fertility and are likely to hold different cultural views. Thus, evaluating the relationship between education and fertility is crucial to understanding the individual-level mechanisms that explain recent very low fertility levels. The literature on education and fertility in China suggests that the educational differentials are substantial (Lavely and Freedman 1990; Niu and Qi 2020; Piotrowski and Tong 2016). Yet most of existing analyses use aggregate-level measures and cross-sectional data or focus on particular regions (Feeney and Wang Feng 1993; Lan and Kuang 2016; Zhang 1990). They mainly investigate the effects of contextual variables related to socio-economic development, such as GDP growth, urbanisation and birth-control policies (Niu and Qi 2020). Only a few studies use longitudinal individual-level data, but they refer to the period up to the 1980s, when the central stages of the fertility transition took place(Piotrowski and Tong 2016). Moreover, previous studies did not control for the effects of fertility policies at the individual level. This control is important because, given the design of the polices, they are likely to have differential effects by educational group, as argued below. Here the aim is to evaluate the effect of education on fertility behaviour at the individual level in the period 1980–2018. We adopt a life course approach and conduct specific analyses by birth order, accounting for the effect of fertility polices at the individual

level (Elder et al. 2003; Huinink and Kohli 2014). The approach highlights the importance of the changing institutional context in shaping fertility decisions and the interrelationships between life course trajectories. We link the changing institutional conditions with differential incentives and responses by educational level. We focus the analyses on woman's educational trajectories and fertility, although we also include several analyses of the male partner's level of education. Moreover, we pay attention to changes over birth-cohorts in the effect of education on fertility, as well as possible interaction effects with fertility policies.

In order to limit heterogeneity and to facilitate the interpretation of the empirical analyses, we restrict the analyses to the cohorts born from 1960 to 1989, who were in the childbearing stage during the period of economic and political reforms that started in the late 1970s - the Reform Era. This was a period characterised by the expansion of the market economy, the rapid increase in educational and social mobility opportunities, and a general (yet unequal) improvement of living standards (Brandt and Rawski 2008). This was also a period deeply marked by the one-child policy (Greenhalgh and Winckler 2005; Gu et al. 2007). These developments triggered a fundamental shift in the context of childbearing.

Through the use of event history analyses, we can evaluate time dependent dynamics for first, second and third order births, including the cohorts of women who have not yet completed their reproductive lives. Previous literature has shown the need to account for selection effects to properly assess the effect of education on fertility (Kravdal 2001). In addition, fertility and educational attainment may be affected by unobserved factors common to both processes, such as social mobility aspirations or familistic values. For instance, a strong endogeneity has been found between first birth timing and the duration of educational enrolment in countries where a high degree of gender inequality and of incompatibility

between the role of mother and worker prevails (Baizan and Martín-García 2006; Billari and Philipov 2004). As a modelling strategy, we adopt a simultaneous equations approach to test the presence of endogeneity between education and fertility (Lillard 1993; Upchurch et al. 2002)[2].

The reminder of the paper is organised as follows. In section two, we review several features of the Chinese institutional configuration and policies, paying particular attention to gender relations, and link them to the specific constraints and incentives for fertility for each educational level. This leads us to propose a set of hypotheses that explain the differential effect of education on each parity. Section three deals with the data and methods used in our analyses. In section four, we present both descriptive results and multivariate results, including the comparison of results of models using standard event history techniques with models using simultaneous equations. The final section provides some concluding remarks and reflections.

2. Women's education and the Chinese institutional context (1980–2018)

The economic and social policy reforms that started in the late 1970s are at the origin of the contemporary welfare model. The transition to the market economy involved a gradual reduction of the state sector and provision of welfare, with the state retreating from being responsible for housing, food or employment (Brandt and Rawski 2008). The reduction of

[2] Different methods have been used in the literature to account for unobserved factors, including quasi-experimental methods exploiting educational reforms (Sohn and Lee 2019) or the use of twin models (Kohler et al. 1999).

public education, healthcare and old-age social security, and even the curtailment of consumption subsidies, led to a complete shift in the costs of children from the collective to the family. Especially in rural areas, state provision deteriorated rapidly since the early 1980s. De-collectivisation of agriculture made the family the core unit of production and welfare. In this context, children became a crucial source of labour and of support in old age, making necessary bearing two or three children, including a son, for economic survival and socio-economic mobility (Greenhalgh and Winckler 2005).

At the same time, this period of accelerated economic growth and urbanisation brought about new opportunities for upward economic and social mobility for individuals and families. Ever-increasing investments in education became necessary to successfully compete in the labour market and take advantage of the rise in the returns to education (Zhang and Zhao 2007). Expansion and reform of the educational system was a key part of the modernisation and market transition process. Policy makers emphasised links between schooling and labour market by expanding vocational and higher education. Previous research has shown that the increased reliance on parental resources enlarged existing inequalities in educational attainment by socio-economic status, location of residence and ethnicity (Hannum et al. 2008; Liu et al. 2009). The increase in educational attainment can be illustrated with data from the China Family Panel Study for the birth-cohorts studied here, although the oldest birth-cohorts could only partially benefit from the expansion of the educational system, since most of their childhood occurred before the onset of the transition. Thus, 29 percent of women born during 1960–69 did not reach a primary level of education, while this was the case for less than 5 percent for the 1980–89 birth-cohort. For the same female birth-cohorts, tertiary education increased from less than 1 percent to about 15 percent

(Table 1). These data also show that the gender gap in education has almost disappeared. A long-standing strand of literature has linked increased investments in education, social mobility aspirations and reduced fertility (Becker and Lewis 1973; Caldwell 1980; Dalla-Zuanna 2007; Chen 2020). The rising material aspirations for the parental and the child generation linked to higher levels of education can be a powerful engine reducing fertility (Basu 2002). Increased participation in education by both genders not only alters the costs of children but also undermines the traditional family economic structure and leads to changes in family relations (Alwin, 1989; Caldwell, 1980; Chen & Li, 2014). Women's generalised access to education, together with employment and contraception, greatly enhance gender equality in the family, consistently with low fertility levels (McDonald 2000).

Table 1 about here

Values emphasising the "quality child" and an intensive involvement of mothers in their child(ren)'s education and care are widely prevalent in contemporary China (Greenhalgh 2008). In a context with intense educational competition, heightened investments in education are needed to secure social mobility, irrespective of the parental social position. But parenting strategies and aspirations that emphasise providing high-quality resources are likely to be more prevalent among more educated parents, not least because of the higher availability of resources linked to social class and because more investments are needed to increase or maintain (relative) parental social level across generations (Breen and Goldthorpe 1997). More educated parents thus are more likely to concentrate their resources in one child and only exceptionally bear a second or third birth.

The existing high level of educational and social homogamy between partners should reinforce this effect (Hu & Qian, 2016; Hu, 2016).

The link between the fate of children and their parents is reinforced by the persistence of a "strong family" culture that emphasises the importance of vertical kinship relationships and family continuity (Chen & Li, 2014). The close social and economic interdependence between generations over the life course includes the provision of care and material support from children to parents in old age that links children's to parent's economic position. The analyses of intergenerational transfers show that the elderly rely on family resources to a substantial extent (Lee 2012). Economic needs as well as normative pressure work in tandem for family continuity, providing incentives for marriage and bearing at least one child (Zhou 2019; To 2013). Marriage is still practically universal, although there are some signs of limited increasing diversification of the partnership formation process, including unmarried cohabitation and premarital conceptions (Ma and Rizzi 2017). Childbearing outside marriage remains rare (Raymo, Park, et al. 2015). Marriage offers opportunities for income and status enhancement, especially for women, in a context with sizeable gender gaps in education and income and where two incomes are necessary for households' economic sufficiency (Shu and Bian 2003).

Yet, marriage also involves a strong normative pressure to have one child shortly after marriage, together with other family obligations (Jones, 2007). Values emphasising the importance of motherhood are widely prevalent (Gu 2009). Moreover, family polices never questioned first births but instead promoted and even idealised the two-parent family with one child (Greenhalgh and Winckler 2005). In this context, it can be expected that most women bear at least one child.

Life course studies have shown the delaying effect of education on the timing of childbirth (Blossfeld and Huinink 1991; Ní Bhrolcháin and Beaujouan 2012; Oppenheimer 1988). The postponement of first births results, on the one hand, from the difficulty in combining the roles of parent and student and, on the other hand, from the subsequent delay in the adoption of adult roles, such as integration in the labour market and marriage.

Lower socio-economic status families have lower access to public pensions and have a lower saving capacity, providing incentives for additional births. The reliance on children by the low educated is enhanced by the lack of economic security and the need to diversify sources of income (e.g. by migrating to urban areas). As a result, the low educated should show higher fertility levels. Yet, some of the factors favouring a strong interdependence between generations may have weakened over time because of the decline in household production and the growing economic independence of children and women, potentially leading to a reduction of the educational differentials in fertility. The spread of fertility norms favouring the one-child family and the increased need for educational investments may have contributed to such a convergence over time between educational groups in fertility behaviour (Zheng et al. 2009, 2018).

Moreover, the strong interdependence between generations involves that parental obligations are also substantial. Care from grandmothers is essential to allow a minimum of compatibility between women's jobs and childrearing in a context where the majority of women with low-age children are full-time employed (Dasgupta et al. 2015)[3]. It is remarkable that the statutory retirement age for women is 50 years (for female public servants, it is 55; and 60 for men), allowing them to participate in childcare[4]. The Chinese welfare regime then blends ample opportunities for career advancement, also for women, with several typical characteristics of the "unsupported" familistic model (Ferrera 2013; Leitner 2003). Full-time labour market participation of women is expected, but compatibility with mother roles is difficult, given the lack of formal childcare availability and in spite of grandmothers' help

[3] Female labour force participation rate was around 74% in 1990 and slightly declined to a bit over 60% in 2018. https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS?end=2019&locations=CN&start=1990

[4] This statutory retirement age was stablished in 1978 and is still effective by the time of drafting this paper in 2021. In March 2021, the government started a campaign to progressively delay the statutory retirement age.

(Ngok and Fan 2018; Zhong and Peng 2020). Thus, the gap in care is especially acute between the end of maternity leave[5] (of about 3 to 6 months) and the start of education at age 3 or 6 of the child. Leave arrangements reflect deeply gendered cultural conceptions about gender roles (Brinton and Lee 2016). Women's career advancement is highly compromised by bearing a child, especially a second child, as women fear discrimination by employers (Zhou 2019). Statistical gender discrimination is further reinforced by the early age of retirement for women that discourages skill investments from employers to their female employees, as the investments will be used for a shorter period of time. Highly educated women are especially likely to be hit by discriminatory practices, because they have higher returns to experience and job tenure than lower-educated women, and therefore any interruption in employment associated with motherhood results in stronger income penalties (England et al. 2016). Conversely, for lower-educated women, labour market interruptions involve a lower penalty in terms of future earnings and the probability of returning to an equivalent job if they leave the labour market to take care of a child.

From the discussion above, we derive the following hypotheses:

Hypothesis 1: *Irrespective of the educational level, most women bear at least one child. The effect of education on first childbearing is mainly limited to its postponement by the highly educated*.

[5] Currently paternity leave has a duration of 14–30 days. Leave regulations depend on provincial authorities and are mainly relevant for formal sector employees, thus marginalising the large informal sector and the self-employed in agriculture.

Hypothesis 2: *Women's educational attainment is strongly negatively associated to the hazard of bearing a second or third child.*

Hypothesis 3: *Male partner's educational attainment has a negative effect on the hazard of transition to a second or third birth.*

Hypothesis 4: *The negative effect of education for second and third births rates declines across birth-cohorts.*

Birth-control policies are, of course, an essential component of the regime package, which have been thoroughly studied (e.g. Gu et al. 2007). The policy prescriptions have greatly varied over time, which allowed for different number of children and range of conditions under which one, two or exceptionally three births are allowed for particular couples (single mothers are subject to paying a "social supporting fee".[6]). The "Later-longer-fewer" period from 1971 to 1980 greatly boosted contraception and late marriage. Its prescriptions included (1) later marriage, which means a minimum marriage age of 25 for males and 23 for females, (2) longer birth intervals, of at least 4 years between two births, and (3) fewer children, or at most two children.

The strict "one-child policy", introduced in 1980, was initially resisted in rural areas, where state control was weakest and the economic and social benefits of several children were more evident (Greenhalgh and Winckler 2005). Lack of compliance and difficulties in imposing the new regulations prompted an adaptation of the policies to the socio-economic circumstances of families, especially since the mid-1980s. Thus, 2 or even 3 children were allowed in the case of agricultural families (if the first or first two children were girls), while

[6] The charging of a social supporting fee to single mothers has been dropped from birth control regulations since 2016 in some provinces. A majority of provinces, however, still keep the fee.

the one-child norm was strictly imposed in economically advanced areas (Zeng 1989). The "political costs" of having a child not allowed by policy were probably higher for better educated couples. Such economic and social penalties may include obstacles in career advancement, access to housing, or the lack of "hukou" registration for the unauthorised child and its associated benefits, such as access to public schooling. Sanctions could be more readily applied in urban areas and particularly to state sector employees. As a result, conforming to the policy confers economic and social benefits that were positively stratified by the level of education. The gradual loosening of the policy led to the adoption of a comprehensive "two-child policy" since 2016. The above arguments lead us to propose that *the negative effect of birth-control policies on fertility was stronger for the highly educated* (Hypothesis 5).

The exceptional stringency of the policy has very likely influenced the spread of preferences for a small number of children and the related social norms about their upbringing, contributing to the persistence of below replacement fertility beyond direct policy effects. Low fertility favours higher investments in education, as well as more gender equality (McDonald 2000). Moreover, family size ideals are partly shaped by the actual family size of the previous generation (Lutz et al. 2006). Then, a high prevalence of one-child families among the better educated should lead to small family size ideals among their children. Yet, the general spread to all educational groups of new fertility norms and the general improvement of socio-economic conditions may have contributed to a decline in educational differentials in fertility across birth-cohorts.

3. Data and methods

Data

The data sets that we used are from the China Family Panel Studies[7] (CFPS) for 2010–2018 (Institute of Social Science Survey, Peking University, 2015). The first wave of the CFPS was designed as a nationally representative sample of the population of the People's Republic of China living in private households in 2010 (Xie and Lu 2015). Almost 15,000 families and 30,000 individuals within these families were interviewed, with an approximate response rate of 79 percent. These original sample members were reinterviewed every two years and, if they split off from their original households to form new households, all adult members of these new households were also interviewed. Similarly, children in the original sample households were interviewed when they reached 9 years of age. In addition to providing information on respondents within the panel survey period (2010 onwards), the CFPS asked respondents to provide detailed retrospective fertility histories. These retrospective data were matched to the within-panel data to construct detailed fertility histories from age 15 years for all adult female respondents.

We used information on female birth-cohorts 1960 to 1989, which consisted of an initial sample of 15,086 women. The analyses are thus focused on the reform period (since the late 1970s) and avoid the convoluted social and economic conditions experienced by previous birth-cohorts. To avoid possible bias due to correlation between the responses of women belonging to the same household, we randomly selected a woman in each household

[7] The data that support the findings of this study are openly available in at "China Family Panel Studies (CFPS)" at https://doi.org/10.18170/DVN/45LCSO by Institute of Social Science Survey, Peking University, 2015.

with more than one eligible female respondent, leading to the exclusion from the sample of 2,264 women. We also excluded from the study sample births of respondents less than age 15. We kept in the analyses one twin (or triplet) birth only. The final analytical sample included 12,822 first birth episodes, 11,766 second birth episodes and 6,396 third birth episodes, belonging to 12,838 women (Table 2).

Table 2 about here

The events of first, second or third conception leading to a birth are indicated by the date of the birth, given to the nearest month, minus nine months. We focus on conception time, rather than on birth time, because this allows a closer connection between the decision to have a child and the situation of the individual in parallel careers. For first births, observation begins with age 15 and ends with the event of the conception of the first child or, for right-censored cases, with the date of the interview or by reaching age 45, whichever comes first. Similarly, the episodes of second and third births start the month just after previous birth and end with the event of conception or with censoring (interview date or 15 years after previous birth).

The survey does not provide detailed educational histories but contains information on the educational level attained at each survey wave. Thus, to construct educational histories, we assumed that women were enrolled in each level of education up to the minimum age required to attain that level and updated the level of education accordingly.

We performed analyses including the male partner's level of education for second and third birth episodes. This variable refers to the men's educational level at the beginning of the episode for married and unmarried couples (if this information is unavailable, it refers to the level of education reported at the first subsequent interview). These analyses exclude periods in which the women were not in a partnership. We did not analyse the effect of men's education on first births, with first birth spells starting at union formation. Time since union formation has an unclear meaning in explaining first birth decisions, given the strong endogeneity which very probably exists between union formation and first births in China (Jones, 2007) and the high number of prenuptial conceptions (Ma and Rizzi 2017).

Previous studies have shown that family background factors independently influence both education and fertility (Axinn et al. 1994; Chen 2020; Kan and Hertog 2017; Yi et al. 2015). Moreover, the values and goals learned during childhood, the social environment and the economic resources available in the parental home can act as common factors influencing fertility and educational behaviour (Nisén et al. 2014; Tropf and Mandemakers 2017). The CFPS is rich in indicators about the respondents' family of origin, including her mother's educational level, the respondent's number of siblings, the type of residence during childhood (rural or urban Hukou registration), the parental political status (whether at least one of the parents was a member of the communist party during the respondent's childhood), and the occupational status of the family of origin. The occupational status of the family reports the highest occupation between the parents when the respondent was 14. It was categorised as follows: professional, administrative and service workers, skilled manual workers, unskilled manual workers, farmers (Table 2). All the above-mentioned information is estimated at the latest wave so as to correspond to the most complete life history available. We constructed a

fertility policy variable indicating whether a birth was allowed. This time-varying variable accounts for the policies applying specifically to each woman, considering her marriage and fertility history, province of residence, ethnicity, rural/urban residence, gender of previous child(ren), her and her partner's number of siblings, and time period. We assigned values to the explanatory variables with missing information using a multiple imputation technique (Honaker et al. 2011).

Statistical methods

The empirical strategy involves first the use of separate hazard models for the processes of first, second and third birth conception. This can be represented mathematically in the following way (Lillard and Panis 2003):

$$\ln h_i^{1B}(t) = \gamma' T_i(t) + \beta' X_i(t) \quad (1)$$

$$\ln h_i^{2B}(t) = \gamma' T_i(t) + \beta' X_i(t) \quad (2)$$

$$\ln h_i^{3B}(t) = \gamma' T_i(t) + \beta' X_i(t) \quad (3)$$

where $\ln h_i(t)$ is the log-hazard of occurrence at time t for woman i, $\gamma' T_i(t)$ denotes a piecewise linear spline that captures the baseline effect of duration on intensity, and $\beta' X_i(t)$ represents (potentially time-varying) covariates.

The specification above, however, does not consider the possible existence of selection effects linked to the unobserved heterogeneity in the population in the propensity to bear a child. For instance, some woman's unobserved characteristics, such as a greater propensity towards building a career as opposed to a family or primary infecundity, may systematically lead to lower fertility. Familistic attitudes and the greater economic

advantages of fertility for the household economy (e.g. agricultural households) are likely to lead to higher fertility. Previous research has shown that these biases can be corrected by using simultaneous equations for first, second and third births, in which a common heterogeneity term is added to each birth equation (Kravdal 2001).

A second type of potential bias may arise if unmeasured attributes affect both educational attainment and fertility. Educational attainment goals and strategies might not be exogenous to fertility choices, as these two roles compete in time and resources (Huinink and Kohli 2014). Unmeasured attributes such as health status, social mobility aspirations or familistic values may affect both fertility and educational attainment, potentially biasing the estimated effect of education on fertility. Previous studies have shown that this type of bias is particularly likely in contexts where the compatibility between different roles, such as being a mother and employee, is more difficult and where gender inequality is also high (Martin-Garcia and Baizan 2006; Upchurch, Lillard, and Panis 2002; Billari and Philipov 2004). As noted above, institutional conditions, including family policies, are likely to influence individuals' values, with consistent effects over the life course, potentially leading to self-selection (or endogeneity) effects between fertility and education. To investigate whether there is a joint determining effect for both processes, we run a multi-process model of educational attainment and fertility. The statistical specification is derived from the framework developed by Lillard (1993), Upchurch et al. (2002), and (Kravdal 2001). It consists of four simultaneous equations, three of them specified as event history models for first, second and third birth conceptions, and an additional probit equation for educational attainment (Lillard and Panis 2003).

$$\begin{cases} \ln h_i^{1B}(t) = \gamma' T_i(t) + \beta' X_i(t) + \varepsilon_i \\ \ln h_i^{2B}(t) = \gamma' T_i(t) + \beta' X_i(t) + \varepsilon_i \\ \ln h_i^{3B}(t) = \gamma' T_i(t) + \beta' X_i(t) + \varepsilon_i \\ E_{ij}^{*} = \beta' X_{ij} + \lambda_i + u_{ij} \end{cases} \quad (4)$$

The three fertility equations are specified as hazard models in which the random variable ε reflects unobserved woman-specific constant factors influencing births. Educational attainment is specified as a multilevel probit model in which each women makes one or more educational decisions (attaining each level of education). Educational decisions are nested within women. Each woman may make up to 5 educational decisions, corresponding to the attainment (or not) of the following educational levels: primary, lower secondary, higher secondary, college, and university degree. Each educational decision is conditional on the attainment of the previous level of education (except for the primary level). E_{ij}^{*} indicates the latent propensity that a woman *i* attains level *j* (*j* = 1,…5). If $E_{ij}^{*} < 0$, the woman does not attain a particular level of education ($E_{ij} = 0$), and if $E_{ij}^{*} \geq 0$, the woman attains that level ($E_{ij} = 1$). Observed characteristics are captured by the set of regressors X_{ij} [8]. Unmeasured characteristics are in part woman-specific and constant across all her educational decisions (λ_i) and in part specific to each educational decision for each level of education (u_{ij}). The random variables ε and λ are assumed to follow a joint bivariate normal distribution:

$$\begin{pmatrix} \varepsilon \\ \lambda \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\varepsilon^2 & \\ \rho_{\varepsilon\lambda} & \sigma_\lambda^2 \end{pmatrix} \right) \quad (5)$$

[8] The variables included in the model are: mother' education, birth-cohort, parental occupation, number of siblings, whether one of the parents is member of the communist party; ethnic minority membership, and level of education attained by the woman. This last variable controls for the very different probability of attaining each level of education.

In (4), $\rho_{\varepsilon\lambda}$ represents the correlation between the unobserved heterogeneity terms of the processes of fertility and educational attainment. This correlation provides a test of whether women with unobserved above-average risks of fertility ($\varepsilon > 0$) also tend to have below-average educational attainment propensities ($\lambda < 0$) and vice versa. The extent of variation among women in the heterogeneity terms is identified by multiple occurrences of each outcome for some women (births of different parity; different levels of education). Moreover, the observation of repeated events for a subset of women, with most women experiencing events belonging to both processes, means that identification is possible without covariate exclusions (Lillard 1993; Upchurch et al. 2002).

4. Results

First, we present survival curves derived from life table estimates for the processes of first, second and third birth (Figure 1). These survival curves show how these processes evolve over time by birth-cohort groups and by the woman's educational level attained at the last survey interview. Second, in Table 3, we present the estimates for each parity of a standard event history model (Model 1); the results when the equations for first, second and third births are estimated simultaneously (Model 2); and the results when the fertility equations are modelled jointly with educational attainment (Model 3). As can be seen at the bottom of Table 3, the standard deviations of the heterogeneity terms for the fertility (0.52) and educational attainment (2.74) processes are statistically significant in both Models 2 and 3 ($p < 0.01$). This indicates that indeed there are selection effects influencing fertility. Yet, the correlation between the heterogeneity terms is not statistically significant (Model 3), suggesting that there is no spurious relationship between education and fertility and that the

model captures the essential factors affecting fertility. Unsurprisingly, the correlation between the heterogeneity terms is highly sensitive to the variables included in the models. For instance, the inclusion of the fertility policy variable led to a change in the correlation from significantly negative (-0.13, $p < 0.05$) to a non-significant negative correlation, indicating that this variable captures some important common factors to fertility and educational attainment. Moreover, if family background factors are removed from Model 3, we find a strong negative correlation between the processes (-0.18, $p < 0.01$) and a larger effect of education on fertility, highlighting the importance of including these factors to obtain unbiased estimates. The results obtained in Models 2 and 3 are substantially similar, and therefore we will refer to Model 2 in the presentation that follows.

Figure 1 about here

Figure 1 shows that bearing a first birth is almost a universal behaviour for Chinese women, although a modest increase in childlessness is visible for the youngest cohort, i.e. those born in the 1980s. Women with higher secondary or tertiary education show slightly higher levels of childlessness (about 10 percent, with a confidence interval of 0.08–0.13) compared to women with the lowest level of education (about 5 percent, c.i.: 0.05–06) and a substantially delayed first birth timing: there is a 5-year differential between extreme educational groups in the median age at first birth. Such levels of childlessness and postponement are still limited in comparison to Japan, South Korea or Taiwan (Jones, 2007;

Raymo et al., 2015). The multivariate results presented in Table 3 specify these results. Thus, being enrolled in education reduces the rate of first birth by more than 5 times (the relative risk of being enrolled in education versus not being enrolled in education is 0.20 at $p < 0.01$). Similarly, the women's educational level has a strong delaying effect on first birth, since the relative risk of the tertiary educated is about half of the primary educated (0.461 at $p < 0.01$). Overall, these results are consistent with Hypothesis 1 which stated that *irrespective of the educational level, most women bear at least one child* and that *the effect of education on first childbearing is limited to its postponement*.

Table 3 about here

About 55 percent of all women of the cohorts born in the 1960s and 1970s had a second child while, remarkably, this proportion increased to more than 70 percent in the 1980s birth-cohorts, possibly linked to policy relaxations (Figure 1). The survivor functions also show that second births' progression ratios follow a strong educational gradient: while more than 76 percent of women with less than primary education bear a second child fifteen years after bearing the first child, only about 26 percent of women with tertiary education bear a second child at the same duration. Multivariate results show that the relative risks are about 79 percent lower for the tertiary educated (Model 2, Table 3) with respect to the "less than primary" group and highly statistically significant (0.30 / 1.40=0.214; 1 - 0.214=0.79). A similarly strong educational gradient is present for third births, although the proportion of

women progressing to this parity is about 24 percent only, according to the survivor function's results. Thus, these results give a clear support to our second hypothesis: *Women's educational attainment is strongly negatively associated with the hazard of bearing a second or third child.*

Our third hypothesis states that the *male partner's educational attainment has a negative effect on the hazard of a second or third birth.* Here the results are less extreme, albeit the educational differentials are still substantial (Table 4). Thus, couples in which the man has a tertiary education display a risk of second birth 37 percent lower than the "less than primary" educated (0.69 / 1.10=0.63; 1 - 0.63=0.37). Given the small sample size for the highly educated at risk of a third child, we grouped the men with low secondary education and above in the models, which show a non-significant coefficient with respect to the primary educated. By contrast the "less than primary educated" show a relative risk of about 22 percent higher than primary educated men.

Table 4 about here

In Table 5 below, we show interaction effects between the woman's level of education and the birth-cohort for second and third births. The second birth relative risk

differentials between educational levels sharply decline across birth-cohorts. Thus, if the "less than primary" educated women of the 1960–69 birth-cohorts is taken as the reference category, the relative risk for the tertiary educated is 0.06 (0.11 / 1.84 = 0.06), i.e. the risk is reduced by a factor 94 percent. And if the "less than primary" educated women of the 1980–89 birth-cohorts is taken as the reference, the relative risk for the tertiary educated is 0.37 (0.57 / 1.56 = 0.37), i.e. 63 percent lower. These results for second births are clearly consistent with our fourth hypothesis, i.e. *the negative effect of education on second and third birth rates declines across birth-cohorts*, while the evidence is much weaker for such a decline in the case of third births, maybe because the risk of having the third birth is itself already very low (the likelihood ratio test comparing a model with and without the interaction was not statistically significant). The educational differentials also diminished across birth-cohort for third births but to a lesser extent. Thus, the relative risk for women with higher secondary or tertiary education was 0.48 (not statistically significant) with respect to the less than primary educated in the 1960–69 birth-cohort, while the corresponding ratio was 0.29 for the youngest birth-cohort.

Table 5 about here

As expected, the main effects of the fertility policy variable show a substantial negative effect for both second (relative risk: 0.66 at $p < 0.01$) and third births (r.r.: 0.81), albeit it is not statistically significant for third births (probably linked to the low number of

observations for which third births were allowed). To investigate whether *the negative effect of birth-control policies was stronger for the highly educated* (Hypothesis 5), we computed an interaction between the policy and education variables. This interaction yielded statistically significant results for second births but not for third births. As shown in Table 6, the negative effect of the policy on the hazard of second births gradually becomes stronger with the level of education. Thus, the differentials between women who are not allowed to bear a second child with respect to women who are allowed is negligible for women with "less than primary" education; but tertiary educated women subject to the policy show a relative risk 79 percent lower (0.13 / 0.63=0.21; 1 - 0.21= 0.79; $p < 0.01$) than tertiary educated women who are allowed to bear a child.

Table 6 about here

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5. Conclusions

China's fertility levels during the Reform Era (1980–2018) have been surprisingly low, considering its levels of income, urbanisation or agricultural labour force. Even compared to other East Asian countries, China reached very low fertility levels at an earlier stage in economic development (Raymo et al., 2015). While several previous contributions have focused on the effect of macro-level indicators, here we have assessed the individual-level impact of education on fertility during the Reform Era. This association is necessarily context-specific, although the results found bear some similarities (as well as some

differences) with other societies in advanced stages of the fertility transition and with the experience of other societies that have made the transition from a state-planned to a capitalist economy.

Drawing on institutional and gender theoretical perspectives, we have pointed to some key processes, such as the expansion of the market economy, the retreat of social policies providing economic security and support with the cost of children, and changes in fertility control policies. The institutional setting provided incentives for a rapid increase in the levels of education for both genders and for the labour force participation of most women in childbearing age. These conditions were conducive to a modicum of women's autonomy, while substantial gender inequalities remain in the labour market and in care obligations. Family economies still heavily rely on intense intergenerational exchanges.

In this paper, we developed a set of hypotheses that link these institutional influences with a strong educational layering in fertility behaviour. In particular, bearing a second, and to a lesser extent a third birth, shows a neat negative association with education. These results are consistent with educational differentials in social mobility opportunities for both parents and their child(ren) and the related differentials in the costs of rearing children. This is especially so in a context with high returns to education, weak social-support policies and increasing socio-economic inequalities. Economic security considerations together with low investments in children are likely to dominate fertility decisions among low educated parents. By contrast, increased parental education should involve heightened economic and social costs of children, especially for women. It is remarkable that not only women's education but also men's education leads to lower fertility, consistent with this interpretation. We also hypothesised that the vast majority of women, irrespective of their educational level, bear at

least one child, and this was corroborated by our results. In a context with a strong economic and social interdependence between generations, there are compelling incentives for marriage and bearing at least one child. As a result, child(ren)'s future socio-economic position matters for the parents, reinforcing the need for child investments. Our results also confirmed the hypothesis of a decline across birth-cohorts in the negative effect of education. A gradual convergence between educational groups is likely to be the result of the weakening in the role of children as labour and economic security providers among the low educated, together with the spread of family norms favouring the one-child family from highly educated parents to lower educational groups.

A crucial component of the institutional setting is the existence of a stringent fertility control policy based on a strong political and administrative structure. This policy stipulated different family sizes according to the specific socio-economic situation of individuals, thus already implying some degree of educational stratification in fertility. Moreover, we hypothesise that compliance with the policy involved economic and social benefits that were positively stratified by level of education, while the low educated had higher incentives for bearing second and third births and lower penalties associated with contravening the policy. Indeed, our results show that the effect of birth-control policies on second births was substantially more negative for the highly educated, while they did not show significant results for third births. Beyond these direct policy effects, it is likely that the existence of coercive policies regulating marriage and fertility for more than four decades shaped norms about family life, including child investments and women's labour force participation. This can result from a reciprocal interaction between ideal and actual family size. Moreover, the institutional context was increasingly geared to the one-child family, particularly with respect

to the educational system and labour market organisation, which also helps to explain why the policy was widely accepted. The results of our analyses show that the policy effects measured at the individual level were substantial (at least for second births), but they did not preclude the also substantial effects of several other socio-economic indicators, particularly the educational level. This suggests that the institutional configuration that was created during the one-child policy period continues to influence parents' fertility choices.

Finally, our empirical strategy tried to minimise the possibility of a spurious association between education and fertility by using event history models with simultaneous equations and an array of individual and family background variables. It should be noted, however, that the basic results presented above hold irrespective of the particular event-history model used to estimate the effects of education on fertility.

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Table 1. Educational attainment of the birth-cohorts 1960-69, 1970-79, and 1980-89 (in percentage)

Birth-cohort	1960-69		1970-79		1980-89	
Educational level	Women	Men	Women	Men	Women	Men
Less than primary	29.1	13.1	20.3	10.6	4.9	5.0
Primary	24.2	24.7	24.8	21.2	11.3	10.7
Lower secondary	28.8	37.5	31.4	39.0	37.7	36.0
Higher secondary	17.0	22.2	18.8	24.2	31.1	34.1
Tertiary	0.9	2.5	4.6	5.0	15.0	14.2
Total	100	100	100	100	100	100
Sample size (weighted)	2617	2454	2494	2152	2000	1747

Based on data from the Chinese Family Panel Studies 2018. Weighted data.

Table 2. Analytical sample's descriptive statistics

	Proportion	s.e.
Woman's education		
Less than primary	0.224	0.004
Primary	0.204	0.004
Low secondary	0.296	0.004
High secondary	0.141	0.003
Tertiary	0.134	0.003
Missing*	0.000	
Mothers' education		
Less than primary	0.579	0.004
Primary	0.227	0.003
Low secondary	0.131	0.003
High secondary or tertiary	0.063	0.002
Missing*	0.184	
Parental occupation		
Agriculture	0.547	0.004
Unskilled	0.064	0.002
Skilled	0.085	0.002
Services	0.153	0.003
Professional	0.151	0.003
Missing*	0.411	
Birth-cohort		
1960-69	0.358	0.003
1970-79	0.337	0.003
1980-95	0.305	0.003
Missing*	0.000	
Siblings: No siblings	0.096	0.003
1 sibling	0.192	0.003
2+ siblings	0.712	0.003
Missing*	0.321	
Hukou registration: Rural	0.843	0.003
Urban	0.157	0.003
Missing*	0.162	
Parent communist party member: yes	0.183	0.003
No	0.812	0.003
Missing*	0.357	
Ethnic minority: yes	0.092	0.003
No	0.908	0.003
Missing*	0.087	
No. of first birth episodes	12822	
No. of second birth episodes	11766	
No. of third birth episodes	6396	
No. of first births	11777	
No. of second births	6310	
No. of third births	1412	

Source: China Family Panes Studies 2010-2018. Unweighted data. *percentage with missing information. The percentages of the variables include imputed cases.

Table 3. Estimates from separate and joint models for the processes of first, second and third birth (hazard models), and for educational attainment (probit model). Based on data from the China Family Panel Studies (2010-18) for women born between 1960 and 1989

	Model 1			**Model 2**			**Model 3**		
	No heterogeneity			**Heterogeneity**			**Joint modelling**		
First birth	Coef.	Relative risk	Sign.	Coef.	Relative risk	Sign.	Coef.	Relative risk	Sign.
Age spline									
15-20 years	0.72		***	0.74		***	0.74		***
20-23 years	0.28		***	0.34		***	0.34		***
23-26 years	0.05		***	0.12		***	0.12		***
26-30 years	-0.13		***	-0.08		***	-0.08		***
30-45 years	-0.21		***	-0.20		***	-0.20		***
Woman's education									
Less than primary	-0.01	**0.99**		0.02	**1.02**		0.01	**1.01**	
Primary (ref.)	0	**1**		0	**1**		0	**1**	
Low secondary	-0.16	**0.85**	***	-0.21	**0.81**	***	-0.21	**0.81**	***
High secondary	-0.44	**0.64**	***	-0.58	**0.56**	***	-0.57	**0.57**	***
Tertiary	-0.52	**0.59**	***	-0.77	**0.46**	***	-0.76	**0.47**	***
Not enrolled in education	0	**1**		0	**1**		0	**1**	
Enrolled in education	-1.7	**0.18**	***	-1.61	**0.20**	***	-1.61	**0.20**	***
Mothers' education									
Less than primary	-0.02	**0.98**		-0.02	**0.98**		-0.02	**0.98**	
Primary (ref.)	0	**1**		0	**1**		0	**1**	
Low Secondary	-0.06	**0.94**	*	-0.07	**0.93**	*	-0.08	**0.92**	*
High Secondary or tertiary	-0.15	**0.86**	***	-0.19	**0.83**	***	-0.19	**0.83**	***
Parental occupation									
Agriculture	0.07	**1.07**	*	0.07	**1.07**		0.07	**1.07**	
Unskilled (ref.)	0	**1**		0	**1**		0	**1**	
Skilled	0.00	**1.00**		0.00	**1.00**		0.00	**1.00**	
Services	-0.01	**0.99**		-0.03	**0.97**		-0.03	**0.97**	
Professional	0.02	**1.02**		0.01	**1.01**		0.01	**1.01**	
Birth-cohort									
1960-69	0.07	**1.07**	***	0.05	**1.05**	**	0.05	**1.05**	**
1970-79 (ref.)	0	**1**		0	**1**		0	**1**	

1980-95	-0.13	**0.88**	***	-0.17	**0.84**	***	-0.17	**0.84**	***
No *siblings*	-0.13	**0.88**	***	-0.16	**0.85**	***	-0.16	**0.85**	***
1 sibling (ref.)	0	**1**		0	**1**		0	**1**	
2+ siblings	0.02	**1.02**		-0.02	**0.98**		-0.02	**0.98**	
Rural hukou	0	**1**		0	**1**		0	**1**	
Urban hukou	-0.21	**0.81**	***	-0.20	**0.82**	***	-0.20	**0.82**	***
Constant term	-5.61		***	-5.71		***	-5.72		***
Second birth									
Duration spline									
0-1 years	4.46		***	4.45		***	4.45		***
1-3 years	0.12		***	0.17		***	0.17		***
3-6 years	-0.13		***	-0.11		***	-0.11		***
6+ years	-0.17		***	-0.16		***	-0.16		***
Woman's education									
Less than primary	0.30	**1.35**	***	0.34	**1.40**	***	0.34	**1.40**	***
Primary (ref.)	0	**1**		0	**1**		0	**1**	
Low secondary	-0.27	**0.76**	***	-0.34	**0.71**	***	-0.33	**0.72**	***
High secondary	-0.61	**0.54**	***	-0.78	**0.46**	***	-0.78	**0.46**	***
Tertiary	-0.94	**0.39**	***	-1.21	**0.30**	***	-1.20	**0.30**	***
Age at first birth									
<20	0.29	**1.34**	***	0.22	**1.25**	***	0.22	**1.25**	***
20-22	-0.25	**0.78**	***	-0.09	**0.91**	**	-0.09	**0.91**	*
23-25(ref.)	0	**1**		0	**1**		0	**1**	
26-28	-0.34	**0.71**	***	0.01	**1.01**		0.01	**1.01**	
>28	-0.91	**0.40**	***	-0.4	**0.67**	***	-0.39	**0.68**	***
Mothers' education									
Less than primary	0.26	**1.30**	***	0.28	**1.32**	***	0.29	**1.34**	***
Primary (ref.)	0	**1**		0	**1**		0	**1**	
Lower secondary	-0.13	**0.88**	**	-0.16	**0.85**	***	-0.16	**0.85**	***
Higher secondary or tertiary	-0.08	**0.92**		-0.12	**0.89**		-0.12	**0.89**	
Policy allows second child (ref.)	0	**1**		0	**1**		0	**1**	
Policy does not allow second child	-0.4	**0.67**	***	-0.41	**0.66**	***	-0.41	**0.66**	***
Constant term	-6.46		***	-6.68		***		**1.00**	***
Third birth									
Duration spline									
0-1 years	3.26		***	3.27		***	3.26		***

1-3 years	0.04			0.06			0.06		
3-5 years	-0.64		***	-0.63		***	-0.63		***
5+ years	-0.27		***	-0.27		***	-0.27		***
Woman's education									
Less than primary	0.29	**1.34**	***	0.34	**1.40**	***	0.34	**1.40**	***
Primary (ref.)	0	**1**		0	**1**		0	**1**	
Low secondary	-0.17	**0.84**	**	-0.23	**0.79**	***	-0.23	**0.79**	***
High secondary or tertiary	-0.44	**0.64**	***	-0.61	**0.54**	***	-0.61	**0.54**	***
Age at second birth									
<23	0.40	**1.49**	***	0.21	**1.23**	***	0.21	**1.23**	***
23-28 (ref.)	0	**1**		0	**1**		0	**1**	
>28	-0.95	**0.39**	***	-0.73	**0.48**	***	-0.73	**0.48**	***
Mothers' education									
Less than primary	0.28	**1.32**	***	0.32	**1.38**	***	0.32	**1.38**	***
Primary (ref.)	0	**1**		0	**1**		0	**1**	
Secondary or tertiary	0.12	**1.13**		0.08	**1.08**		0.08	**1.08**	
Policy allows third child (ref.)	0	**1**		0	**1**		0	**1**	
Policy does not allow third child	-0.17	**0.84**		-0.21	**0.81**		-0.21	**0.81**	
Constant term	-6.03		***	-6.32		***	-6.32		***
Educational attainment									
Mothers' education									
Less than primary				-1.38		***	-1.38		***
Primary (ref.)				0			0		
Lower secondary				0.83		***	0.83		***
Higher secondary or tertiary				1.90		***	1.90		***
Educational level									
Primary				1.95		***	1.95		***
Low secondary(ref.)				0			0		
High secondary				-2.80		***	-2.80		***
College				-4.56		***	-4.56		***
University				-6.04		***	-6.03		***
Birth-cohort									
1960-64				0.50		***	0.50		***

1965-69 (ref.)	0		0	
1970-74	0.34	**	0.33	**
1975-79	1.32	***	1.32	***
1980-84	2.07	***	2.07	***
1985-89	2.58	***	2.58	***
Parental occupation				
Agriculture	-0.63	***	-0.63	***
Unskilled (ref.)	0		0	
Skilled	0.30	*	0.30	*
Services	0.36	**	0.36	**
Professional	0.29	*	0.29	*
No siblings	0.18		0.18	
1 sibling (ref.)	0		0	
2 siblings	-0.23	**	-0.22	**
3 siblings	-0.27	**	-0.27	**
4+ siblings	-0.70	***	-0.70	***
Parent communist party member	0.63	***	0.63	***
Ethnic minority	-1.30	***	-1.30	***
Constant term	0.78	***	0.78	***
Heterogeneity components				
Standard deviation (fertility) ε	0.52	***	0.52	***
Standard deviation (education) λ	2.74	***	2.74	***
Correlation ε λ			-0.01	
Log-likelihood -127364	-127223		-127224	

Significance: '*'=10%; '**'=5%; '***'=1%.

Table 4. Relative risk of a second birth by spouse's education.

Estimates based on data from the China Family Panel Studies 2010-18

	Second births		Third birth	
Spouse's education	**Relative risk**	**Sig.**	**Relative risk**	**Sig.**
Less than primary	1.10	**	1.22**	
Primary	1		1	
Low secondary	0.95		0.95	
High secondary	0.86	***		
Tertiary	0.69	***		
Births	6189		1375	
Women	11354		6258	

Note: specification as in Model 2. For third births the "low secondary" category includes higher educational levels. Significance: '*'=10%; '**'=5%; '***'=1%.

Table 5. Relative risk of a second or third birth by birth-cohort. Estimates based on data from the China Family Panel Studies 2010-18

Woman's education	**Birth-cohort**		
Second birth	**1960-69**	**1970-79**	**1980-95**
Less than primary	1.84***	1.53***	1.56***
Primary	1.45***	1	1.14
Low secondary	0.87**	0.69***	1.03
High secondary	0.48***	0.41***	0.77***
Tertiary	0.11***	0.22***	0.57***
Third birth			
Less than primary	1.75***	1.34**	1.54**
Primary	1.24*	1	0.96
Low secondary	1.05	0.62***	0.89
High secondary or tertiary	0.84	0.43***	0.44***

Note: specification as in Model 2. Significance: '*'=10%; '**'=5%; '***'=1%.

Table 6. Relative risk of a second birth: interaction between education and fertility control policy. Estimates based on data from the China Family Panel Studies 2010-18

	Fertility control policy	
Woman's educational level	2nd child allowed	2nd child not allowed
Less than primary	1.28***	1.15**
Primary	1	0.80***
Low secondary	0.87**	0.51***
High secondary	0.79**	0.28***
Tertiary	0.63***	0.13***

Note: specification as in Model 2. Significance: '*'=10%; '**'=5%; '***'=1%.

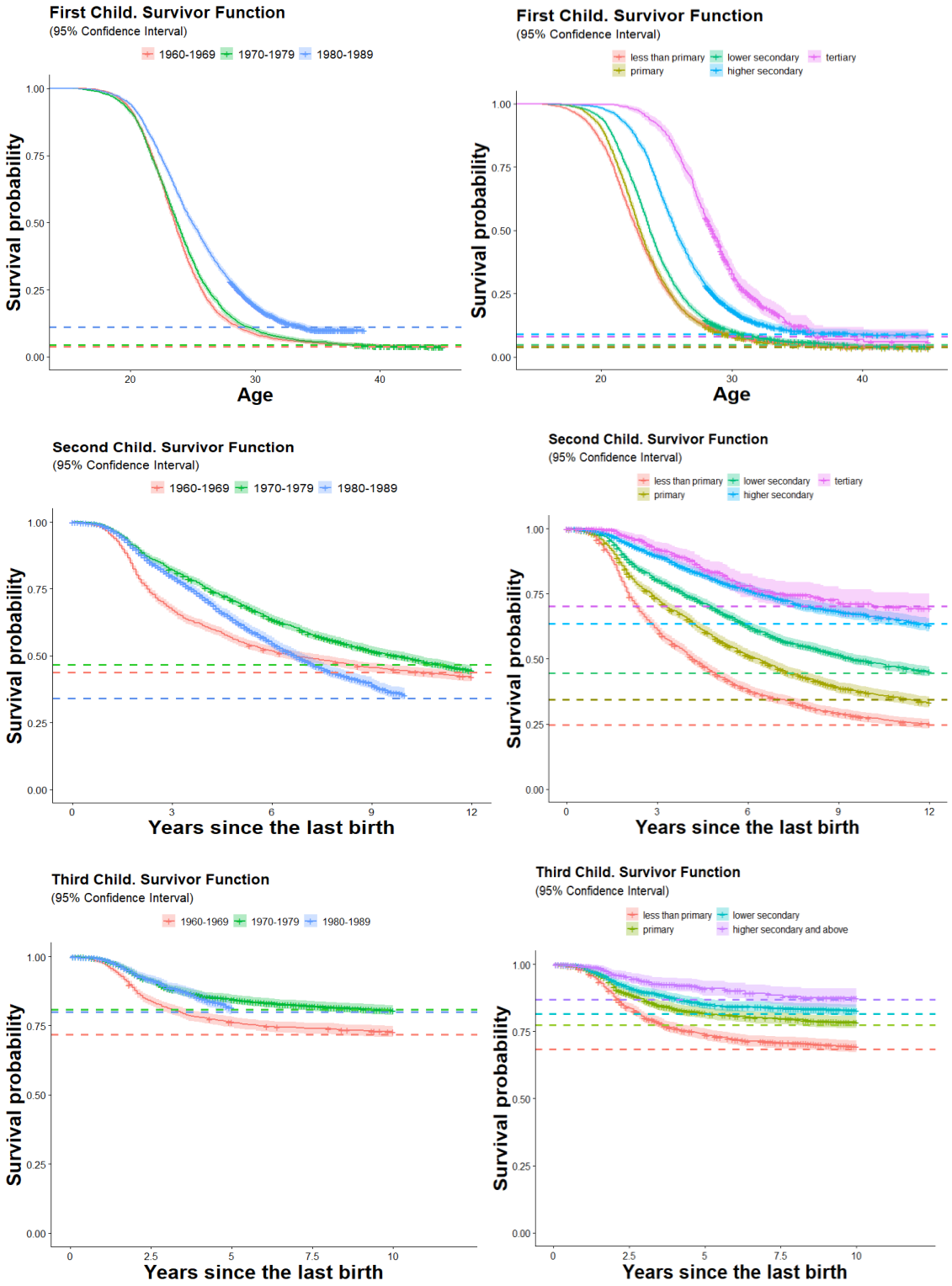

Figure 1. Survivor function of the first, second and third births by women's birth cohort (left graphs) and highest obtained education level of the woman. Note: the survivor function is based on the birth date of the children rather than the conception date.