Anticipated Fertility and Educational Investment: Evidence from the One-Child Policy in China *

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Abstract

Does future anticipated fertility affect educational investment? Theory suggests that the number of children planned in the future can affect the returns to education, the resources available for family consumption and the incentives to find a partner. This paper uses varying eligibility criteria for second child permits during the One-Child Policy in China as a natural experiment, which provides plausible exogenous variation in the cost of the second child. I use second child permits that are conditional on time-invariant individual characteristics and show that they have a strong positive effect on the likelihood of having a second child between 1990 and 2005. They are therefore expected to change anticipated fertility among compliers. I find that fulfilling an eligibility criterion at secondary school age increases the time invested in education and the likelihood of continuing schooling after middle school. The effect appears concentrated in the subset of compliers: individuals who increase their anticipated number of children as a response to eligibility. It can be explained by the high cost of raising children, by the second child having at most a short-term effect on parental labour supply and by concerns about finding a spouse.

Keywords: Fertility, Schooling Investment, Family Planning, China

JEL Classification Numbers: I25, I26, J13, J24, O15.

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1 Introduction

Educational and fertility choices are major life decisions that are deeply interconnected. The microeconomics literature has largely focused on the effect of parental education on fertility (e.g. McCrary and Royer (2011), Osili and Long (2008), Duflo et al. (2015), Lavy and Zablotsky (2015)). The reverse question has rarely been addressed: Do individuals who anticipate having more children invest differently in education than those who anticipate none or fewer? Answering this question is challenging because the number of children one plans to have in the future is usually unobserved. Even if observed, it is highly correlated with other variables that affect the demand for education.

Theory suggests that children can affect labour supply and the income available for family consumption. The desire to have children can also strengthen the incentives to find a partner. Therefore, the anticipated number of children can have an effect on the returns to education and the marginal utility of income. The sign of the overall effect is ambiguous but important. Faced with ageing societies, policy-makers in many high-income countries are eager to encourage childbearing. Child benefits, free childcare and paid parental leave are policies implemented or discussed in most low fertility countries. They incentivize increased fertility by reducing the costs associated with having children. How do such reforms influence educational investment? Do they have the side effect of keeping future parents from investing in education?

This paper uses variation in the strictness of the One-Child Policy in China to estimate the effect of anticipated fertility on educational investment. While one child per family was the norm, having another child was allowed with a "second child permit". The eligibility criteria for these permits were set on the provincial level. This natural experiment provides plausible exogenous variation in the costs of having a second child. Several criteria were conditional on observable characteristics that are time invariant, such as ethnicity or household registration status. This allowed younger individuals and their families to predict if they would be eligible in the future. If second child permits based on such characteristics have a strong effect on fertility outcomes, they are expected to have an effect on anticipated fertility.

The criteria for second child permits varied over time and between provinces, and are not directly related with provincial educational policies. This allows me to use difference-in-differences (DID) and double DID identification strategies (also often called triple differences approach). I calculate whether individuals fulfil a second child permit criterion at the age when they usually finish mandatory secondary school. At this point, they and their family must decide whether to continue with voluntary senior high school. I find that fulfilling a second child permit criterion significantly increases schooling. Between 1990 and 2005, eligible individuals spend on average around 0.9 years more on education. The likelihood of enrolment into higher secondary school is nearly 10 percentage points higher. The effect is stronger for men (but not significantly so); the effect for women is positive but insignificant at around 0.6 years of education.

To affect anticipated fertility, permits need to have an actual impact on fertility outcomes. I use the same second child permit criteria as before and calculate the eligibility status at the mean age when individuals decide to have a second child, for an older cohort. I find that eligibility increases the likelihood of having a second child by around 14 percentage points. This is an important effect but it also shows that not all individuals change their fertility decision once they become eligible.

Some individuals and their families might plan two children independent of their eligibility status. Yet, they still benefit from not having to pay monetary fines once they are eligible. I use the population of those not eligible in the older cohort as the training sample for a random forest estimation. It predicts if individuals would have a second child even when they are not eligible. As expected, I find that the fertility outcome of those predicted to have a second child without permits is not influenced by eligibility. Furthermore, the effect of eligibility on enrolment into higher secondary school is significantly lower. This suggests that the positive effect on schooling investment comes from compliers: those who increase their anticipated fertility from one child to two as a response to becoming eligible. Further treatment heterogeneity analysis suggests that men in provinces with a skewed sex ratio are the most affected.

Primary and secondary schooling decisions are typically made before individuals have children. However, individuals, together with their own parents, might take into account how many children they plan to have in the future. First, children can be an important cost factor that decreases the monetary resources available for other family members' consumption. To prepare for the additional cost in the future, families can use educational investment to smooth consumption over time (intertemporal consumption smoothing effect). This channel is particularly important when individuals have to financially support their own parents at the same time as raising their children. Second, children can also affect the time their parents spend working in the labour market. The income loss increases in the parents' educational level and has an effect lifetime returns to education. The less time the parent can spend in the labour market, the lower are the pay-offs from education (labour supply effect). Third, individuals who want to have children in the future might have a higher incentive to find a partner. If the sex ratio is skewed, individuals of the more frequent sex compete for partners. They can use education to increase their chances (marriage market effect). In section 3, I use a two period model to demonstrate these channels and highlight the assumptions needed.

This paper looks at the effect of anticipated fertility on schooling investment in a low fertility setting. The findings suggest that higher anticipated fertility can increase educational investment. Thus, policies that encourage childbearing can have positive side effects on education. However, labour market conditions are important. I show that if there are not labour supply consequences of children, higher costs of raising children increases the effect of anticipated fertility on education. Wanting children thus does not have a negative effect on education if parents can quickly return to the labour market after childbirth. It is important that they do not have to fear lower returns to education than their childless co-workers. Under constant absolute risk aversion, I show that the effect of anticipated fertility on education is decreasing in the loss of working time due to childcare.[1]

It is not difficult to claim that the conditions for a positive effect are met in China. Nowadays, raising children is considered very costly. An important share of family income is usually spent on children's education. For a family with two children, educational expenditure accounts for up to 30% of available family income. Furthermore, parental labour supply and income are not affected in the long-run by having a second child. Women with a second child work and earn less than women with only one child for at most 3 years and then catch up. Other studies find no or little evidence on the negative effects of fertility on parental labour supply (Guo et al. (2017), He and Zhu (2016)).

[1]This paper also assumes that individuals can plan their fertility outcome and the timing of their pregnancies. This is an appropriate assumption for many high and middle-income countries, including China. A distinct but connected strand of literature looks fertility uncertainty. Contraceptive methods give women certainty over the pregnancy consequences of sex and thus decrease the risk of tertiary schooling investment (Goldin and Katz (2002), Ananat and Hungerman (2012), Miller (2010)).

1.1 Links with the Literature

Theoretical growth models and country level empirical work usually connect low fertility rates and high human capital investment (Becker et al. (1990), Rosenzweig (1990), Kalemli-Ozcan (2003)). Within a given setting, having many children is often correlated with lower levels of parental education. Several papers focus on identifying the causal effect of education on fertility outcome. They usually use shocks to the supply of education to address the issue of unobserved variables being correlated with both fertility and education and the decisions about them being taken simultaneously (e.g. Duflo et al. (2017), Osili and Long (2008), Fort et al. (2016)). In this paper, I use a shock to the cost of children to look at the reverse question.

Female education is often associated with lower fertility rates (Osili and Long (2008), Lam and Duryea (1999), Schultz (1997), Duflo et al. (2015), Duflo et al. (2017), Lavy and Zablotsky (2015)). The main economic argument is that the opportunity costs of having a child for an educated woman are higher than for a non-educated woman (Becker (1981)). Education can also increase the knowledge of contraception methods (Rosenzweig and Schultz (1989)) and the bargaining power of women who want fewer children than men (Manser and Brown (1980)). By raising women's income, education can shift the fertility choice toward fewer children of higher quality (Becker (1960), Becker and Lewis (1973), Willis (1973)). This result, however, does not necessarily hold for developed countries (Fort et al. (2016), McCrary and Royer (2011), Monstad et al. (2008)).

An important share of papers in the fertility and education literature focus on the quality-quantity trade-off. In the theoretical framework based on Becker and Lewis (1973), parents trade-off between the number of children and how much they invest in each child. The One-Child Policy in China has been used to evaluate this trade-off empirically (Qin et al. (2016), Li and Zhang (2016), Rosenzweig and Zhang (2009), Qian (2009)). This paper goes one step further. Given the number of children, parents take into account the number of grand-children when they make investment decisions.

Recent work by Huang et al. (2016) is the most closely related. However, they only use regional variation in monetary fines that I find has no effect on either schooling investment or on fertility choice. They also assume that an increase in monetary fines decreases anticipated fertility and do not discuss that it might increase the cost of a second child while keeping anticipated fertility constant.

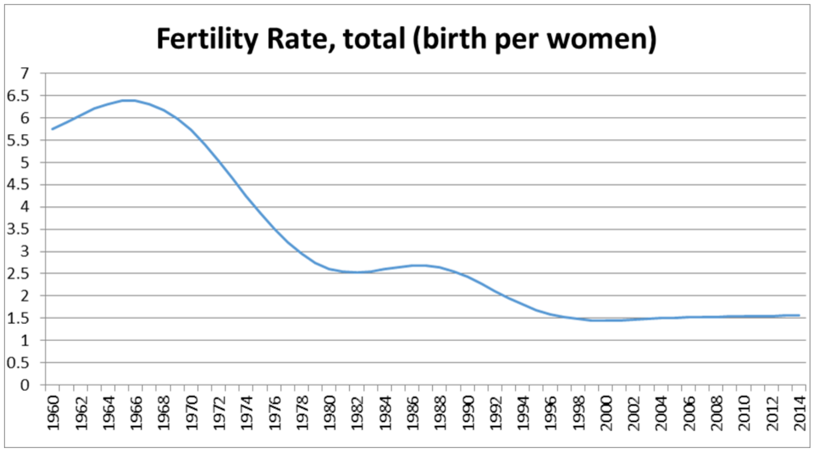
The exemptions for ethnic minorities have been used to study inter-ethnic marriages (Huang and Zhou (2015)) and ethnic identity (Jia and Persson (2017)). As this paper, they imply that on top of having fertility consequences, the One-Child Policy shaped many other socioeconomic decisions.

2 Context: The One-Child Policy, second child permits and education in China

Empirical identification relies on exogenous variation in the cost of having another child. The OCP in China between 1979 and 2015 was based on the goal of one child per family, setting out fines and penalties for the birth of a second child. At the same time, provincial governments could issue permits for the second child and in rare cases for the third. The criteria under which one could apply for such a permit changed over time. This section describes the policy and its regulations, as well as the functioning, motivation and implications of second child permits.

Family planning has been of particular importance to the Chinese government for the past decades. After the Great Famine (1959-1961), the central government promoted ambitious family planning policies. These include the “Later, Longer, Fewer” campaign from 1971-1979, the OCP from 1979-2015 and the recent Two-children policy. During the “Later, Longer, Fewer” campaign, the government promoted later marriage, longer birth intervals and fewer children. One child per family was optimal and two was acceptable for urban couples, three for rural couples. Penalties were introduced for those who did not comply (Whyte et al. (2015)). Birth control and abortion were promoted. The campaign also included a strong element of coercion. Women, mainly in rural areas, were pressured to abort out-of-quota children and to get sterilized after the birth of the third child (Whyte et al. (2015)). Fertility rates in China fell sharply during this period (see figure 1), though there is no consensus about how much of the fall was due to measures specifically targeting fertility. The OCP was introduced after the sharp drop in fertility rates.

Between 1978 and 1980, the central government introduced the goal of one child per family. Provinces were to implement this goal by setting fines for the birth of a second child and by providing birth control measures. Between 1979, the policy was rolled out on a county-to-county



Source: World Bank. It uses the World Bank definition of Total Fertility Rate. It is calculated as the average number of children that would be born to a woman if she were to experience the exact current age-specific fertility rates through her life.

Figure 1: Fertility rate in China, 1960 - 2014

bases (Qian (2009), Almond et al. (2013)). However, in rural areas where the one-child limit met significant resistance, implementation was delayed (Baochang et al. (2007)). In 1983, the OCP precipitated a huge wave of abortions and sterilizations (Whyte et al. (2015))[2].

Between 1982 and 1984, provincial governments started to issue more or less formal guidelines under which conditions married or remarried couples could apply for a second child permit. Thereby, they relaxed the one child per family limit significantly (Scharping (2013)). Between 1986 and 1991, provincial governments produced official family planning regulations which outlaid in detail the different criteria. Most of them were revised at least once in the 1990s and again after 2001. While transparency about family policies increased, the use of coercive measures such as forced abortion and sterilization dropped substantially (Whyte et al. (2015)).

The 1980s represent the time of introduction and adjustment of the policy, whereas the 1990s and 2000s represent a time of stability from a family policy perspective. Transparency of the policy measures is important to form adequate fertility expectations. This motivates using the time frame of 1990 to 2005 for the empirical evaluation. Furthermore, the 1980s coincide with the implementation of the Law on Nine-Year Compulsory Education. The law was introduced to attain universal education for nine years: six years at primary school (from age 6/7 to 12/13) and three years at junior high school (from age 12/13 to 15/16). After junior high school, students can

[2] 14.4 million abortions, 20.7 million sterilizations and 17.8 million IUD insertions (Whyte et al. (2015))

voluntarily continue with general or vocational senior high school. Therefore, the first and most relevant educational investment decision is taken when the child is around 16 years old.

During the OCP, couples that wanted to have a child had to apply for a permit allowing them to do so and only married couples were able to apply. Couples that had a second child without a second child permit officially had to pay monetary fines. These were set as a function of the couple's income (Scharping (2013)). Couples with higher income thus had to pay higher fines in absolute terms. Additionally, parents potentially faced non-monetary penalties. These included losing their job or having their career opportunities restricted. There is no accessible data on the enforcement of monetary fine and how frequent other social penalties were. Couples officially had to obtain the second child permit before having the second child. However, this posed a significant financial burden to local rural governments. Second child permits were presumably given out after the birth if the couple fell into an exemption category (Scharping (2013)).

Eligibility criteria for second child permits varied on the provincial level and between rural and urban areas. The household registration status (*hukou*) was an important determinant for eligibility. It is either agriculture/rural or non-agricultural/urban. Couples could only apply for a child permit at their place of household registration. This restricted strategic between-province and urban-rural migration. Most exemptions also required that the applicant respect late childbirth (birth of the first child after age 24 for women) and an acceptable birth interval (between 4 and 7 years).

Provinces introduced several different exemptions over time for different reasons. The most known is the policy that allowed couples in rural areas whose first-born was a girl to have a second child. In five provinces, couples living in rural areas were always allowed to have two children (Baochang et al. (2007))[3]. These exemptions were introduced to appease the rural population and to ensure sufficient labour in the agricultural sector.

Couples from ethnic minorities were often allowed to have two children or were even completely exempted from the policy. However, this depended on the province, if the couple lived in a rural or specific minority area and sometimes on the size of the minority population. The fertility policies for ethnic minorities depended on the strategy the province uses toward those minorities. Autonomous

[3] The provinces are Hainan, Yunnan, Qinghai, Ningxia and Xinjiang. In the province of Guangdong, couples with a rural household status were also allowed to have two children until 1998 (Scharping (2013)).

regions generally had more lenient fertility constraints for minority couples. Most autonomous regions are not included in this study as the individual data set does not cover those regions.

Following a statement from the central government, all provinces at some point introduced the criterion that if one or both spouses were an only child they were eligible. This policy was motivated by the idea that the one-child-per-family policy should only hold for one generation. Provinces implemented this criterion over the course of the 1990s to early 2000.

There were specific exemptions for certain occupational groups such as fishermen and mine workers, as well as for veterans. Some provinces also had rules for couples who already adopted a child or that had their first child overseas. These policies are not taken into account here because they are not observable or can be anticipated at the age of 16. The category of couples with "real difficulties" is the vaguest and potentially flexible one. This makes an evaluation impossible without governmental application and acceptance data.

To summarize, I use the following criteria for the empirical analysis:[4]

1. In five provinces, couples in rural areas were allowed to have two children. In the province of Guangdong, second child permits were given to couples in rural areas until 1998.

2. Couples living in rural areas whose first child is a girl can anticipate being eligible with a likelihood of 50%.[5]

3. Couples in which one or both spouses belong to a national minority can have two children. This can apply to the whole province, the rural area or a specific minority area.

4. Couples in which one or both spouses are an only child can have two children.

3 Model

The motivation of the theoretical part is two-fold: First, it illustrates different channels through which anticipated fertility can affect educational investment in the most traceable form. Second, the

[4] Specific exemptions I also use: In Jiangsu province, men can have a second child if the first born is a girl and they do not have a brother. In Jilin province, in rural areas, if one spouse is an only child and the first born is a girl, the can have a second child.

[5] 50% is an approximation. However, there are no reports of couples falling into that exemption that tried to avoid having a son as the first child. The main simplification is that I ignore sex differences in the cost-benefit analysis of parents.

model shows how different types of individuals react differently to a change in the cost of another child. Some anticipate to have another child, some do not change the number of children planned but benefit from not having to pay the fine. I use the results to guide the empirical investigation which aims at isolating group-specific effects. These two goals are achieved with a simple two-stage model, which can be extended for additional questions.

3.1 Set-up

In the model, a representative family consists of two parents and their child, the individual who is a teenager at the beginning. They must decide how much to invest in the education of the teenager in the present (period 1). In the future (period 2), the individual is grown up, married, earns income together with his/her spouse. The newly formed couple can have children themselves. The parents in period 1 are potential grand-parents. The family has to pay a fine for the second child if they are not eligible for a second child permit. The fine depends on the educational level of the now grown-up individual.

The educational decision and fertility decision are modeled as made by the family. There are some argument for this is a simplifying assumption. For one, the teenager can influence educational investment by making more or less effort and by persuading the parents of their school choice. Parents can influence the teenager's fertility decision by passing on their own fertility preferences and by offering their help raising their grand-children. This is particularly persuasive in China where the family is still the most important social unit for many individuals. Also, grand-parents draw important benefits from having grand-children. They are invested in the continuation of their family line, besides other biological, social and altruistic motivations. However, they may see having grand-children as being particularly costly. While the the grown-up teenager raises the children, less resources are available for the then grandparents. This can overlap with the time when they are retired and have financial and care needs.

In the model, the educational investment stage and the reproductive stage do not overlap. This is realistic with regard to primary and secondary education in China, which are usually finished before starting the reproductive stage. In China, the minimum age for marriage is 20 for women and 22 for men and individuals are strongly discouraged from having children without being married.

Period 1 "the present"

In period 1, the family consumes c^1. The income Y of the family is given exogenously and is used for consumption, investment in education I or saving s. Utility in period 1 is given by

$$u(c^1) = u(Y - \eta I - s) \tag{1}$$

where $u(.)$ is the utility of consumption, assumed to be strictly increasing and concave. $\eta > 0$ is the constant cost of education, Y the exogenous income, I the educational level of the focus child and s the level of savings. I assume that families are credit constrained such that $s \geq 0$.

Period 2 "the future"

In period 2, the teenager is grown up and married. The income earned is consumed by the family and spent on the n children the newly formed couple has. The family gets utility from having children which is I assume is additively separable from the utility of consumption.

Utility in period 2 is given by:

$$u(c^2) + \alpha_i h(n) = u(y(I, J, n) + Rs - p(I, n, Z) - f(n)) + \alpha h(n) \tag{2}$$

where $p(I, n, Z)$ indicates the fine that the family has to pay with $Z \in \{0, 1\}$ indicating eligibility status. The fine is dependent on the educational level of the teenager I. This reflects the fact that monetary fines are dependent on the household income and that the family might have to pay non-monetary fines such as losing the job or not being promoted. The fine is 0 for the first child and only has to be paid when the family is not eligible for a second child permit (i.e $Z = 0$):

$$p(I, n, Z) = \begin{cases} 0 \;\; if \; n = 1 \\ 0 \;\; if \; n = 2 \;\&\; Z = 1 \\ \rho(I)(n-1) \;\; if \; n \geq 2 \;\&\; Z = 0 \\ \rho(I)(n-2) \;\; if \; n \geq 2 \;\&\; Z = 1 \end{cases} \tag{3}$$

$f(n)$ is the cost of raising n children (strictly increasing and concave), $\alpha h(n)$ represents the utility of having children (strictly increasing and concave), with α being an individual fertility preference parameter drawn from a given distribution. $y(I, J, n)$ is the household income, assumed to be strictly increasing and concave in the educational level I, the spouse's educational level J and decreasing in the number of children n. For now, we assume that the educational level of the spouse J is exogenous. J is endogenized in section 3.4. An example is an income generation function that remunerates individuals for each hour worked multiplied by their productivity : $y(I, n) = (T - \mu n)P(I)$. Productivity $P(I)$ is a concave function of education and T is the maximum time an individual can work. Working hours decrease μ for each child. One can interpret T as the number of years an individual works in his/her life where the number of children decreases the years of working.

Given their fertility preferences and eligibility status, family i solves:

$$\underset{I,s,n}{max}\; u(Y - \eta I - s) + \delta[u(y(I, J, n) + Rs - p(I, n, Z) - f(n)) + \alpha h(n)] \tag{4}$$

with δ as the discount factor.

3.2 Optimal educational level and optimal number of children

Maximising with respect to education gives the optimal level of education as a function of the number of children n:

$$u'(c^2)\left[\frac{\partial y(I^*, J, n)}{\partial I^*} - \frac{\partial p(I, n, Z)}{\partial I^*}\right] = \frac{\eta}{\delta}u'(c^1) \tag{5}$$

The number of children affects educational investment by decreasing family consumption in the second period, by affecting the returns to education directly through $\frac{\partial y(I^*,J,n)}{\partial I^*}$ and indirectly through $\frac{\partial p(I,n,Z)}{\partial I^*}$ when the number of children is higher than 1.

Maximising utility with respect to n gives us the optimal number of children as a function of education:

$$u'(c^2)\left[\frac{\partial p(I, n, Z)}{\partial n} + \frac{\partial f(n^*)}{\partial n^*} - \frac{\partial y(I, J, n^*)}{\partial n^*}\right] = \alpha\frac{\partial h(n^*)}{\partial n^*} \tag{6}$$

On the left-hand side is the marginal (opportunity) cost of having n^* children. It consists of the marginal cost of raising and educating n^* children ($\frac{\partial f(n^*)}{\partial n^*}$), the fine if the family has more than one child and a decrease in income due to shorter working hours. On the right-hand side is the marginal benefits of having n^* children. The effect of education on the optimal number of children reflects standard results: Education increases income and thus makes having children less costly. However, education also increases the opportunity cost of having children through $\frac{\partial y(I,J,n^*)}{\partial n^*}$. Higher education also implies having to pay a higher fine for the second child, increasing the cost of having another one.

Maximising with respect to savings adds the following constraint:

$$R = \frac{u'(c^1)}{\delta u'(c^2)} \tag{7}$$

3.3 Effect of 2nd child permits

I focus my attention to the choice set for the number of children being either one or two ($n \in [1, 2]$). This encompasses the choice set of the majority of Chinese (the theoretical discussion easily extends to an unrestricted choice set). The number of children is a discrete variable and there is no fine for the first one. Therefore, eligibility does not necessarily change the optimal number of children given by equation 6. The effect of the exemption depends on if eligibility changes anticipated fertility or not. There are three cases (with the standard policy evaluation names in brackets):

1. **Always one child (never-takers)**: $n^*(Z = 0) = 1$ and $n^*(Z = 1) = 1$

   The optimal number of children with eligibility or without is the same. The family is unaffected by the exemption.

2. **Always two children (always-takers)**: $n^*(Z = 0) = 2$ and $n^*(Z = 1) = 2$

   The fertility decision is not altered by the eligibility status because the family always wanted two children. But the family benefits from not having to pay the fine for the second child.

3. **Increasers (compliers)**: $n^*(Z = 0) = 1$ and $n^*(Z = 1) = 2$

   Becoming eligible, the optimal number of children increases by one child.

The model disregards any level of uncertainty and assumes full information. To illustrate the basic mechanisms, this model suffices. As the model does not have uncertainty, it is known in which category the family will fall. [6]

Second child permits affect the educational investment of *Increasers* and *Always-2-children* as followed:

Always 2 children:

Optimal education with $Z = 0$:

$$u'(y(I^*, J, 2) + Rs - \rho(I^*) - f(2)) \left[\frac{\partial y(I^*, J, 2)}{\partial I^*} - \frac{\partial \rho(I^*)}{\partial I^*} \right] = \frac{\eta}{\delta} u'(Y - \eta I^* - s) \tag{8}$$

Optimal education with $Z = 1$:

$$u'(Y(I^*, J, 2) + Rs - f(2)) \left[\frac{\partial y(I^*, J, 2)}{\partial I^*} \right] = \frac{\eta}{\delta} u'(Y - \eta I^* - s) \tag{9}$$

Being eligible has two opposing effects:

Intertemporal consumption smoothing: Eligibility decreases the marginal utility of consumption in period 2 ($u'(c^2)$) because the fine $\rho(I)$ does not have to be paid any more. This decreases education because the family responds with higher consumption and lower educational investment in period 1.

Returns to education: Eligibility increases the returns to education by $\frac{\partial \rho(I^*)}{\partial I^*}$ because the fine is dependent on income which increases in education.

Since there are two potential opposing effects, the total effect can be negative or positive.

Increasers:

Optimal education with $Z = 0$:

$$u'(y(I^*, J, 1) + Rs - f(1)) \left[\frac{\partial y(I^*, J, 1)}{\partial I^*} \right] = \frac{\eta}{\delta} u'(Y - \eta I^* - s) \tag{10}$$

[6] One could easily include for example uncertainty in the income gained in period 2 by adding a random shock to the income term. Given the distribution of this term, one knows the distribution in the type of family. For example, a family with a given α could an *increaser* with 80% likelihood and *always-2* with 20% likelihood.

Optimal education with $Z = 1$:

$$u'(y(I^*, J, 2) + Rs - f(2)) \left[\frac{\partial y(I^*, J, 2)}{\partial I^*} \right] = \frac{s}{\delta} u'(Y - \eta I^* - s) \tag{11}$$

Again, eligibility has two effects:

Intertemporal consumption smoothing: Eligibility increases the marginal utility of consumption in period 2 ($u'(c^2)$) by increasing spending on children by $f(2) - f(1)$. Also, the grown-up child earns less due to having to care for two children (when $y(I^*, J, 1) > y(I^*, J, 2)$). Marginal utility of additional earning in the future increases and the family uses education as a way to shift consumption from period 1 to period 2, such that equation 5 holds.

Labour supply and returns to education: Eligibility decreases the returns to education if the grown-up child has to cut productive working hours ($\frac{\partial y(I^*,J,2)}{\partial I^*} < \frac{\partial y(I^*,J,1)}{\partial I^*}$). This decreases returns to education and thus decreases the incentives to invest in education.

The sign of the overall effect is discussed in the appendix in section using as an example the income generation function $y(I, n) = (T - \mu n)P(I)$. The effect is positive if the intertemporal consumption smoothing effect is stronger than the labour supply effect.

When the cost of children increases, this strengthens the income smoothing channel. However, it also enforces the labour supply effect as the lost income due to a reduction in working hours is more painful. If there is no labour supply channel, higher cost of raising children unambiguously increases the effect of anticipate fertility on education. Also, if we assume constant absolute risk aversion (CARA), higher costs of raising children always increases the effect.

I also discuss the effect of the loss in working time due to child care in the appendix (section 9.3.3). A higher loss in working time increases the labour supply channel and has an ambiguous effect on the income channel. If we assume CARA, less working time lost due to a child (i.e. a the smaller μ) increases the effect of anticipated fertility on education.

These factors are summarized in the following proposition:

Proposition 1 *Assuming, CARA, the overall effect of anticipating another child on education:*

1. *increases in the cost of raising a child $f(n)$,*

2. *decreases in the loss of working time due to childcare δ.*

Proofs are in the appendix in section 9.3.3 and 9.3.2.[7]

3.3.1 The type of family according to fertility preferences α

The effect of the policy depends on if the family is behaving as an *always-2*, *always-1*, or *increaser*. It depends on the exogenous parameters α and gives the following comparative statics: For given cost and fine levels, families with a low fertility preference α are *always-1*, those with a medium α are *increasers* and those with a high α are *always-2*. This is illustrated in figure 4 in the appendix. Define the threshold $\underline{\alpha}$ as the α at which for $Z = 1$, equation 6 is equal for $n = 1$ and $n = 2$. Define the threshold $\bar{\alpha}$ as the α at which at $Z = 0$, equation 6 is equal for $n = 1$ and $n = 2$.

Proposition 2 *If*

1. $\alpha < \underline{\alpha}$*: the family has 1 child independent of eligibility (always-1).*
2. $\alpha > \underline{\alpha}$ *and* $\alpha < \bar{\alpha}$*: the family has one child if not eligible and two children if eligible (increaser).*
3. $\alpha > \bar{\alpha}$*: the family has two children in any case (always-2).*

This follows from the fact that the number of children n^* is increasing in α and by the definition of the thresholds. More interestingly, how do these threshold change according to other variables?[8]

Proposition 3 *The threshold* $\bar{\alpha}$*, above which the family is an always-2,*

- *decreases in cost of raising a child* $f(.)$*,*
- *decreases in fines* $\rho(.)$*.*

The threshold $\underline{\alpha}$*, above which the family is an increaser*

- *decreases in cost of raising a child* $f(.)$*,*
- *is unaffected by the fines* $\rho(.)$*.*

[7]Furthermore, assume the hourly wage depends on productivity $P(I)$ multiplied by a factor τ which captures technology or labour market conditions. Assuming CARA, the the effect of anticipated fertility on education increases with τ. This is shown in section 9.3.4.

[8]Another section will be added to the appendix illustrating these results.

Second child permits should not have any effect on the always-1. A positive or negative overall effect can be driven by families that are *benefiters*, or *always-2*, or both of them. Proposition 2 helps to empirically disentangle the overall effect of second child permits on schooling investment, by differentiating between the effect it has on individuals that are *increasers* and *always-2*.

3.3.2 Effect on saving

In this model, saving and educational investment are both tools to smooth consumption. Denote E_I the net returns to education $\frac{1}{\eta}\left[\frac{\partial y(I^*,J,n)}{\partial I^*} - \frac{\partial p(I,n,Z)}{\partial I^*}\right]$, such that the first order condition 5 can be rewritten as:

$$E_{I^*} = \frac{u'(c^1)}{\delta u'(c^2)} \tag{12}$$

The family uses only education if at $I = I^*$ given by equation 5 $E_{I^*} > R$ (case i). It uses only savings if at $s = s^*$ given by equation 7 $E_{I^*} < R$ (case ii). It uses both if at $I = I^*$ and $s = s^*$ $E_{I^*} = R$ (case iii).

Intertemporal consumption smoothing: If with anticipated fertility the need for intertemporal consumption smoothing increases, in case i, the family uses educational investment for smoothing until either $E_{I^*} = \frac{u'(c^1)}{\delta u'(c^2)}$ or $E_{I^*} = R$. In case ii and iii, because the returns to savings are linear and the returns to education are decreasing, the family only uses savings to smooth. However, under certain assumptions, the family increases investment in education and savings as a reaction to increased anticipated fertility. For example, when educational investment is considered safe and savings are considered risky (or the other way around).

Labour supply effect: Higher anticipated fertility decreases the expected labour supply and thus the returns to education. This can tilt the favour towards using savings rather than educational investment for consumption smoothing.

3.4 Gender differences and marriage

In this section, I distinguished between families with male or female focus child. I also consider marriage market returns to education. First, I assume that spouses match positive-assortatively on educational levels. The spouse's educational level J is a function of own education I: $J(I) = \sigma I$

with $0 < \sigma \leq 1$. This captures the correlation between the educational levels. Furthermore, I assume that only women reduce their working hours when they have a child and that the spouses' incomes enter additively. Both assumptions are in line with descriptive statistics (see section 7).

The maximisation problem of a family with a daughter is:

$$\max_{I,s,n} u(Y - \eta I - s) + \delta[u(y(I, n) + y(J(I)) + Rs - p(I, n, Z) - f(n)) + \alpha h(n)] \tag{13}$$

$$u'(c^2)\left[\frac{\partial y(I^*, n)}{\partial I^*} + \frac{\partial y(J(I^*))}{\partial J(I^*)}\sigma - \frac{\partial p(I, n, Z)}{\partial I^*}\right] = \frac{\eta}{\delta}u'(c^1) \tag{14}$$

Families with a daughter who anticipates a reduction in working hours expect to experience the *labour supply effect*. However, this effect gets mitigates by the returns to education in the marriage market $\frac{\partial y(J(I^*))}{\partial J(I^*)}\sigma$. While the labour market returns to education $\frac{\partial y(I^*,n)}{\partial I^*}$ depend on the number of children, the marriage market returns do not. The stronger the correlation of educational levels, the better the daughter's educational investment can be used for intertemporal consumption smoothing. For families with sons, it is the opposite. Though the marriage market returns to education are also positive, they decrease in the anticipated number of children.

However, for men, there might be another factor, relevant in this context. So far, I assume that everyone marries. I now introduce the possibility of staying single. If a person stays single in period 2, he/she ears income and does not have children: $u(c_s^2) = \tilde{y}(I)$. Denote c_m^2 the consumption in period 1 when being married and c_s^2 the consumption when staying single. Denote ω the probability of marrying in period 2 and τ the ratio of men to women. I assume that the marriage surplus, defined as the utility of being married minus the utility of staying single, is positive independent of the educational level of the individual and the potential spouse and the number of children: $u(y(I) + y(J(I), n) + Rs - p(I, n, Z) - f(n)) + \alpha h(n)) - u(\tilde{y}(I)) > 0, \forall I, n$. As a consequence, if there are as many men as women, then everyone gets married in period 2. If the sex ratio is skewed, all of those of the scarce sex get married and some of those of the abundant sex stay single. I assume that the likelihood of marriage for the abundant sex is a function of the sex ratio and the individual's education: $\omega(I, \tau)$.[9] We focus on the situation where there are more men than women,

[9]The assumptions is related to assuming non-transferable utility. In the transferable utility case, families could compensate a lack of education with monetary transfers. By restricting monetary transfers, through transaction cost,

which is the relevant case for China: $\tau > 1$. The utility of a man is then given by (FOC in the appendix):

$$\max_{I,s,n} u(Y - \eta I - s) + \delta[\omega(I,\tau)\underbrace{u(y(I) + y(J(I),n) + Rs - p(I,n,Z) - f(n)) + \alpha h(n)}_{\text{married}}) + (1-\omega(I,\tau))\underbrace{u(\tilde{y}(I))}_{\text{single}}] \tag{15}$$

Marriage market effect: An increase in the number of anticipated children implies a (weak) increase in the marriage surplus, because it increases the utility of being married but not the utility of being single. It increases the incentives to invest in education to increase the odds of finding a spouse to make the now more beneficial situation more likely.

Furthermore, keeping the number of anticipated children constant, a reduction in the cost of the second child due to second child permits increases the marriage surplus. Thus the incentives to invest in education in order to increase the likelihood of finding a spouse.

The marriage market effect are thus be positive for *increasers* and *always-2* alike.

Proposition 4 *An increase in anticipated fertility increases the incentives to invest in education to improve the odds of finding a spouse, given that the sex ratio is skewed.*

As in the previous sections, the general equilibrium effects are not taken into account. The likelihood of finding a spouse is not only dependent on own education but also the distribution of educational levels within the same marriage market. If several individuals within the same marriage market become eligible, this can change the educational distribution of the abundant sex.

3.5 The effect of fines on education

How does the amount of fines change the incentives to educate? Second child permits can be interpreted as a reduction in the cost of having a second child, and the size of the cost reduction depends on $p(I)$. The effect of these monetary fines is again different for different types of individuals. For *increasers*, defined as those that anticipate a second child only if they are eligible for

limited commitment or simply social norms, families have to use pre-marital investment such as education in order to make their child attractive in the marriage market. See for example Chiappori et al. (2006).

a second child permit, the size of the fine does not matter. However, as mentioned in proposition 2, how many *increasers* there are in the population depends on the size of fine. The higher the monetary fines, the higher the cost reduction due to 2nd child permits, thus the more people react to it.

On top of changing the composition in the population between *increaser* and *always-2*, the amount of the fines change the incentives to educate for *always-2*. Higher fines, as a function of household income, increase the need to smooth consumption intertemporally, but also have a stronger negative effect on education. Higher fines also strengthen the marriage market effect: not having to pay high fines increases the marriage surplus more than not having to pay low fines.

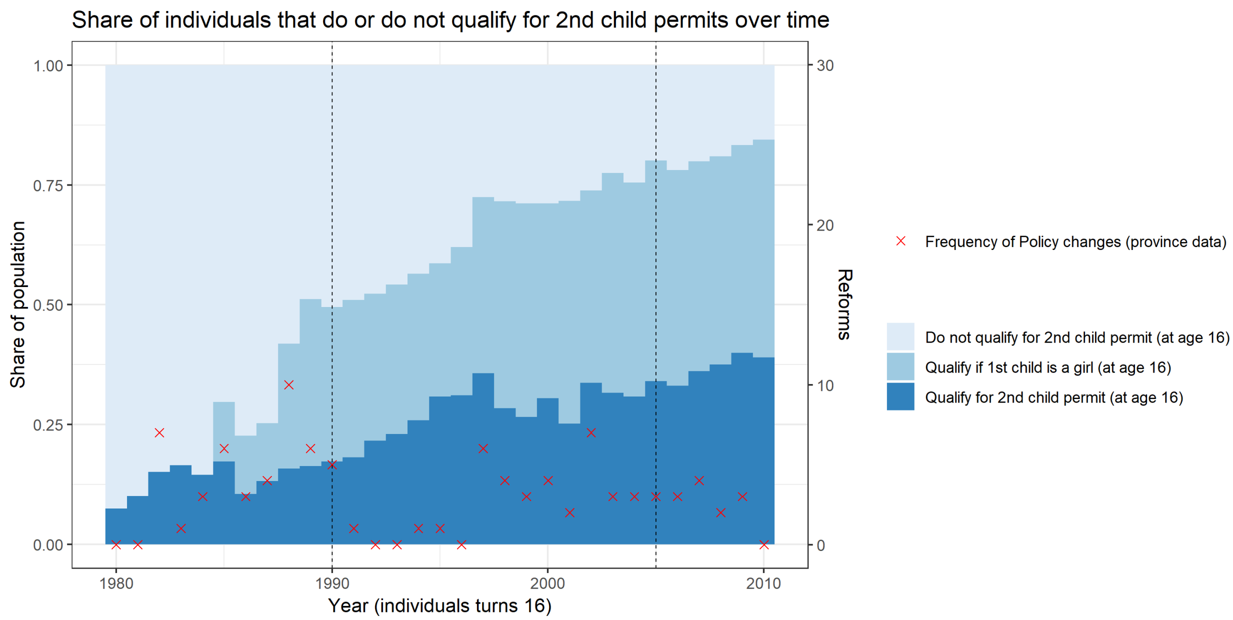
4 Data

4.1 Individual Data

For the empirical analysis, I use individual survey data from the 2010 China Family Panel Study (CFPS). It was designed by a Peking University research team, supported by Peking University 985 funds and carried out by the Institute of Social Science Survey of the Peking University. The dataset is available online in English and Chinese. Not all provinces are represented in the sample. In particular, the sample does not cover the autonomous regions of China except for Guangxi Zhuang. The main population is sampled from Gansu (12%), Henan (11%), Guangdong (9%), Shanghai (8.5%) and Liaoning (8.4%).

For the main cohort, I use individuals that turned 16 between 1990 and 2005 which leads to a sample of 7840 observations of which 53% are female. Summary statistics are displayed in table 5 in the appendix. The sample is predominantly rural: 70% hold an agricultural household status and 30% hold a non-agricultural household status. 89% of the sample indicate that they are of majority Han ethnicity. The main ethnic minorities in the sample are Miao (2.1%), Yi(2.3%) and Man (1.5%). On average, individuals stayed in school for 7.6 years (women: 7.1, men: 8.2). Those with a non-agricultural household status spend nearly twice as many years at school as those with agricultural household status (11.4 compared to 6.1).

Empirical identification relies on geographical and temporal variation in the eligibility criteria. Figure 2 illustrates the share of individuals that fulfilled an eligibility criterion at the age of 16. I differentiate between two categories: those that fulfil a criterion to have another child, and those that fulfil the criterion to have a second child if the first child is a girl (i.e. being eligible with a likelihood of approximately 50%). There was high variation at the beginning of the OCP between 1982 and 1990 when provinces introduced criteria for the first time. However, the variation is too high to allow individuals to form adequate expectations. In the time span between 1990 and 2005, there are some policy reforms are provinces update their criteria catalogues, but the policy setting is mostly stable.



Data Source for individual data: CFPS 2010. Figure shows if an individual qualifies for a second child permit the year they turn 16. Includes individuals that turn 16 between 1980 and 2010. Frequency of reform changes is based on province level data. Source: Scharping (2013), Baochang et al. (2007) and family planning regulations. One reform is defined as a change for one sub-group.

Figure 2: Share of population qualifyiny for 2nd child permit and incidences of second child permit reforms.

Those in the main cohort are too young to have finished their reproductive stage at the time of the survey. I am thus unable to use the number of children allowed at secondary school age as an instrument for the actual number of children. I use also individuals that turned 16 between 1980 and 1995 as the older cohort because they have already finished the reproductive stage. I use the older cohort to show the effect of second child permits on the likelihood of having a second child and to investigate treatment heterogeneity. Summary statistics for the older cohort are also displayed in table 5. As expected, educational levels are lower but other characteristics are the same (sex, ethnicity). There are also more individuals with an agricultural household registration status.

4.2 Policy exemptions

The information about province level policies is compiled from Scharping (2013), Baochang et al. (2007) and official family planning regulation documents. The documents were accessed online in Mandarin Chinese and translated into English. [10] An excerpt of the data is displayed in table 4 in the appendix. Based on this information, I calculate if at the time of educational decision-making an individual fulfils a second child permit criterion. The main educational decision is made around the age of 16. At this time, students on average must decide whether to continue with senior general or vocational high school after completing compulsory junior high school.

For the main analysis, I use those who turned 16 between 1990 and 2005. This has several reasons: First, only after 1990 Chinese citizens had official legal documents that they could rely on. Before, conditions for second child permits were only presented as guideline. It is debatable whether implementation and knowledge of exemptions were comparable between provinces. Second, I do not want to mix up the effects of the policy with the implementation time of the 1986 compulsory secondary school reform. To assure that in the year of the survey (2010), basic educational investment is finished, the upper threshold is set at 2005. Also, as previously mentioned, in this time span there are several reforms in different provinces but at the same time. Yet, the policy framework is sufficiently stable so that fertility anticipations can be formed based on the current policy situation.

5 Empirical methodology

The goal of this study is to isolate the effect of anticipated fertility on education. I denote I the educational outcome and $\tilde{N}$ anticipated fertility. Furthermore, denote with P the cost of an out-of-quota child. Ideally, one would want to estimate:

$$I_i = \theta_1 \tilde{N}_i + \theta_2 P_i + \mu_i \tag{16}$$

[10] This collection of policy information collected by Wanying Zhao is available upon request in English.

using anticipated eligibility $\tilde{Z} \in \{0, 0.5, 1\}$ as an instrument for $\tilde{N}$. The first stage would take the following form:

$$\tilde{N}_i = \beta \tilde{Z}_i + X_i + \epsilon_i \tag{17}$$

where X indicated individual-level characteristics that determine eligibility status, province fixed effects and time fixed effects. Conditioned on X, the anticipated eligibility status $\tilde{Z}$ is assumed to be uncorrelated with the error term ϵ.

5.1 Effect of eligibility on education

However, $\tilde{N}$ and P are unobserved. Instead, only the actual fertility outcome N is observed in the older cohort for which the actual eligibility status $Z \in \{0, 1\}$ is know after the birth of the first child. So what can be identified? Denote $I(\tilde{Z})|X$ the educational level dependent on anticipated eligibility at the age of 16 given characteristics X. I can identify the intention-to-treat effect $E(I(1)|X) - E(I(0)|X)$ which compares the educational level of individuals that fulfil a second child permit criterion at secondary school age with those that are not, with the following regression:

$$I_i = \tilde{\theta} \tilde{Z}_i + X_i + \tilde{\mu} \tag{18}$$

The intention-to-treat effect $\tilde{\theta}$, estimated in section 6.1, is a policy-relevant parameter. From theory we know that is is a weighted average of the effect of the policy on the three different groups *always-1*, *increasers* and *always-2*, which correspond to never-takers, compliers and always-takers (Angrist et al. (1996)). Other fertility policies, such as child benefits or paid parental leave, that change the costs of a child, would also affect compliers and always-takers. The intention-to-treat effect is thus a parameter of interest, as it indicates how the policy overall affects education. However, it is also of interest to understand how the two different groups react, in order to be able to make policy recommendations for other settings where the composition of the population is different.

In order to interpret the coefficient as the effect of the policy on compliers, one has to assume that the behaviour of the other groups is unaffected (exclusion restriction). In this context, it is easy to do for the group of *always-1*, but it is restrictive in the case of *always-2* since, as we have seen in the theory section, they benefit from not having to pay income-dependent fines.

The intention-to-treat effect can be decomposed into the effect on *increasers* which goes through anticipated fertility $\tilde{N}$ and on *always-2* whose effect goes through the fine for an out-of-quota child. By definition, *increasers* are those that change anticipated fertility from 1 to 2 as a response to eligibility, thus β is the share of *increasers* in the population. Denote π the share of *always-2* in the population and ρ the average amount of fines. The average effect of eligibility on out-of-quote fines then defines as: $E(P(1)|X) - E(P(0)|X) = \pi\rho$. Thus, the intention-to-treat effect can be decomposed into:

$$E(I1|X) - E(I(0)|X) = \theta_1[E(\tilde{N}(1)|X) - E(\tilde{N}(0)|X)] + \theta_2[E(P(1)|X) - E(P(0)|X)] \quad (19)$$

$$= \beta\theta_1 + \pi\rho\theta_2 \quad (20)$$

In the standard LATE case, the exclusion restriction implies that $\pi\rho\theta_2 = 0$: either there are no always-takers or always-takers are unaffected by the instrument Z. Furthermore, if anticipated fertility $\tilde{N}$ was observed, one can estimate β, the "take-up rate". Even if the take-up rate is unobserved, by assuming a non-negative effect of the instrument on take-up together with the exclusion restriction, one is able to identify the sign of the effect.

5.2 Effect of eligibility on fertility outcome

Since anticipated fertility is unobserved, β cannot be estimated. However, it is reasonable to assume that the anticipated eligibility status can only affect anticipated fertility when eligibility affects the fertility outcome. Fertility outcome N is observed in the older cohort, as is eligibility status $Z \in \{0, 1\}$ after the birth of the first child, so that we can estimate:

$$N = \tilde{\beta}Z + X + \epsilon \quad (21)$$

This regression provides an estimator of the take-up rate of the 2nd child permit categories included in Z. Results are discussed in section 6.2. One should keep in mind that there are criteria for 2nd child permits that are not included in Z because they are not observable or because they rely on the realization of the first birth or occupational choice. Therefore, $\tilde{\beta}$ is not the take-up rate of all 2nd child permits criteria. However, $\tilde{\beta}$ measures the effect of categories important for forming fertility anticipations.

5.3 Isolating the effect on *increasers*

In the older cohort, we observe individuals that have a second child without being eligible. Keeping in mind the caveat that some of those were eligible for different 2nd child permits, we can nonetheless use information gained from this cohort to decompose the overall intention-to-treat effect, under some assumptions, guided by the theoretical model.

In the theoretical model, fertility preferences determine if the individual is an *always-1*, *increaser*, or *always-2*. The share of *always-2* is denoted with π. I use the fertility proxies W to predict if an individual in the main cohort will be a *always-2* or not. For this, those not eligible in the older cohort are used to estimate the effect of W on the likelihood of having a second child:

$$Prob(N_i = 2|Z_i = 0, X) = f(\alpha W_i|Z_i = 0, X) \tag{22}$$

The purpose of this exercise is prediction and not inference, thus, the values of α are not of interest and only capture correlation, not necessarily causality. To get the highest predictive power and to account for potential non-linearities, I use a classification random forest with 500 trees, where the prediction is determined by majority rule at the respective node. The number of predictors used for each tree is determined by minimising the out-of-bag error rate.

The effect of the fertility predictors, based on the training set of those in the older cohort who are not eligible, is then extrapolated to the whole older cohort and the main cohort.Denote the prediction status of an observation L which can be either 0 (not predicted to be an *always-2*) or 1 (predicted to be an *always-2*). Regressions 26 and 18 are then run with L as an interaction term. We therefore observe the coefficients $\tilde{\theta}(L) = E(Y(1) - Y(0)|L)$.

Denote the share of *always-2* in the sample of those predicted to be *always-2* $\bar{\pi}$ and the share in the sample of those predicted to not be *always-2* $\underline{\pi}$. If the prediction is informative about the underlying distribution of *always-2*, then $\bar{\pi} > \pi > \underline{\pi}$. Under the assumption that the prediction is informative, the decomposition allows to make statements about the signs of the coefficients θ_1 and θ_2.

It is again useful to draw comparisons to the standard case in which $\tilde{N}$ is observed. In this case, we could estimate the share of *always-2* (π) and *increasers* (β). Once they are known this decomposition allows to estimate θ_1 and θ_2 separately (as shown in Hull (2015)).

6 Results

6.1 Effect of second child permits on education

The first and most relevant educational choice for most families is made when the focus child is 16 years old. This is the age at which I calculate anticipated eligibility. Educational attainment is first measured in years of education ($I_{ip\ in\ 2010}$). It is then replaced by a dummy variable indicating enrolment into senior high school and college or university. I estimate 3 different specifications. Each specification relaxes an assumption but also includes more control variables and thus puts more burden on the model. Specification 1 is a DID estimation that assumes a national trend (equation 22). It includes province fixed effects (now denoted γ), province-specific effects (denoted κ), characteristics defining potential eligibility groups and additional controls (X). It assumes that annual effects are the same for each province and each population.

$$I_{ip\ in\ 2010} = \tilde{\theta} Z_{ip\ age(16)} + X_i' \kappa_p + \gamma_t + \kappa_p + \epsilon_{ipt} \tag{23}$$

Specification 2 is a DID estimation with province-specific trends (equation 24). It relaxed the assumption that the annual effects are the same for each province. It still assumes that the annual effects are the same for each population within the province.

$$I_{ip\ in\ 2010} = \tilde{\theta} Z_{ip\ age(16)} + X_i' \kappa_p + \gamma_t' \kappa_p + \epsilon_{ipt} \tag{24}$$

The third specification is a Differences-in-Differences-in-Differences (Double DID or Triple Differences approach, equation 25). It relaxes the assumption that the potentially eligible populations and the general population have the same trend.

$$I_{ip\ in\ 2010} = \tilde{\theta} Z_{ip\ age(16)} + X_i' \kappa_p + X_i' \kappa_p' \gamma_t + + \gamma_t' \kappa_p + \epsilon_{ipt} \quad (25)$$

In specification 1 and 2, I compare the difference between those that were and those that were not eligible at age 16 within the same population in a province with a population were no change in eligibility occurs. In specification 3, I compare this difference-in-difference with the same comparison in another province where in the same time span no reform change for these populations happened.

Identification comes from the geographical and time variation of the introduction and scope of second child permits. The double DID approach allows controlling for population-specific time trends. It thus relaxing the common trend assumption. The exclusion restriction is that conditioned on province trends the sub-groups that become eligible have the same educational trend as the sub-groups in other provinces that do not change eligibility status. To support this identifying assumption, I run a pre-OCP placebo test. Identification also implies that provincial family planning policies are independent of educational measures that target the same group. For instance, if provinces that allow second child permits for ethnic minority couple these measures with an increase in the educational budget for ethnic minorities areas, the policy measure captures both. So far, I have not encountered evidence in the literature for such behaviour. I run additional robustness checks to verify that the results are not driven by a specific easily targeted group.

One might be concerned about potential spill-over through migration. However, the Chinese household registration system restricts the possibility to migrate particularly between provinces and between urban and rural areas. Applications for the second child permit can only be submitted at the place of registration. Moving the place of registration is difficult.[11] Recent reforms are supposed to loosen these restrictions.

The results for the effect of second child permits on schooling investment are shown in table 1 with the specification 1, 2 and 3 in column 1, 2 and 3. Fulfilling a second child permit criterion at the age of 16 increases the years of education by around 0.9 years on average. The coefficient does not change significantly between the three specifications. Yet, standard errors increase. The

[11] Within the main cohort, only 1.2% indicated a different provincial code as place of residence at the age of 12 than at the age of 3 while 5.4% indicated a different county or district code (within-province migration).

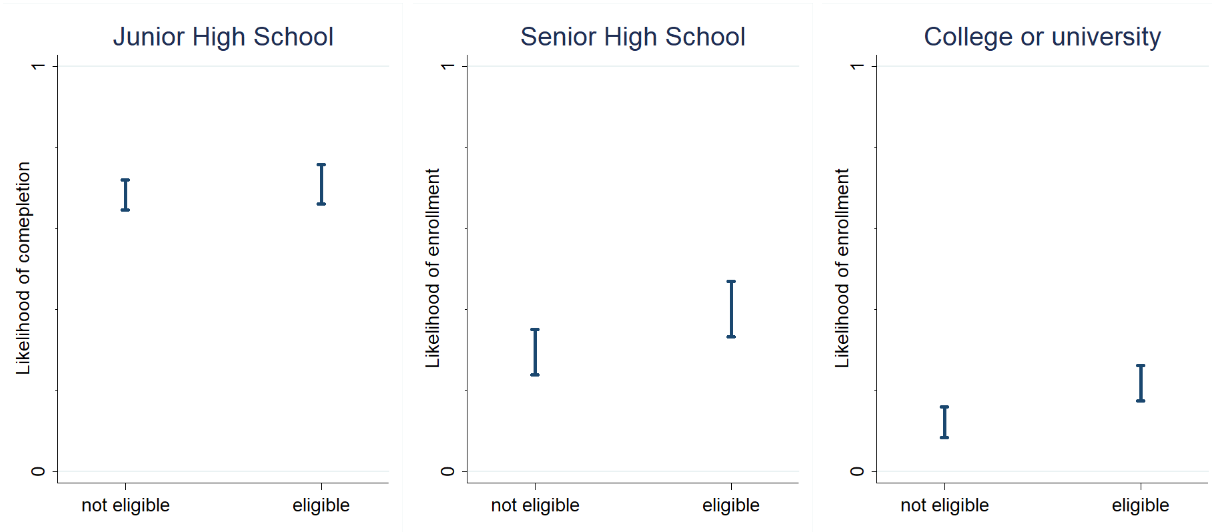
	Dependent variable: Years of education				
	DID national trend (1)	DID province trends (2)	Double DID (3)	Double DID (4)	Double DID (5)
Anticipated eligibility at age 16	0.829**	0.911**	0.895*	0.898	1.143**
	(0.385)	(0.440)	(0.467)	(0.560)	(0.553)
Female X Anticipated eligibility at age 16				-0.00592	-0.509
				(0.414)	(0.357)
Female Dummy	Yes	Yes	Yes	Yes	Yes
Eligibility Indicators	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Eligibility Controls x Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Eligibility Controls x Year FE	No	No	Yes	Yes	Yes
Year FE x Province FE	No	Yes	Yes	Yes	Yes
Female x Province FE; Female x Year FE	No	No	No	No	Yes
Observations	7840	7840	7840	7840	7840
R^2	0.432	0.461	0.467	0.467	0.474

Note: Sample includes individuals that turned 16 between 1990 and 2005. The dependent variable is the years of education the individual completed in 2010. Standard OLS regression with standard errors clustered on provinces-times-urban-area levels in parenthesis. Significance levels: * 0.10; ** 0.05; *** 0.01. Anticipated eligibility at age 16 is calculated on the basis of the province, eligibility characteristics and time. Eligibility controls include dummies for being an only child, having a rural household status and ethnic minority status. Data source: China Family Panel Survey 2010.

Table 1: Effect of the number of children allowed at age 16 on the years of education.

effect is higher for men but not significantly so (see column 5). The coefficient for women alone lies at 0.6 years of education and is not significant. This empirical result suggests that men and to a smaller extent women who expect to be allowed to have two children increase their educational investment.

At which stage of the educational career does eligibility play a role? Instead of years of education, I now use indicator variables for finishing junior high school and enrolment into senior high school, technical college and university as outcomes. Results are displayed in table 6 in the appendix and graphically shown in figure 3. First, there is no effect of eligibility on junior high school completion (column 1 and 2). This is expected and can be regarded as a falsification test. At the age of 16, individuals have completed or are about to complete their mandatory junior high school degree. Second, enrolment into senior high school increases by around 9 percentage points (column 3 and 4). The effect carries on. Enrolment into at least college (vocational or university studies - column 5 and 6) increases significantly by around the same size. Enrolment into university



Note: Displays 95% confidence intervals of marginal effects of eligibility. Cased on DID estimates with province specific trends (table 6). Estimates for not eligible and eligible (0.5 - eligible category is omitted)

Figure 3: Effect of anticipated eligibility on finishing junior high school, enrollment into senior high school and enrollment into college or university

. .

increases by 6 percentage points (column 7 and 8).

Following, I run a placebo test to argue that the exclusion restriction is not violated (table 7 in the appendix). I map the eligibility status of those in my main cohort to those that turned 16 before the introduction of any second child exemptions. I find that the placebo variable does not have any effect on the educational level of those that turned 16 between 1972 and 1982.[12]

As another robustness test, I check the effect of eligibility on the likelihood of senior high school enrollment at different age thresholds. If eligibility was simply correlated with provincial educational investment or local educational demand factors, there is no reason why the age cut-off of 16 should be relevant. We would expect similar results at the age of 17 or 18. However, if it is the second child permit reforms that drive the results, we should not see any effect on those who become eligible at the age of 17 or 18, because the decision to continue schooling or not has already been taken. Those that become eligible before the age of 16, should also be affect, but the effect should be smaller because those who become eligible at 16 would fall into the control group. The result are graphically displayed in figure ??. They are in line the predictions if the effect was indeed driven by second child permit reforms. At age 17 and 18, the effects are insignificant and close to

[12]Results do not change if I choose one year later or earlier.

0. At age 14 and 15, the effect size is only half as much as at the age of 16 and insignificant for the age of 14.

Furthermore, I investigate which group drives the results (see table 8 in the appendix). First, the coefficient for eligibility with 50% likelihood is not significantly different from zero. However, it is positive and within the expected range (column 1). I then include interaction terms for the different eligibility groups. The effect is the same for the minority and agricultural sub-groups (column 2 and 4). It is only significantly different for those who are an only child (column 3). It seems that anticipated eligibility does not have a significant effect on an only child. This can have several reasons. For one, those who are an only child might have low fertility preferences and thus fall into the category of *always-1*. Furthermore, the policy that allows only children to have two children was announced by the central government and slowly implemented in all province. It is possible that only children who were not eligible when they were 16 anticipated to be eligible once they were older.

There are other variables that might have an effect on the impact of the policy. I check if individuals with a highly educated father have a different intensity of the effect. The idea is that the father's education is a proxy for household income. However, I do not find any significant difference. On the one hand, individuals with an educated father are more likely to have the means to pay the fines. But they are also more likely to have lower fertility preferences. As an interesting addition, I find that individuals whose father is a member of the Communist party are not significantly affected by eligibility. It is plausible that they have already internalized the rule of one child per family and thus their fertility expectations are not affected by a change in eligibility rules.[13]

6.2 Effect of eligibility on fertility outcome

I use the older cohort to estimate the effect of actual eligibility on fertility outcome. N_i is measured as having a second child in 2010 or not. The analysis is restricted to married individuals that had one child before 2003. This is to make sure they have enough time to have a second child while conforming with promoted birth intervals and do not have more than two children. Eligibility is measured at the age of 27 for women and 28 for men which is the year before the average age of

[13] It is also possible that they always plan with two children.

the birth of the second child.

In specification 1, the indicator variable of having a second child in 2010 or not is regressed on the eligibility status at the age of 27/28. I control for individual characteristics that determine eligibility, as well as birth year and province fixed effects, and the sex of the first child:

$$N_{i\ in\ 2010} = \tilde{\beta} Z_{ip\ age(27/27)} + X_i + \gamma_t + \kappa_p + \epsilon_{ipt} \tag{26}$$

Equation 26 can be estimated by a logit regression. However, the underlying assumptions such that $E(\epsilon_i Z_i|X_i) = 0$ are strong. The effect of the characteristics that make someone eligible such as belong to an ethnic minority or having an agricultural household status are assumed to be the same in each province. Also, year fixed effects are assumed to be the same for all provinces and for all population groups. To relax these assumptions, I also run a DID and double DID specification as in the previous section.

The results are displayed in table 2. Eligibility for a second child permit at the age of 27/28 has a highly significant effect in all specifications (columns 1 to 3). On average, being eligible increases the likelihood to have a second child by 14 percentage points, based on the DID specification. Effects are similar for men and women (columns 5 and 6).

The official number of children allowed at age 27/28 thus influences real fertility decisions. However, an increase of approximately 14 percentage points implies that there is a share of the population that does not significantly change their fertility outcomes due to the policy. This might be because they want only one child or because they were planning to have two children and to pay the fine.

The coefficient measures only the impact of eligibility based on criteria that are observable at the age of 16. There are several criteria that are based on unobservable and (for the econometrician) not predictable characteristics. These include the first child being disabled and the family being in "poor economic conditions". Furthermore, eligibility is only measured at 27/28 which is the year before the average age of the birth of a second child. This implies that individuals who become eligible at the age of 28/29 fall into the control group. The same applies to those who become non-eligible at age 27/28 but might have already had a second child or had gotten a second child permits before the change. Therefore, the coefficient does not measure the complete impact of 2nd

	Dependent variable: Indicator: Having a second child					
	OLS DID	Logit	OLS Double DID	OLS Double DID	OLS-DID Women	OLS-DID Men
	(1)	(2)	(3)	(4)	(5)	(6)
Eligibility at age 27(women)/28(men)	0.143***	0.110***	0.152***	0.144***	0.153***	0.139***
	(0.0438)	(0.0284)	(0.0449)	(0.0447)	(0.0483)	(0.0477)
Eligibility Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Local Fertility Rate	No	No	No	Yes	No	No
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Elig. Controls x Province FE	Yes	No	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE x Year FE	Yes	No	Yes	Yes	Yes	Yes
Elig. Controls x Time FE	No	No	Yes	Yes	No	No
Observations	8423	8423	8192	8423	4554	3869
R^2	0.420		0.447	0.434	0.457	0.442

Note: Dependent variable = 1 if the individual had a second child. Coefficients are average marginal effects. Sample includes individuals that turned 16 between 1977 and 1992, are married, had their first child before 2003 and have no more than two children. Logit or OLS regressions with standard errors in parenthesis. Standard errors are clustered on the province interacted with an urban dummy which indicated that in 2010, the area is defined as an urban area. Eligibility at age 27/28 is calculated on the basis of the province, eligibility characteristics, sex of the first child and time. Eligibility controls: Household status, only child status, minority status. Additional controls: sex, sex of the first child. Data source: China Family Panel Survey 2010.

Table 2: Effect of eligibility status at age 27/28 on the likelihood of having a second child.

child permits and probably underestimates even the effect of the criteria included.

6.3 Isolating the effect on *increasers*

To decompose the effect of eligibility on education, I want to split the sample into two groups: those that are expected to be *always-2* and those that are not. I use the subsample of those not eligible in the older cohort as a training set for a random forest estimation. The predicts if someone has a second child without being eligible. Only those that turn 16 before 1990 are included so that the training sample and the sample for the main cohort do not overlap. Motivated by proposition 2 in the theory section, I include potential fertility proxies on top of eligibility characteristics, province indicators and a trend variable. The local, district-level fertility rate is calculated as the average number of children of those between 30 and 35 (when the individual turns 16). I also include the number of siblings and an indicator if the mother has finished at least junior high school. Also included are if the individual grew up in an urban area (independent of hukou status) and if the father is a member of the Communist party.

The random forest grows 1000 classification trees. For each tree 3 predictors are used which are randomly selected from all predictors. The number of predictors is chosen to minimize the out-of-bag error rate. Prediction is made based on the average of those trees. An observation is predicted to be an *always-2* if more than half of the observation that falls into the same category have a second child (majority rule). Figure 7 shows the importance of the different predictors. Unsurprisingly, the province and the local fertility rate are the most important predictors. The trend, number of siblings, and the household registration status are important as well.

The random forest is then used to predict if an individual in the older cohort and the main cohort would be an *always-2*. This variable is then interacted with the eligibility status. Results are displayed in table 3. The first two columns (1 and 2) show the effect of eligibility at age 27/28 on the indicator of having a second child. As expected, the take-up rate among those that are not predicted to be *always-2* is significantly higher than among those predicted *always-2*. For those predicted to be *always-2* second child permits have an effect close to zero.

The effect of anticipated eligibility at age 16 is still positive and significant for those that are not predicted to be *always-2* (column 3 and 4). The interaction has a negative sign but is not significant. I find that the effect of eligibility is significantly higher for those that are not predicted to be *always-2* (columns 5 and 6). These results suggest that the positive effect of eligibility on educational investment is driven by those that increase their anticipated fertility as a response to eligibility status.

	Dependent variable:					
	Having a 2nd child		Years of Education		Enrollment into SHS	
Cohort	1977-1992 DID (1)	1977-1992 Double DID (2)	1990-2005 DID (3)	1990-2005 Double DID (4)	1990-2005 DID (5)	1990-2005 Double DID (6)
Eligibility at age 27/28	0.180***	0.183***				
	(0.0511)	(0.0512)				
Eligibility at age 27/28 X Predicted *Always-2*	-0.125**	-0.129**				
	(0.0535)	(0.0545)				
(Anticip.) eligibility at age 16			1.048*	1.212***	0.134**	0.120*
			(0.537)	(0.440)	(0.0651)	(0.0652)
Predicted Always-2 X (Anticip.) eligibility at age 16			-0.511	-0.475	-0.0914***	-0.0942***
			(0.384)	(0.375)	(0.0323)	(0.0309)
Predicted *Always-2*	0.793***	0.794***	-0.836**	-0.929***	-0.0485	-0.0448
	(0.0176)	(0.0180)	(0.347)	(0.329)	(0.0304)	(0.0298)
Observations	8104	8104	7528	7528	7528	7528
R^2	0.631	0.633	0.472	0.466	0.423	0.428

Note: Includes eligibility characteristics, province and time fixed effects, province X time fixed effects, eligibility characteristics X province fixed effects, female dummy. Anticipated eligibility at age 16 is calculated on the basis of the province, eligibility characteristics and time. Eligibility controls include dummies for being an only child, having a rural household status and ethnic minority status. Column 1 and 2 include sex of first child, column 2, 4 and 6 include eligibility characteristics X time fixed effects. Standard OLS regression with standard errors clustered on provinces-times-urban-area levels in parenthesis. Significance levels: * 0.10; ** 0.05; *** 0.01. Data source: China Family Panel Survey 2010.

Table 3: Decomposing the effect of eligibility

6.4 Effect of eligibility and the sex ratio

The theoretical model predicts heterogeneity in the cost of raising children, in the change in labour supply and in the sex ratio. I investigate the latter, as the cohort sex ratio is observable and plausibly exogenous on the individual level.[14] I use the 2000 Census to calculate the share of women for each birth year.[15] For the 1977-1992 cohort, the average share of women is 0.495, for the 1990-2005 cohort the average share is 0.488. The geographical variation of the 1990-2005 cohort is displayed in figure 6.

At first, I check if the sex ratio has an effect on the take-up rate of second child permits (see table 9, column 1). I find that the interaction between eligibility and sex ratio is insignificant. I still include the sex ratio in the random forrest prediction for *always-2*. It is less important than the local fertility rate, province fixed effects or the household status, but as important as the number of siblings and the trend variable (see figure 8).

I find that the sex ratio has a significant effect on the impact of second child permits. The interaction term between sex ratio and anticipated eligibility status at age 16 is negative and significant (see table 9 column 2). Thus, the fewer women compared to men are in the cohort, the stronger the effect of second child permits. This is indeed driven by the more frequent sex (men). In columns 3 and 4 where I look at men and women separately, the coefficient is significant (and also lager in size) for men. If the effect is driven by *always-2* or not is verified in columns 5 to 7. Splitting up the sample further decreases power. However, the size of the coefficient for men that are not predicted *always-2* stays the same (though it is not significant) in column 7 (p-value = 0.22).

7 Discussion: Why would those that expect more children educate more?

The theoretical model provides different mechanisms how anticipated fertility can affect education investment. It can have an effect on family consumption, the labour supply and the incentives to find a partner. In this section, I provide descriptive statistics to discuss the intertemporal con-

[14] Expenditures for the second child are not observed and endogenous, as are labour market conditions.
[15] The census, having more observations than the CFPS, gives a cleaner measure.

sumption smoothing and labour supply channels. Looking at expenditure data and parental labour supply can help to put the results into context.

The cost of raising children not only depends on how much money is spent on the need of the children but also on the available income at that moment. If parents also have to financially support their own parents while raising their children, it makes the financial burden of children more relevant. It is also more important for the grandparents that have a strong say in the educational decision making. Therefore, I also look at the financial and living situation of the elderly.

7.1 Cost of raising children

The fertility literature in developing countries has treated children as an investment for parents that pay off quickly because children are productive from an early stage on. The idea of children as productive household members relies on children being able to work from an early stage on. In developed countries, children are often seen as expensive. Children have to be financially supported until the end of the educational stage. Furthermore, retirement schemes and health insurance mitigate the need to rely on children during sickness or old age.

In China, education is mandatory until age 16 and children are not allowed to work. If families abide by these rules, they have additional expenses for at least 16 years per child. Indeed, gross enrolment rates for primary school have constantly been above 100% for the past years. At the secondary school level they have increased from around 70% to over 90% between 2007 and 2015 and for tertiary education from 20% to 45% (UNICEF). At the same time, child labour is not prevalent. Tang et al. (2016) estimate that in 2010, only about 7.74% of children aged from 10 to 15 were working. Most of them combined education with their economic activity.

Expenditure on the education of their children is an important cost for parents in many countries. Figure 9 in the appendix shows total expenditure on education as a share of family income for families with one child. Though educational expenditure is low in the first four years, 10 to 20% of family income is spent on education afterwards. Figure 10 shows the different expenditure items as a share of family expenditure. Expenditure increases at the age of 5, probably driven by tuition fees for pre-school. Tuition drops at age 6 or 7 when children start primary school. At the same time families spend more on extracurricular activities and home tutoring. Tuition becomes more important again at the age of 17 when students enter senior high school, then college or university.

Figure 11 in the appendix contrasts the educational expenditures of a family with two children with a family with only one child. To compare these families, I use a nearest-neighbour matching technique.[16] Families with two children pay more for education than families with one child starting when the second child is around 5 years old. When the second child is around 15/16 years old, educational expenditure accounts for more than 20% of family income.

This descriptive result is replicated in a regression analysis displayed in table 10 in the appendix. Using standard OLS regression, I find that families with a second child spend twice as much on education than families with only one child. I instrument the number of children with eligibility at age 27/28 to address the endogeneteiy issue. The result stays the same (column 3). The IV approach is only suggestive. Eligibility potentially affects other variables that influence educational expenditure that I cannot control for, such as savings.

A recent report estimates that Chinese parents pay around $42,892 for their child's education (HSBC (2017)). Though this is less than in the USA ($58,464) where college attendance is higher, it is more than in other countries such as the UK ($24,862), Canada ($22,602) or France ($16,708) (HSBC (2017)). Furthermore, the report revealed that 93% of Chinese parents have paid for a private tutor. Chinese parents seemed to have expected these expenses. Out of the countries that were surveyed, China had the highest rate of parents (around 55%) indicating that they can fund their child's education through savings or investment.

The suggestive evidence and the additional literature indicate that raising children in China is indeed costly. In particular, families spend an important share of their income on the education of their children.

7.2 Old-age support and the double burden of parents

The effect of anticipated fertility also depends on the importance of children's financial support to parents. It makes children more costly when investment in children and financial support for the grand-parents are paid at the same time. Children are still an important source for old age support in China. According to the CFPS, in 2010, 45% of individuals over 60 live with at least

[16] First, the likelihood of having a second child is regressed on age, agricultural household status, educational level and age at the birth of the first child and the propensity score is predicted. Each individual is then matched with his/her nearest neighbour (of the same sex) without replacement based on the propensity score. The matched control individual "adopts" the birth year of the second child from his/her neighbour.

one of their children, 69% of those with a son and 31% with a daughter. For families with an agricultural household status and at least one person older than 60, social security/pensions transfers accumulate to on average 2068 Yuan (approx. 218€)[17], making up less than 10% of family income. For families with a non-agricultural household status, it accumulates to on average 20353 Yuan (2137€, around 47% of family income). 33% of individuals over 60 state having received economic support from at least one of their children.

Families with both spouses born between 1964 and 1979 give 4% of their annual income to relatives. They increase family member support by 1 percentage point for each grandparent that does not live with them (see table 12 in the appendix). Using OLS , there is no significant difference in the amount given to relatives between families with one child and two children. Once having a second child is instrumented (column 3), I find that families with one child give around 3 per cent of family income to a grandparent who does not live with them. This is not the case for families with two children. The expenses for the second child seem to impact the ability to financially support grandparents.

7.3 Parental labour supply and earnings

Do parents work more or less when they have a second child? The CFPS includes data on how much the individual worked on average per month in 2010. Figure 12 in the appendix shows the average log working hours of men and women as a function of how many years have passed since the birth of the second child. It is displayed for parents that have exactly two children and a matched control group with one child. If at all, men work significantly less only at the year of birth of the second child but not afterwards.[18] Women work significantly less in the first four years following the birth of the second child. Then work the same hours or potentially even more from year 5 onward. Figure 13 in the appendix displays parents' monthly income. In line with the previous results, men earn less in the year of birth and there is no evidence for a lasting effect. Women's earnings are less in the first four years after the birth of the second child. Long-run earning patterns are noisy: there is no clear trend for either higher or lower earnings.

Again, the descriptive results are replicated in a regression analysis (see table 11 in the ap-

[17]Based on the conversion rate of 0.105, the approximate average exchange rate at the beginning of 2010.
[18]There are other years where they work significantly less at 10% but the difference is not systematic.

pendix). Using standard OLS, I find that having a second child is negatively associated with working hours for men and women in 2010 (columns 1, 2, 4 and 5). When having a second child is instrumented, the coefficient for women is no longer significant but still negative (column 3). The effect of having a second child for men is insignificant with a positive sign (column 6).

Guo et al. (2017) and He and Zhu (2016) address the endogeneity between childbirth and labour market conditions by using twinning as a natural experiment. Guo et al. (2017) do not find evidence on the negative effects of fertility on parental labour supply. He and Zhu (2016) find a small negative effect on women's labour force participation in the 1990s and an insignificant effect in 2000s. Angrist and Evans (1996), Jacobsen et al. (1999) and Lundborg et al. (2017) show for other countries that one more child has no or only a small effect on labor market earnings of women.

Overall, the descriptive statistics, suggestive IV results and the related literature suggests that in the Chinese context having a second child does not have a long-run effect on parental labour supply and earnings. Therefore, the positive effect of an increase in anticipated fertility on education is not surprising.

8 Conclusion

In this paper, I use a novel empirical approach to address the question of how anticipated fertility affects educational decisions. This question has not been in the focus of the fertility literature. I use the One-Child Policy in China and the existence of second child permits for a subset of individuals. I find that individuals invest more in education when they fulfil an eligibility criterion for a second child permit. Treatment heterogeneity analysis suggests that the effect is driven by compliers: those who increase their anticipated fertility once eligible.

In the theory section, I sketch economic channels of how anticipated fertility can positively influence educational investment. Because children are expensive one wants to ensure earning sufficient income in the future. The positive effect also depends on the relationship between lifetime returns to education and fertility outcomes. If men and women can stay in or re-enter the labour market without loss of their skills one does not expect a negative effect. The policy implication is thus to ensure the availability of flexible childcare, to fight potential discrimination of parents in the labour market and to support parents who want to re-enter the labour market.

There are other channels of how anticipated fertility can affect education. For one, individuals who plan to have more than one child in the future might also plan to take over important childcare tasks. They invest more in education to be well prepared for it. Also, one parent might want to increase her/his bargaining power when he/she counts on having to secure sufficient resources for more than one child. Since bargaining power within the household and education are supposedly positively correlated, increasing education can be a way to increase bargaining power. There is also potential psychological effect. For example, being allowed to have two children in a society where children are seen as essential can give one a more positive attitude towards the future and more motivation at school.

Similarly, there are many other variables that anticipated fertility could have an effect on. Do men and women who anticipate several children choose certain types of jobs or avoid certain sectors? Do saving patterns change? Do they look for different types of partners? These questions are important to ensure that individuals have the same opportunities independent of their desire to have children. They can also help understand saving, investment and marriage patterns.

China is one specific social and economic environment that has been perturbed by strict policies. Comparing individuals who plan to have two children instead of one (intensive margin) is not the same as comparing individuals who do not plan to have any children with those that do (extensive margin). Studies from developed countries find that having one more child has at most a weak effect on the mother's long-run (Angrist and Evans (1996), Jacobsen et al. (1999), Lundborg et al. (2017)). However, the first child has a significant effect. This suggests that the effect of having a child compared to not having any on education can also be different.

China announced a Two-children policy in 2015, which allows everyone to apply for a second child permit. There is an ongoing discussion about the effect of the OCP on fertility rates and thus the effect of the new policy. The results of this paper suggest that the Two-children policy has an effect on fertility, but it is expected to be small. The policy is also predicted to increase educational investment.

The findings of this paper are a result of the Chinese social and economic environment. However, low fertility is a concern in many medium and high-income countries. This finding is a positive sign for policymakers who want to promote fertility and education at the same time. Identification relies on a setting with an exogenous, predictable and important variation in the cost of a child.

This will make replication in other countries difficult. Panel studies can be used which ask for fertility goals and when they can be coupled with changes in fertility policies. A dynamic and structural framework can be applied in this context. This paper is one of the first empirical papers that address the identification issue of the relationship between anticipated fertility and educational investment. It will hopefully lead to a constructive discussion.

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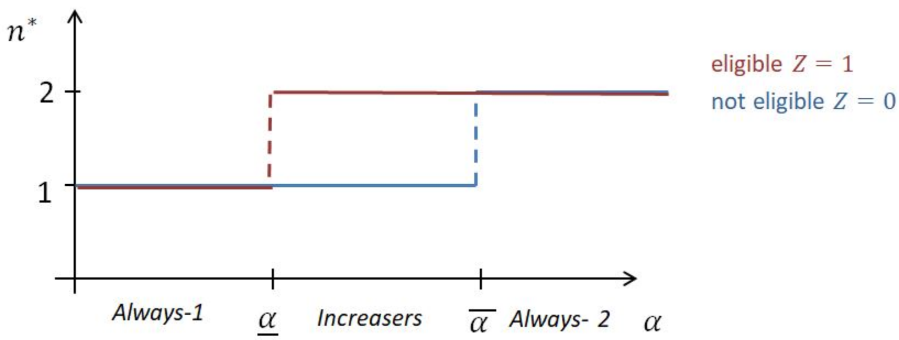
9 Appendix

9.1 Figures



Note: Optimal number of children n^* on the y axsis and fertility preferences α on the x axsis. The red (blue) lines demonstrate the optimal number of children as a function of fertility preferences when the individual is eligble (not eligible). The thresholds $\bar{\alpha}$ and $\underline{\alpha}$ are determined by the FOC.

Figure 4: The effect of fertility preferences on the number of children.

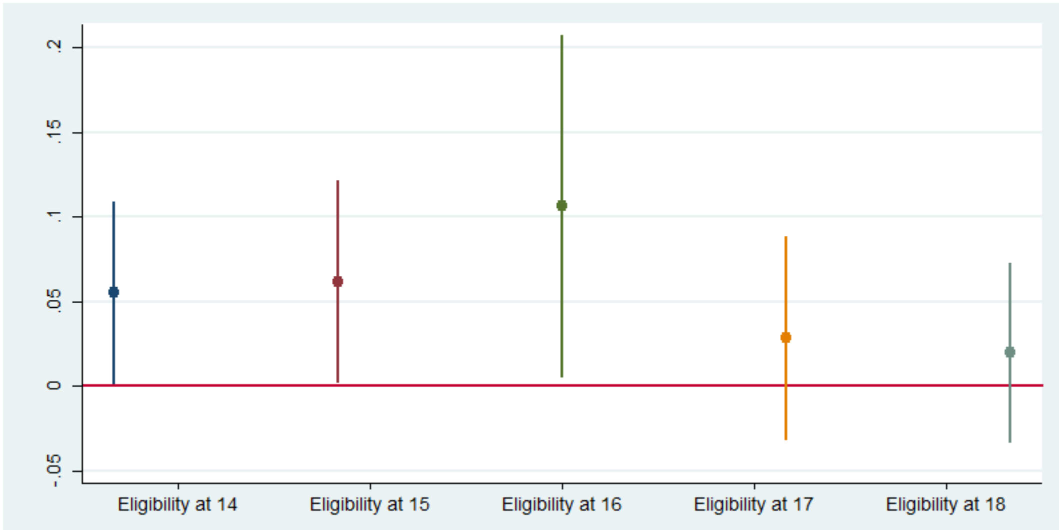


Figure 5: Effect of anticipated eligibility on likelihood of senior high school enrolment at different age thresholds. Based on DID specification with province level trends. 90% Confidence intervals.

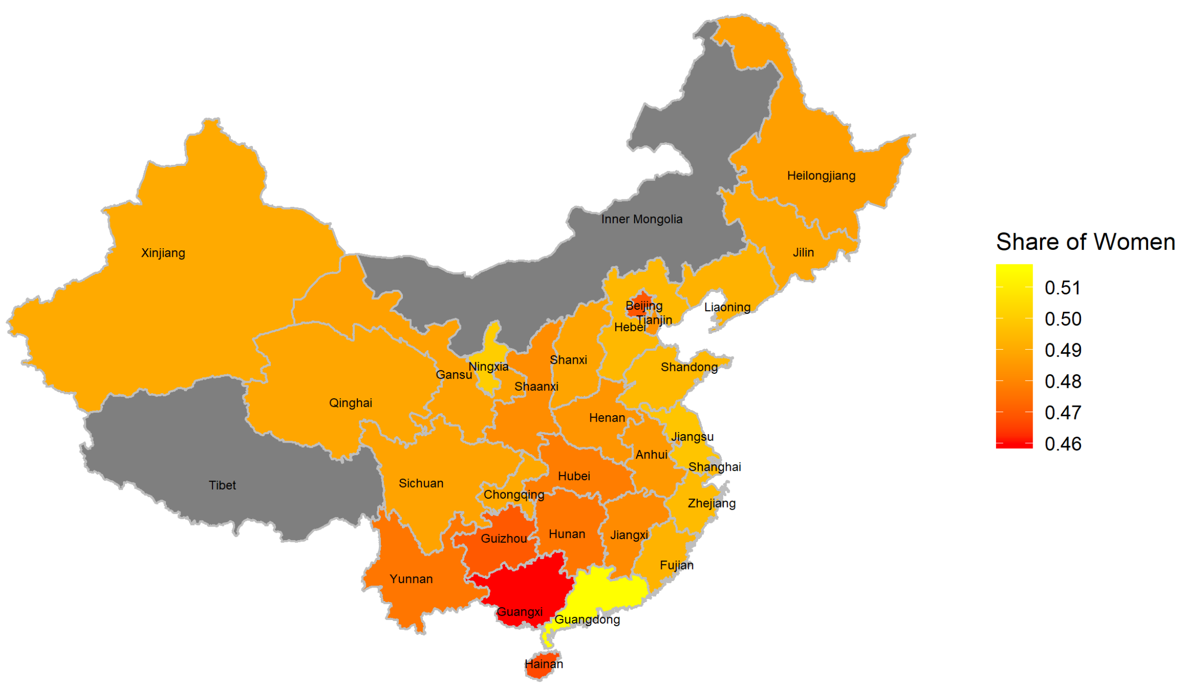
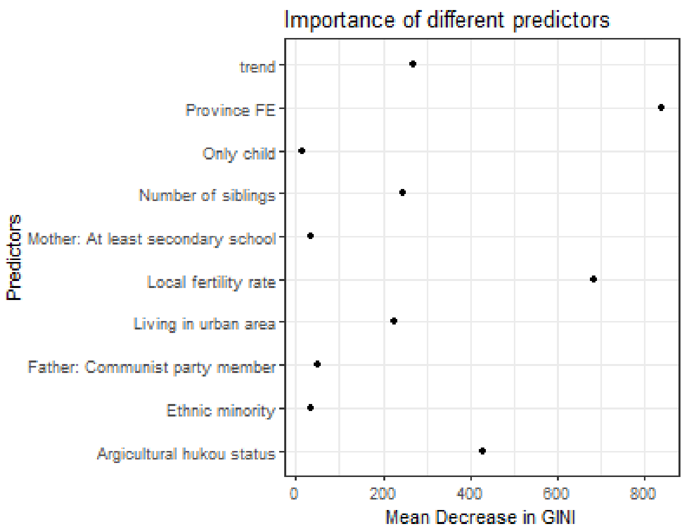
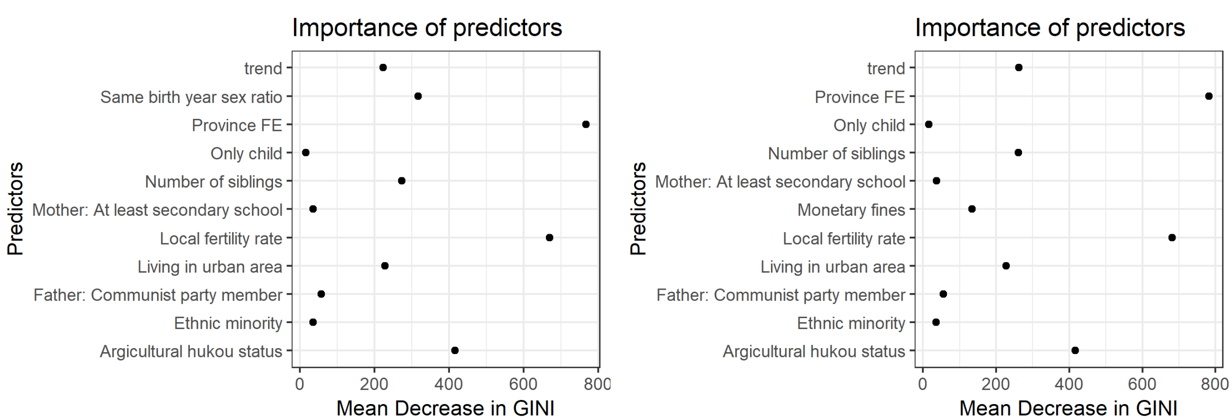


Figure 6: Average cohort sex ratio for those who turned 16 between 1990 and 2000. Based on the 2000 Census.



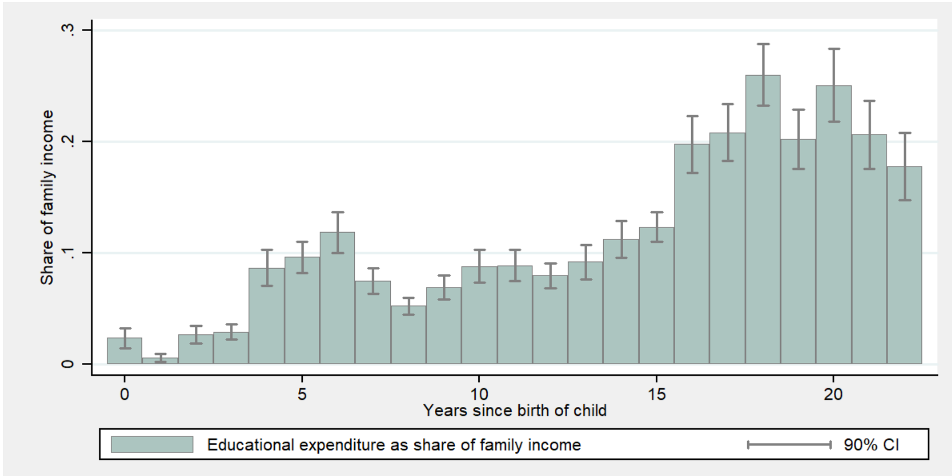
Note: Displays the importance of predictors in the random forest estimation. Importance is measured as how much the predictor decreases the GINI coefficient within each node. If all observations at one node are either 0 or 1, GINI is 0. If the observations are mixed, the GINI coefficient is high. The GINI is a measure of node purity.

Figure 7: Importance of predictors in random forrest estimation



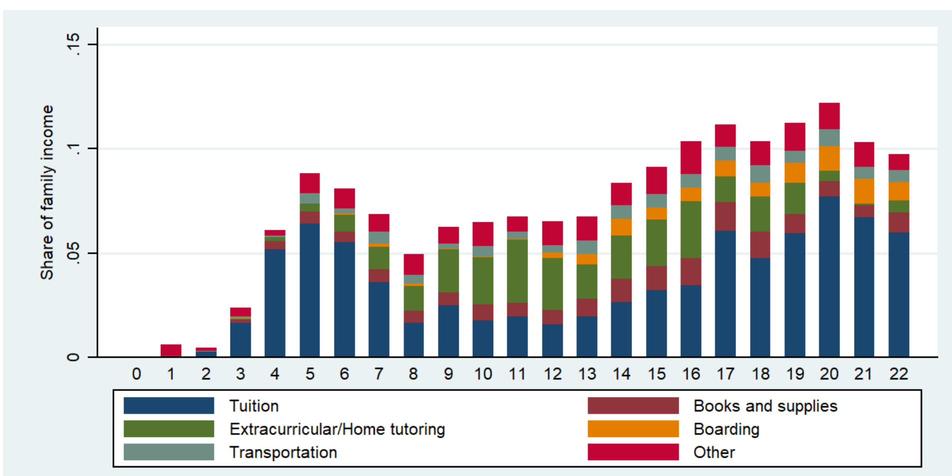
Note: Displays the importance of predictors in the random forest estimation. See figure 7

Figure 8: Importance of predictors including the cohort sex ratio (from 2000 census) on the left and monetary fines on the right



Note: Share of family income allocated to education for families that have an only child. Data is based on the family questionnaire and question of how much was spend on education last year. Source: CFPS 2010.

Figure 9: Total educational expenditure as share of family expenditure

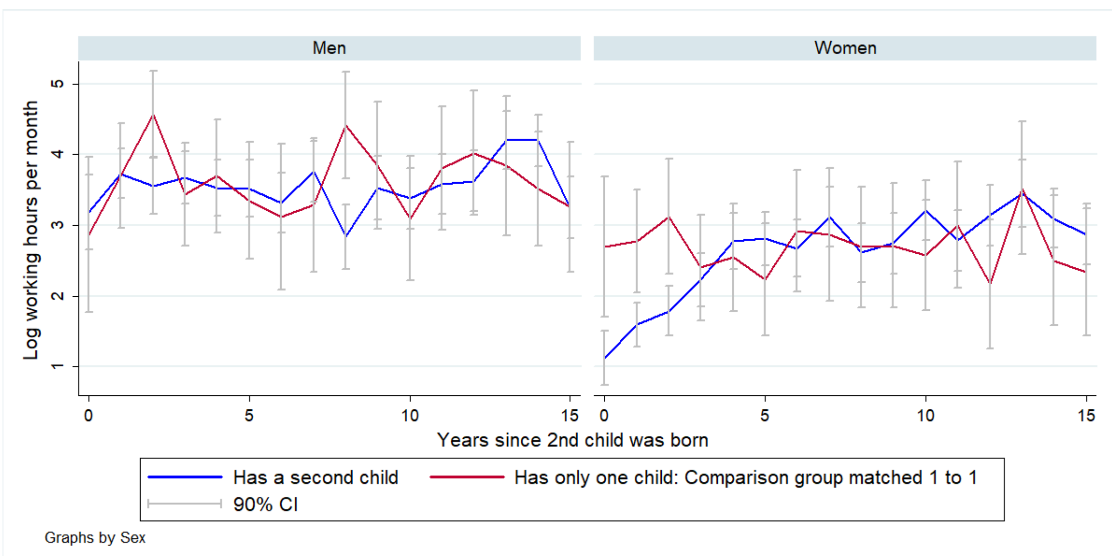


Note: Share of family expenditure allocated to education for families that have an only child. Data is based on the child questionnaire until the age of 15 and the adult questionnaire from age 16 onward. Includes families with an only child where the child lives with at least one parent. Excludes families that doe not pays all the educational cost (28 observations). The question is asked for each educational item. Source: CFPS 2010.

Figure 10: Different items of educational expenditure as share of family expenditure.

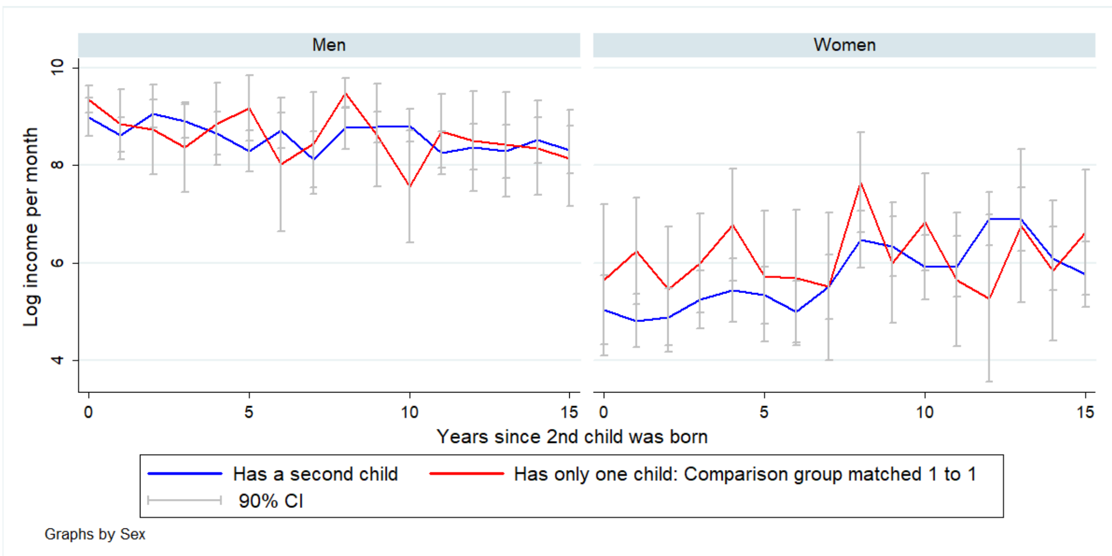
Note: Share of family expenditure allocated to education comparing those with two children with a matched comparison group. The comparison group is matched 1 to 1 based on the propensity scores taking into account age, education, household registration status and the age at the birth of the first child. Data is based on the family questionnaire of the CFPS 2010.

Figure 11: Expenditure on education for families with two children and a matched control group with one child



Log of monthly working hours for men and women with 90% confidence intervals. Blue is the average of those who have two children. Red is a matched control group with one child. The comparison group is matched 1 to 1 without replacement based on the propensity scores taking into account age, education, household registration status and the age at the birth of the first child. The matched control observation adopts the year of birth of the second child.

Figure 12: Log monthly working hours in 2010 according to the year of birth of the second child



Log of monthly income for men and women with 90% confidence intervals. Blue is the average of those who have two children. Red is a matched control group with one child. The comparison group is matched 1 to 1 without replacement based on the propensity scores taking into account age, education, household registration status and the age at the birth of the first child. The matched control observation adopts the year of birth of the second child.

Figure 13: Log monthly income in 2010 according to the year of birth of the second child

9.2 Tables

	Hebei	Chongqing	Hubei	Zhejiang	Jiangsu
Family only has girl (rural area)	1989	1997	1987	1995	2002[19]
Ethnic minorities	1982	2002	2002	1990	-
Spouses are only child	1982	1997	2002	1989	1990

Note: Provinces have several other eligibility criteria such as for couples who had their first child outside of China, remarried couples, couples with a disabled first child etc. that I do not regard. Based on Scharping (2013) and family planning documents.

Table 4: Example of when provinces formalized eligibility criteria.

[19] Only if husband does not have a brother.
[20] Truncated at 7
[21] Taking into account the sex of the first child.

Variable	Mean	Std. Dev.	Min.	Max.
Main Cohort (turning 16 between 1990 and 2005)				
Years of education completed (in 2010)	8.681	4.631	0	22
Female	0.534	0.499	0	1
Han ethnicity	0.893	0.309	0	1
Rural/agricultural household registration status	0.689	0.463	0	1
Year born	1981.291	4.738	1974	1989
Nb children allowed: 2 (at age 16)	0.275	0.446	0	1
Nb children allowed: 1.5 (at age 16)	0.376	0.484	0	1
N		7840		
Older cohort: (turning 16 between 1977 and 1992)				
Years of education completed (in 2010)	6.527	4.664	0	22
Female	0.529	0.499	0	1
Han ethnicity	0.915	0.278	0	1
Rural/agricultural household registration status	0.732	0.443	0	1
Year born	1968.208	4.346	1961	1976
Nb children allowed: 2 (at age 16)	0.137	0.343	0	1
Nb children allowed: 1.5 (at age 16)	1.711	0.865	0	7
Number of children[20]	1.673	0.821	0	7
Allowed to have 2nd child[21]	0.36	0.48	0	1
N		11626		

Note: Data source China Family Panel Study 2010. Only those with information on the main variables (education, year of birth etc).

Table 5: Summary statistics

	Dependent variable: Indicator of enrollment in (at least)							
	Junior High School		Senior High School		College		Undergraduate Studies	
	DID	Double DID	DID	Double DID	DID	Double DID	DID	Double DID
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Anticip. eligibility at age 16	0.0272	0.0254	0.106^{*}	0.0898^{+}	0.0967^{**}	0.0981^{**}	0.0611^{**}	0.0658^{**}
	(0.0368)	(0.0376)	(0.0601)	(0.0610)	(0.0399)	(0.0398)	(0.0280)	(0.0291)
Female dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eligibility controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eligib. controls x Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE x Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eligibility controls x Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	7840	7840	7840	7840	7840	7840	7840	7840
R^2	0.312	0.318	0.418	0.424	0.324	0.340	0.167	0.184

Note: Sample includes individuals that turned 16 between 1990 and 2005. Dependent variable is the likelihood of completing junior high school (columns 1 and 2), enrolling into senior high school (columns 3 and 4) and finishing senior high school (columns 4 and 5). OLS regressions with standard errors in parenthesis. Standard errors are clustered on the province times urban level. Anticipated eligibility at age 16 is calculated on the basis of the province, eligibility characteristics and time. Eligibility controls include dummies for being an only child, having a rural household status and ethnic minority status. Significance levels: * 0.10; ** 0.05; *** 0.01. Data source: China Family Panel Survey 2010.

Table 6: The effect of the eligibility on the likelihood of completing a degree.

	Dependent variable: Years of Education	
	(1)	(2)
Number of children allowed (16)	-0.112	-0.791
	(0.592)	(0.616)
Female dummy	Yes	Yes
Eligibility controls	Yes	Yes
Province FE	Yes	Yes
Eligibility controls x Province FE	Yes	Yes
Year FE	Yes	Yes
Year FE x Province FE	Yes	Yes
Eligibility controls x Year FE	No	Yes
Observations	6705	6903
R^2	0.332	0.321

Note: Sample includes individuals that turned 16 between 1970 and 1980. Dependent variable is the years of education the individual completed. Standard OLS regression with robust standard errors in parenthesis. Significance levels: * 0.10; ** 0.05; *** 0.01 Data source: China Family Panel Survey 2010.

Table 7: Placebo test.

	Dependent variable: Years of Education			
	(1)	(2)	(3)	(4)
Eligibility at age 16 = 0.5	0.258			
	(0.263)			
Eligibility at age 16 = 1	0.961**			
	(0.382)			
Eligibility at age 16		0.815**	1.110***	1.337*
		(0.381)	(0.385)	(0.693)
Agri. household status X Eligibility at age 16		0.277		
		(0.318)		
Only Child X Eligibility at age 16			-1.469**	
			(0.723)	
Han ethnicity X Eligibility at age 16				-0.545
				(0.690)
Female dummy	Yes	Yes	Yes	Yes
Eligibility controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Eligibility controls x Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Year FE x Province FE	Yes	Yes	Yes	Yes
Eligibility controls x Year FE	Yes	Yes	Yes	Yes
Observations	7840	7840	7840	7840
R^2	0.467	0.467	0.468	0.467

Note: Sample includes individuals that turned 16 between 1990 and 2000. Dependent variable is the years of education the individual completed. Standard OLS regression with robust standard errors in parenthesis. Significance levels: * 0.10; ** 0.05; *** 0.01 Data source: China Family Panel Survey 2010.

Table 8: Effect of the number of children allowed at age 16 on the years of education - Robustness Checks.

	Dependent variable: Having 2nd child	Dependent variable: Enrollment in Senior High School					
Cohort	1977-1992 all (1)	1977-1992 all (2)	1990-2005 Women (3)	1990-2005 Men (4)	1990-2005 all (5)	1990-2005 Women (6)	Men (7)
Eligibility at age 27/28	0.124***						
	(0.0460)						
Eligibility at age 27/28 X Sex ratio (std)	0.0369						
	(0.0294)						
(Anticip.) eligibility at age 16		0.112*	0.0793	0.127*	0.136**	0.107	0.133*
		(0.0643)	(0.0776)	(0.0699)	(0.0619)	(0.0745)	(0.0718)
(Anticip.) eligibility at age 16 X Sex ratio (std)		-0.0219*	-0.0105	-0.0355***	-0.0177	0.00260	-0.0367
		(0.0124)	(0.0176)	(0.0127)	(0.0207)	(0.0279)	(0.0296)
Predicted *Always-2* X (Anticip.) eligibility at age 16					-0.0787*	-0.0755	-0.0723
					(0.0395)	(0.0508)	(0.0548)
Predicted *Always-2* X Sex ratio (std)					-0.0142	0.00130	-0.0333*
					(0.0167)	(0.0262)	(0.0180)
Predicted *Always-2* X (Anticip.) eligibility at age 16 X Sex ratio (std)					0.00270	-0.0225	0.0206
					(0.0264)	(0.0366)	(0.0371)
Predicted *Always-2*					-0.0750**	-0.0741***	-0.0645
					(0.0300)	(0.0264)	(0.0408)
Observations	8423	7840	4184	3656	7528	4015	3513
R^2	0.421	0.419	0.480	0.428	0.424	0.485	0.435

Note: All regressions are OLS Difference-in-Difference specification with province level times fixed effects, control for eligibility characteristics times province fixed effects and gender. Column 1 and 2 control for sex of the first child, includes only those that are married and had their first child before 2003. Anticipated eligibility at age 16 is calculated on the basis of the province, eligibility characteristics and time. Eligbility at age 27/28 is calculated on the basis of province, eligibility characteristics, sex of the first child and time. Eligibility controls include dummies for being an only child, having a rural household status and ethnic minority status. Clustered standard errors on province X urban level in parenthesis. Column 7 includes only those that are predicted to not have a second child when not eligible based on the random forest specification, column 8 those that are predicted to have a second child when not eligible. Significance levels: * 0.10; ** 0.05; *** 0.01 Data source: China Family Panel Survey 2010.

Table 9: Sex ratio and eligibility.

	Dependent variable: Log(expenses on education)		
	OLS	OLS	IV
Cohort (years they turn 16)	1980 -1995	1980 -1995	1980 -1995
	(1)	(2)	(3)
Indicator: Having a second child	1.020***	1.057***	0.975**
	(0.0876)	(0.0892)	(0.405)
Eligibility Controls	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Province FE X Eligibility controls	No	Yes	No
Province FE x Year FE	No	Yes	No
Year FE x Eligibility controls	No	Yes	No
Observations	8471	8471	8471
R^2	0.112	0.185	0.112

Note: Sample includes individuals that turned 16 between 1980 and 1995. Robust standard errors in parenthesis. Additional controls: Sex, educational level, educational level of spouse, age at marriage, age at first birth, house ownership, number of adults in the household, if partner has a job, sex of the first child. In column 3: First stage run by logit regression, instrument: number of children allowed at age 30. T-stat: 5.57; F-stat: 69.18). Data source: China Family Panel Survey 2010.

Table 10: Effect of the second child policy on educational expenditure.

	Dependent variable: Women: Log working hours			Men: Log working hours		
	OLS	OLS	IV	OLS	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Indicator: Having a 2nd child	-0.259***	-0.258**	-0.139	-0.237**	-0.183*	0.333
	(0.0973)	(0.106)	(0.420)	(0.0950)	(0.102)	(0.289)
Eligibility Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE X Eligibility controls	No	Yes	No	No	Yes	No
Province FE x Year FE	No	Yes	No	No	Yes	No
Year FE x Eligibility controls	No	Yes	No	No	Yes	No
Observations	4424	4424	4424	3892	3892	8316
R^2	0.080	0.169	0.080	0.096	0.211	0.064

Note: Sample includes individuals that turned 16 between 1980 and 1995. Robust standard errors in parenthesis. Additional controls: Sex, educational level, educational level of spouse, age at marriage, age at first birth, house ownership, number of adults in the household, if partner has a job, sex of the first child. In column 3 and 6: First stage run by logit regression, instrument: eligibility at age 30. T-stat: 3.96/4.03; Chi-stat: 15.65/16.28). Data source: China Family Panel Survey 2010.

Table 11: Effect of a second child on parental working hours.

	Dependent variable: Share of family income spend to support relatives		
	OLS	OLS	IV
Cohort (years they turn 16)	1980 -1995	1980 -1995	1980 -1995
	(1)	(2)	(3)
Indicator: Having 2nd child	-0.00313	0.000427	0.0218
	(0.00636)	(0.0240)	(0.0221)
Nb of individual's grandparents living somewhere else	0.0105***	0.0113***	0.0321***
	(0.00353)	(0.00373)	(0.0116)
Indicator: Having 2nd child X	-0.000790	-0.00209	-0.0450**
Nb of individual's grandparents living somewhere else	(0.00514)	(0.00497)	(0.0204)
Eligibility Controls	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Province FE X Eligibility controls	No	Yes	No
Province FE x Year FE	No	Yes	No
Year FE x Eligibility controls	No	Yes	No
Observations	8104	8104	8104
R^2	0.028	0.076	0.021

Note: Sample includes the individuals that turned 16 between 1980 and 1995. Robust standard errors in parenthesis. Additional controls: Sex, educational level, educational level of spouse, age at marriage, age at first birth, house ownership, number of adults in the household, if partner has a job, sex of the first child. In column 3: First stage run by logit regression, 1. instrument: number of children allowed at age 30 adjusted for sex of first child, first stage run by logit regression: T-stat: 5.62; Chi2-stat: 31.64; 2.instrument: Nb of individual's grandparents living somewhere else x eligibility at age 30 adjusted for sex of first child), first stage run by OLS: T-stat: 8.42; F-stat: 70.91. Data source: China Family Panel Survey 2010.

Table 12: Effect of the second child policy on household balance.

9.3 Model appendix

9.3.1 The effect of another child on optimal education

Child care generally is time-intensive and parents might forgo earnings because they have to reduce working hours. Let us use the example income generation function from the model section: $Y(I,n) = (T - \delta n)\rho P(I)$, where T is the maximum working hours and for every child the parents has to spend δ hours on child care. Each working hour is remunerated with $\rho P(I)$ where $P(I)$ is the productivity, which is a function of human capital, and ρ is a scaling parameter which can be interpreted as technology or labour market conditions. So parents that have one more child, have a reduction in income:

$$\frac{\partial Y(I,n)}{n} = -\delta \rho P(I) \tag{27}$$

We also define $f(n)$ as $\mu F(n)$ where μ captures difference in the cost, and $F(n)$ is an increasing, concave function in n. In this section, we ignore savings.

We can see that given the example income generation function, the cost of having to care for a child is a function of human capital. Looking at the optimal educational level (disregarding penalties for the second child):

$$u'(y(I^*,n) - \mu F(n)) \left[\frac{\partial y(I^*,n)}{\partial I^*}\right] = \frac{\eta}{\delta} u'(Y - \eta I^*) \tag{28}$$

We now look at how the optimal educational level changes with n:

$$\underbrace{u''[y(I^*,n) - \mu F(n)]}_{(-)} \underbrace{\left[\frac{\partial y(I^*,n)}{\partial n} - \mu f'(n)\right]}_{(-)} \underbrace{\frac{\partial y(I^*,n)}{\partial I^*}}_{(+)} + \underbrace{u'(y(I^*,n) - \mu F(n))}_{(+)} \underbrace{\frac{\partial^2 y(I^*,n)}{\partial I^* \partial n}}_{(-)} \tag{29}$$

We see that the first part is positive: $u''()$ is negative; $\frac{\partial y(I^*,n)}{\partial n}$ is negative, as well as $-\mu F'(n)$ while $\frac{\partial y(I^*,n)}{\partial I^*}$ is positive. This is the (negative) income effect: The cost of raising children directly though $f(n)$ as well as indirectly through the forgone income $\frac{\partial y(I^*,n)}{\partial n}$ decrease income available for consumption and thereby increase the marginal utility of additional earning.

The sign of the second part depends on the sign of $\frac{\partial^2 y(I^*,n)}{\partial I^* \partial n}$. Using our income generation function from before:

$$\frac{\partial^2 y(I^*, n)}{\partial I^* \partial n} = -\delta P'(I) \tag{30}$$

Since hourly wage/productivity is increasing in human capital, returns to education decrease in the number of children. The less time the individual can spend working, the less payoff the individual received from investment in education. This is the (negative) substitution effect: reducing working hours due to children decreases the payoffs of educational investment.

The overall effect is positive when the income effect is larger than the substitution effect:

$$u''(y(I^*, n) - \mu F(n)) \left[\frac{\partial y(I^*, n)}{\partial n} - \mu F'(n)\right] \frac{\partial y(I^*, n)}{\partial I^*} > -u'[y(I^*, n) - \mu F(n)] \frac{\partial^2 y(I^*, n)}{\partial I^* \partial n} \tag{31}$$

If we assume constant absolute risk aversion (CARA) with a the coefficient of absolute risk aversion, we get:

$$a \frac{\partial y(I^*, n)}{\partial I^*} \left[\mu F'(n) - \frac{\partial y(I^*, n)}{\partial n}\right] > -\frac{\partial^2 y(I^*, n)}{\partial I^* \partial n} \tag{32}$$

9.3.2 How does the overall effect change with the cost of raising children μ?

We first take the total derivative of the left hand side of equation 31 (consumption smoothing effect) in terms of μ:

$$\underbrace{u'''(y(I^*, n) - \mu F(n))}_{(+)} \underbrace{\frac{\partial y(I^*, n)}{\partial I^*}}_{(+)} \underbrace{\left[\mu F'(n) - \frac{\partial y(I^*, n)}{\partial n} \mu F(n)\right]}_{+} - \underbrace{u''(y(I^*, n) - \mu F(n))}_{(-)} \underbrace{\frac{\partial y(I^*, n)}{\partial I^*}}_{(+)} \underbrace{F'(n)}_{(+)} \tag{33}$$

Under the assumption of prudence ($u'''(.) > 0$), the higher costs of raising children strengthens the consumption smoothing channel. This implies that if there is no labour supply effect of children, i.e. $\frac{\partial^2 y(I^*, n)}{\partial I^* \partial n} = 0$ and $\frac{\partial y(I^*, n)}{\partial n} = 0$, then the effect of anticipated fertility on education increases with the cost of raising children (Proposition 1, part 1).

We not take the total derivative of the right hand side of equation 31 (labour supply effect) in terms of μ:

$$\underbrace{u''[y(I^*, n) - \mu F(n)]}_{(-)} \underbrace{\frac{\partial^2 y(I^*, n)}{\partial I^* \partial n}}_{(-)} \underbrace{\mu F(n)}_{(+)} \tag{34}$$

We can see that the cost of raising children also strengthens also the labour supply channel.

If we assume CARA, as in equation (32), the we see that the cost of raising children increases the left-hand side, but has no effect of the right-hand side, such that the overall effect is:

$$a\frac{\partial y(I^*,n)}{\partial I^*}F'(n) \tag{35}$$

of which all parts are positive.

9.3.3 How does the overall effect change with the loss in working time δ?

In order to investigate the effect of working time reduction, we assume now that the forgone earnings are the only cost of having children (ignoring $f(n)$):

$$u''(y(I^*,n))\frac{\partial y(I^*,n)}{\partial n}\frac{\partial y(I^*,n)}{\partial I^*}+u'(y(I^*,n))\frac{\partial^2 y(I^*,n)}{\partial I^*\partial n} \tag{36}$$

Using our example income generation function:

$$\underbrace{u''((T-\delta n)P(I^*))(-\delta P(I^*))(T-\delta n)P'(I^*)}_{\text{Income smoothing channel}}-\underbrace{u'((T-\delta n)P(I^*))(\delta P'(I^*))}_{\text{Labour supply channel}} \tag{37}$$

Taking total derivatives of the label supply channel in terms of δ:

$$u'(c^2)P'(I)+u''(c^2)\delta nP'(I)(-nP(I)) \tag{38}$$

of which both terms are positive. The labour supply effect is thus increased in the loss of working time.

Taking total derivatives of the income smoothing channel in terms of δ:

$$\underbrace{u''(c^2)}_{(-)}\underbrace{P(I)P'(I)}_{(+)}\underbrace{[2\delta n-T]}_{?}+\underbrace{u'''(c^2)}_{(+)}\underbrace{nP(I)\delta P(I)(T-\delta n)P'(I)}_{(+)} \tag{39}$$

While the second term is positive under the assumption of prudence, the sign of the first term depends on the sign of $2\delta n - T$. If $T > 2\delta n$, then the the loss in working hours increases the income smoothing channel (while the reverse is not necessarily true).

We can again use at the case of constant absolute risk aversion. Rewrite equation 32 without cost of raising a child and using the income generation function:

$$a(T-\delta n)P'(I)\delta P(I) > \delta P'(I) \tag{40}$$

which reduces to:

$$a(T-\delta n)P(I) > 1 \tag{41}$$

As an increase in δ decreases the left hand side, it decreases the effect of anticipated fertility on education.

9.3.4 How does the overall effect change with income?

Suppose the income generation function now it $Y(I,n) = (T-\delta n)\tau P(I)$ where τ captures some technology factor or labour market conditions. By simply plugging it in equation 41, we can see that under CARA higher wages lead to a higher effect of anticipated fertility on education.

$$a(T-\delta n)\tau P(I) > 1 \tag{42}$$

If we do not make the assumption of CARA, the effect is as ambiguous as the loss of time due to child care, just with the opposite sign.

9.3.5 Gender Difference and Marriage Markets

The first order condition for equation 22:

$$\begin{aligned}\frac{\partial \omega(I^*,\tau)}{\partial I^*}\left(u'(c_m^2)\left[\frac{\partial y(I^*)}{\partial I^*} + \frac{\partial y(J(I^*),n)}{\partial J(I^*)}\sigma - \frac{\partial p(I,n,Z)}{\partial I^*}\right] + \alpha h(n)\right) + \\ u'(c_s^2)\frac{\partial \tilde{y}(I^*)}{\partial I^*}\left(1 - \frac{\partial \omega(I^*,\tau)}{\partial I^*}\right) = \frac{\eta}{\delta}u'(c^1)\end{aligned} \tag{43}$$

9.4 Further empirical results

9.4.1 Effect of fines on education

What can be observe with a (noisy) measure on P that is measured at the province level? Once the full set of controls X is included, the effect of P is captured in the province times year fixed effects. However, we can look at the differential effect of fines for those that are eligible. Eligibility for a second child permit means an anticipated cost reduction in the monetary cost of the second child, and this cost reduction is a function of the fines. The cost reduction is essentially an interaction between eligibility and the monetary fine levels:

$$I_i = \delta \tilde{Z}_i' P_i + X_i + \tilde{\mu} \tag{44}$$

Monetary fines can also be used to test predictions derived from the theoretical mode: First, monetary fines should change the distribution of *always-2* in the population. For this, I first check if eligibility has a higher effect on fertility outcome when fines are high. I also verify if monetary fines are important making predictions in the prediction status L (see previous subsection). Second, monetary fines do not have an effect for those that are either *increasers* and *always-1*. Third, monetary fines potentially have an effect on *always-2*, though it is unclear in which direction.

In order to investigate the effect of fines on education, I use the fine data set from Ebenstein (2010) which is based on Scharping (2013) and includes the official monetary fines (as well as bonuses) that are set on the province level. Unfortunately, the fines are only available until 2000, so that only 2/3 of the main cohort can be used.[22] The fines are set as a multiple of the previous year's household annual income and ranged between 0.15 and 5 between 1990 and 2000. These official monetary fines measure the true costs of an out-of-quota child imperfectly: We do not know if these fines where actually implemented, and there were other penalties such as losing one's job that are important. Furthermore, there were several costly avoidance strategies whose employment probably correlated with the official fines.

The results including monetary fines are displayed in table 13. Second child permits can be interpreted as a cost reduction which equals eligibility status times the fine amounts. This definition of cost reduction is included in column 1 and 3 and the coefficients are interpreted as followed: a cost reduction of one time the annual income increases the likelihood of having a second child by 9.4 percentage points but does note have a significantly positive effect on education. Differentiating between those predicted to be *always-2* and those not (column 3), we find that those that are not predicted to be *always-2* react positively to a cost reduction while those that are predicted to be *always-2* do not. Here, the prediction process for *always-2* includes the fine levels as a possible predictor.

However, the amount of monetary fines does not add explanatory power over just using an eligibility dummy (see column 2 and columns 5 to 8). Being eligible in a province with higher fines does not have a higher effect on the likelihood of having a second child than being in a province with lower fines. Fines are also not important in predicting *always-2* (see figure **??**). This is probably due to these official fines measuring the real cost of an out-of-quote child very noisily.

[22] The previous results hold for this subsample.

	Dependent variable:					
	Having 2nd child		Enrollment in Senior High School			
Cohort	1977-1987 (1)	1977-1987 (2)	1990-2000 (3)	1990-2000 (4)	1990-2000 (5)	1990-2000 (6)
Cost reduction	0.0941*** (0.0249)		0.0182 (0.0129)	0.0276* (0.0138)		
Eligibility at age 27/28		0.148*** (0.0433)				
Eligibility at age 27/28 X Monetary fine (std)		0.0114 (0.0110)				
Predicted *Always-2* X cost reduction				-0.0249** (0.0108)		
(Anticip.) eligibility at age 16					0.0929** (0.0431)	0.129*** (0.0397)
(Anticip.) eligibility at age 16 X Monetary fine (std)					-0.000107 (0.0239)	-0.00487 (0.0269)
Predicted *Always-2* X (Anticip.) eligibility at age 16						-0.0712 (0.0429)
Predicted *Always-2* X Monetary fine (std)						-0.0360 (0.0464)
Predicted Always-2 X (Anticip.) eligibility at age 16 X Monetary fine (std						0.0227 (0.0549)
Predicted *Always-2*				-0.0703** (0.0275)		-0.0706* (0.0379)
Observations	7607	7607	5405	5187	5405	5187
R^2	0.420	0.421	0.445	0.455	0.446	0.456

Note: All regressions are OLS Difference-in-Difference specification with province level times fixed effects, control for eligibility characteristics times province fixed effects and gender. Anticipated eligibility at age 16 is calculated on the basis of the province, eligibility characteristics and time. Eligibility controls include dummies for being an only child, having a rural household status and ethnic minority status. Column 1 and 2 control for sex of the first child, includes only those that are married and had their first child before 2003. Clustered standard errors on province X urban level in parenthesis. Column 7 includes only those that are predicted to not have a second child when not eligible based on the random forest specification, column 8 those that are predicted to have a second child when not eligible. Significance levels: * 0.10; ** 0.05; *** 0.01 Data source: China Family Panel Survey 2010.

Table 13: Monetary fines and eligibility.

9.4.2 Effect of second child permits on other variables

Anticipated fertility can also have an effect on other choices. For example, those that anticipate to have more children could get married earlier and have their first child earlier. However, it should be remembered that in order to apply for a second child permit, couples often have to respect certain criteria, one being 'late birth' of the first child. Late birth is defined as the woman being at least 25 years old when having the first child. For those being born between 1970 and 1980, average age at first birth lies at 24.75 overall, 24 for women and 25.56 for men. Thus, this criterion might actually push those that plan to apply for a second child permit to wait until age 25 for having the first child.

Since the decisions are taken at a later stage in life, I use the eligibility status at age 22 for the timing of marriage, and the eligibility status at age 25 for the timing of first birth. The sample is adjusted accordingly. I also control of the years of education to correct for any effect that fertility expectations could have through education. The result using the triple differences specification are displayed in table 14 in the appendix. The coefficient of eligibility status at age 22 on the age of marriage is significantly negative once it is interacted with the sex of the individual (column 2). When female specific year and province fixed effects and an interaction between the female indicator and education are included (column 3), eligibility significantly decreases the age at marriage only for men.

We find the same results for the age at the birth of the first child: When female specific year, province, and educational effects are included, eligibility at age 25 significantly decreases the age at first birth only for men (column 6). A potential explanation is that eligible women are concerned with the official guidelines about late marriage and late birth. It is also possible that for women the legal limit for marriage is generally binging. At the same time, there are no thresholds for men and the legal marriage age might not be binding for most men, so that they can adjust the age of marriage and first birth to their anticipated fertility.

	Dependent variable:					
	Age at marriage			Age at first birth		
Cohort (years they turned 16)	1981-1996	1981-1996	1981-1996	1984-1999	1984-1999	1984-1999
	(1)	(2)	(3)	(4)	(5)	(6)
Nb children allowed at age 22	-0.618	-0.732*	-0.949**			
	(0.397)	(0.419)	(0.422)			
Nb children allowed at age 25				-0.680*	-0.846**	-0.967**
				(0.358)	(0.376)	(0.380)
Female X Nb children allowed at age 22		0.212	0.635***			
		(0.276)	(0.236)			
Female X Nb children allowed at age 25					0.314	0.602**
					(0.196)	(0.243)
Female dummy; Education	Yes	Yes	Yes	Yes	Yes	Yes
Eligibility controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Eligibility controls x Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE x Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Eligibility controls x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Female x Year FE,Province FE & Education	No	No	Yes	No	No	Yes
Observations	8703	8703	8703	9725	9725	9725
R^2	0.237	0.237	0.247	0.209	0.209	0.218

Note: Sample includes individuals that turned 22 between 1990 and 2000 for columns 1 to 3 and individuals that turned 25 between 1990 and 2000 for columns 4 to 6. Eligibility at age 22 and 25 is calculated on the basis of the province, eligibility characteristics and time. Eligibility controls include dummies for being an only child, having a rural household status and ethnic minority status. OLS regression with robust standard errors in parenthesis. Data source: China Family Panel Survey 2010.

Table 14: Effect of eligibility on age at marriage and age at first birth.