The Impact of Women's Education on Fertility Quantity

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Abstract

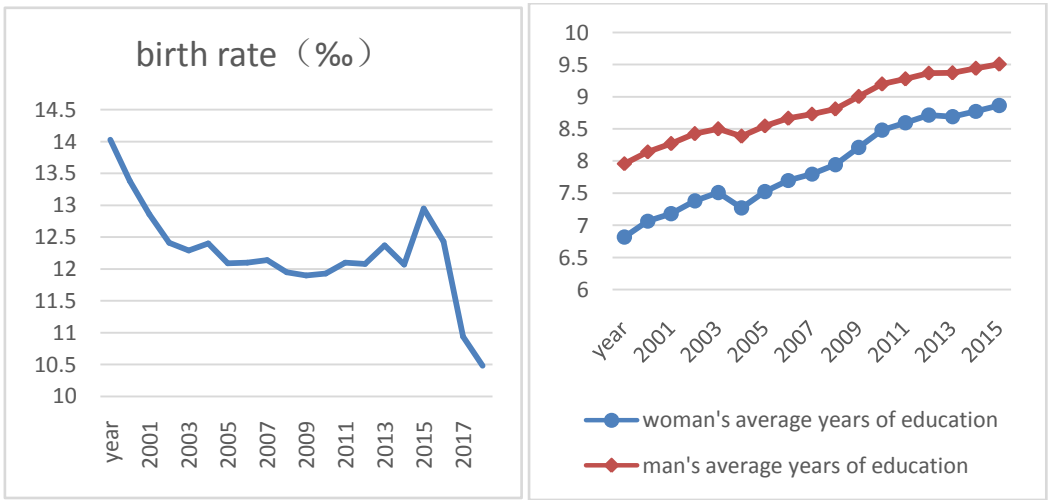
The continued decline of the birth rate in the context of the increasingly serious population aging is worrying, and the relaxed fertility policy has not succeeded in stimulating the effective growth of the birth population. This article intends to provide a new perspective for the sluggish birth rate from the perspective of increasing female human capital investment, using the China Comprehensive Social Survey (CGSS),and introducing the 1999 education expansion into Regression Design (RDD) as identification strategy. The results show that the increase in the number of years of education for women has significantly reduced the number of births of their lifetime children, especially the number of boys. Finally, this article expounds the mechanism of the changes in female education and birth from three aspects: age at first marriage and unmarried rate, number of boys giving birth and contraceptive rate.

Keywords: Women' Education Fertility Quantity Education Expansion RDD

1. Introduction

As the marriage registration rate of the marriageable population decline, the age at first marriageincrease, the fertility level of the married population decline, and the birth rate of the population also decline. Factors that affect the number of births include macro-fertility policies, micro-economic income, housing prices, retirement policies (Yan C L,2018), etc. However, this is not a good and complete explanation of the continuing decline in the birth rate: the full liberalization of the "two-child policy" since 2016 has not caused a significant "baby boom"; rising wage levels in urban areas have not been accompanied by the increase in the birth rate; the significant increase in housing prices in recent years cannot explain the long-term decline in the birth rate; etc.

As women are the main bearers of fertility, the average years of education of women in China has been increasing in recent years, and the gap between women and men has gradually narrowed (Figure 1). Therefore, this article focuses on the impact of women's education on the fertility quantity. Using the China General Social Survey 2005, 2006, 2008, 2010-2013, a total of 7 rounds of survey data, introducing the 1999 higher education expansion enrollment policy as an instrumental variable intoRegression Discontinuity Design(RDD) to analyze the causal effect of women's education on fertility quantity. Due to the traditional marriage customs in China, women join men's family after marriage, so men are always prior to women in the family's human capital investment decision, and the difference between gender is huge. After the policy of education expansion in 1999, women's probability of obtaining education is significantly higher than before. This policy has more effectively promoted the improvement of women's education, so it is feasible to select this exogenous policy as the identification strategy in this paper.



Data source:*China Population and Employment Statistical Yearbook 2000-2019*

Figure 1 2000-2019 birth rate and average years of education

2. Literature Review

When discussing the impact of education on fertility behavior, a large number of existing literatures have confirmed that education does have significantly impact, which is mainly reflected in delaying the birth (Zhou, 2005; Chen et al, 2011; Ali FR M, Gurmu S., 2016, etc.), changing gender preferences (Guo, 2008; Zhao, 2019, etc.), and changing the concept of fertility (Song et al, 2017) to affect fertility quantity (Jain, 1981; Chen et al, 2002; He et al, 2017, etc.).

Existing literatures systematically analyzes the fertility quantity, including the willing fertility and the actually born, all agree that education is a statistically significant factor (Jain, 1981; Skirbekk et al., 2004; Kravdal&Rindfuss, 2008; Chen et al, 2002; He et al, 2017, etc.). Considering a series of social, economic, family, and personal characteristics in the theoretical model derivation and empirical model regression analysis, women's education and husband's education, also show statisticallysignificant impact on fertility behavior. However, the specific relationship between education and fertility quantity, including willingness to have children and actual number of children is still controversial. Whether the relationship between them is simply a negative correlation or a U-shaped relationship remains to be proved. In addition, there are also a small number of studies believe that education has no significant impact on the willingness to have more children.Feng (2010) based on survey data of married young people in five major cities, describing and analyzing the willingness and related influencing factors of "single couples" to give birth to a second child withnon-singular couples as a reference,which comes to a conclusion that education have no effect on their willingness.

The impact of education on fertility quantity is mainly reflected in the following aspects: delaying to enter marriage and childbirth, increasing the opportunity cost of childbirth, and changing the concept of childbirth.

2.1Delay to enter marriage and childbirth

Affected by Chinese traditional culture, people always marry first and childbirth afterward. Although unmarried childbearing is becoming universal in the transition from traditional society to modern society,"marriage before childbirth" is still dominated.Thus, the extension of years of education inevitably postponed their marriage, and therefore postpone their childbirth(Liu ,2016; Yang et al,2018; Ali FR M. Gurmu S., 2016).

2.2Increase the opportunity cost of fertility

The improvement of employment environment and the increase of average wages due to education have significantly increased the opportunity cost of raising children (Zheng et al, 2009; Duan et al, 2020). Although the increase of family income has reduced the economic pressure of raising children to a certain extent, but the loss of opportunity cost is even more severe. With increasing competition in a modern society, the impact of childbirth on career development cannot be ignored. A significant increase in opportunity cost has forced people to reduce their fertility. Yang et al (2018) introduce the quasi-natural experiment formed by the implementation of the Compulsory Education Law in 1986 to demonstrate that the deepening of education significantly reduced birth, byconstructing a utility function model with time as input, expounding themechanismof preference and opportunity cost. The significant negative impact of childbirth on the wage rate of women in China (Yu et al, 2014) also largely suppresses women's actual fertility quantity.

2.3 Change the concept of fertility

On the one hand, education will effectively change people's concept of fertility to a large extent (Zhou, 2005). Education has improved people's awareness of self-realization (Song et al, 2017), making people more self-conscious. The number of children born will be sacrificed to pursue personal values, so that the willing fertility quantity and the actual number of children show a downward trend. As far as China's economic and social evolution is concerned, agricultural society has a large demand for labor due to the limitation of production tools, and the traditional concept of "more children, more happiness" has a long-term influence on people's ideal and willingness of fertility quantity. With the advancement of production technology and the continuous improvement of education level, people of different ages obtain different education, and thus vary in willingness to bear children.

At the same time, education will change people's traditional concept of gender preference. The continuous increase in education, especially women's, will affect fertility quantity by changing the traditional concept of gender preference. Constrained by the demand for labor in agricultural period, family have a natural preference for boys. In addition, daughter always join her husband's family after marriage, and therefore the labor force is reduced in her family. Especially in the years when family planning policy was strictly enforced, the number of births was strictly controlled, thus the preference for gender selection was further strengthened (Gu et al, 2005). However, with the general increase in education in recent years, the average education of women has even surpassed that of men, and at the same time the employment conditions and wage of women have been significantly improved, the comparison of costs and benefits of raising boy or girl has been reversed gradually, which are conducive to improve the sex ratio of the birth population (Zhao, 2019).

On the other hand, education will change people's concept of raising children, so in the long term, the quality of children will gradually replace the quantity. This trend is also inevitable in terms of economic development and social progress (Becker et al., 1986).This effect is indirect but real. Becker compares children as general consumer goods for the family, when family income continue to increase, the demand for the number of children will gradually give way to the quality. In addition, people are forced to invest more and more in human capital of their children. The increase in education expenditures for individual children has significantly increased the cost of raising children (Zheng et al, 2009; Sun, 2010). With the constraints of family income, rational parents have to reduce their fertility quantity.

The above studies have well demonstrated the impact of higher education levels on fertility behavior. The statistical correlation between them is obvious. However, most existing studies have studied the impact of education on fertility without distinguishing gender differences. As women are the main bearers of fertility, the increase of education level has different effects on the fertility quantity between gender. Therefore, this paper focuses on the impact of women's increased education level on fertility quantity. Some of the existing studies only analyze the statistic relationship between education and fertility, and they did not use empirical models to identify the causal relationship between the two. Evenfew studies construct empirical model to analyze the causal relationship, the endogenous problem of identification is not solved well, leading to biased estimation results. This paperincorporates the 1999 higher education expansion policy into the identification strategyas an instrumental variable,and useRegression DiscontinuityDesign (RDD) to solve the endogenous problem. Then we can more accurately estimate the causal impact of women's education on fertility quantity.

3. Model and Data

We adopt Regression Discontinuity Design (RDD) to identify the casual relationship between women's education and their fertility quantity, thus we can avoid some endogenous problem such as omitting variables, mutual cause and effect, etc.Compared with other models, it is more suitable to use RDD to estimate the local average treatment effect in this paper.

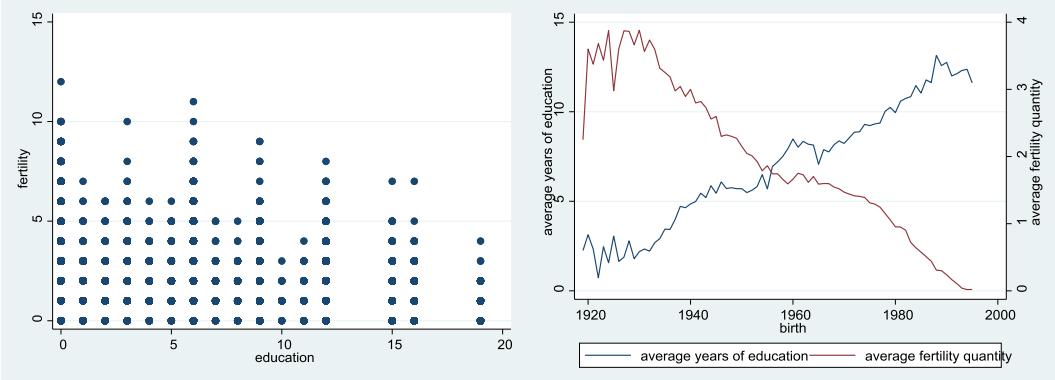
We introduce the 1999 higher education expansion policy as an instrumental variable to identify the effect between the two. Existing studies have proved that the 1999 education expansion policy has significantly improved the gender gap in women's access to education (Zhang et al, 2013; Shao, 2015; Liu, 2016), women's level of education has effectively improved afterward. Therefore, we believe that it is effective to use the policy as a shock to identify this impact. Because the 1999 policy affects those who graduated from high school in this year and later, and the age of high school graduation is around 20 generally. So the policy actually affects people born in 1979 and later. In other words, women born in 1979 and later are likely to obtain more education. Thus we set the year of birth in 1979 as breakpoint. Women born in 1979 and later is treated. In addition, because of the 1999 policy, the probability of women receiving more education is improved, rather than jump from 0 to 1, therefore we use a fuzzy Regression Discontinuity Design (RDD) rather than a sharp RDD. The model is conducted as follow (refer to Zou et al (2015)):

$$Fertility_i = \beta_0 + \beta_1 Education_i + \beta_2 S + \beta_3 S^2 + \varepsilon_i$$

$$Education_i = \alpha_0 + \alpha_1 D_i + \alpha_2 S + \alpha_3 S^2 + \epsilon_i$$

Among them,$Fertility_i$ represents the fertility quantity of woman i; $Education_i$represents theyears of education of woman i; $S = (birthyear - 1979)$represents the gap between the birth year of woman i and the breakpoint; $D_i$represents the group variable, that is, if a woman's birth year is later than 1979, $D_i = 1$ means that she has been treated, otherwise it is 0; we add a multi-order term of the differencebetween the birth year of woman i and breakpoint to construct a nonlinear relationship for RD estimation. The order selection is judged by the AIC criterion (Zou et al, 2015).

The data we used comes from 7 rounds of the China General Social Survey (CGSS) 2005, 2006, 2008, 2010-2013. The survey covers a total of 72 municipal districts and 62 counties (county-level cities). In order to be more representative, the survey uses stratified sampling. The interviewed households are updated in every survey, and one adult over 18 years old is interviewed in each household. Wedelete the unmarried and cohabiting samples, retain the relevant data of age-appropriate women;then delete the samples whose core data is missing. We finally obtain a total of 51904 samples.



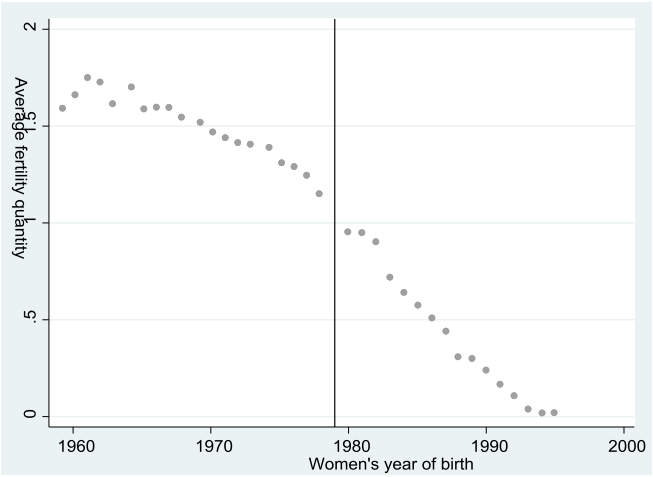
a b

Data Source: CGSS 2005-2013

Figure 2 Average Women's Year of Education and Fertility Quantity

As shown in Figure 2a, there is an obvious negative relationship between the women's average years of education and theirnumber of children born. As the average years of education for the interviewed women continue to increase, their average number of children born has shown an overall downward trend. Figure 2b shows that the later a woman's year of birth, the longer her years of education, the less her fertility quantity she actually gives birth.It is consistent with our expectation, and it verifies that there may indeed be significantly statistically negative between women's education and their fertility quantity.

In particular, for women born around 1979, the years of education they obtained showed a slight and significant increase, at the same time, the average number of children they actually give birth to dropped to less than one child (as shown in Figure 3).



Data Source: CGSS 2005-2013

Figure 3 Women's Year of Birth and Average Fertility Quantity

4. Empirical Result

4.1 Descriptive statistics

Table 1 Descriptive statistics of variables

	All sample	Left 1969	1974	Cutoff 1979	Right 1984	1989
Women's year of education	7.166	8.372	9.296	10.240	11.462	12.577
Fertility quantity	1.853	1.545	1.467	1.313	1.222	1.115
Boy	1.007	0.814	0.789	0.735	0.670	0.667
Girl	0.845	0.732	0.678	0.577	0.552	0.448
Family income	32136.9	33358.7	37022.6	48415.2	52550.5	57880.7
Husband's year of education	8.883	8.664	9.525	10.142	11.153	10.248
Father's year of education	3.708	4.070	4.859	5.680	7.348	8.791
Mother's year of education	2.273	2.477	3.258	4.111	5.985	7.55
Unmarried rate	9.76	0.55	1.17	7.47	29.50	60.37
Age of first marriage	22.587	22.728	22.997	22.932	23.431	23.5
Number	51904	1087	1024	723	583	323

4.2 Empirical result

Table 2 Impact of education expansion policy on the average years of education for women

	Y: year of women's education			
	（1）	（2）	（3）	（4）
Dummy of birth	0.176*	0.083*	0.075*	0.078*
	（0.072）	（0.033）	（0.030）	（0.032）
$(birth-1979)$	0.140***	0.147***	0.147***	0.162***
	（0.002）	（0.005）	（0.005）	（0.007）
$(birth-1979)^2$	0.000***	0.000*	0.000**	0.001***
	（0.000）	（0.000）	（0.000）	（0.000）
$(birth-1979)^3$		0.000	0.000	0.000***
		（0.000）	（0.000）	（0.000）
$(birth-1979)^4$			0.000	0.000***
			（0.000）	（0.000）
$(birth-1979)^5$				0.000***
				（0.000）
Dummy of region and year	Yes	Yes	Yes	Yes
Constant	14.105***	14.165***	14.169***	14.201***
	（0.602）	（0.604）	（0.604）	（0.604）
Number	44782	44782	44782	44782
R^2	0.351	0.351	0.351	0.352
F-test	356.02	350.89	345.87	341.26

Note: the robust standard error is shown in brackets. ***p＜0.01, **p＜0.05, *p＜0.1.

We firstly estimate the impact of the birth on their education. Table 2 shows the results of the local estimation of RDD. The bandwidth selection follows the principle of optimal bandwidth. The explained variable is the years of education of the interviewed women. The estimation results show thatthe impact of the dummy of birth on the years of education is significantly positive, indicating that women's birth after 1979 significantly increases the years of education, which means that we use the dummy of birth as instrumental variable are feasible to measure the impact of college enrollment expansion policies on women's year of education.

The estimation in Table 2 is equivalent to the first stage regression. Then we focus on the main regression, that is, the effect of women's years of education on their fertility quantity, which is the second stage regression. Table 3 shows the 2SLS estimation results. We use RDD to estimate the impact of women's education on their total fertility quantity, boy, and girl respectively.Apart from women's years of education, we control some other variables which reflect the characteristic of family, such as women's job, husband's years of education and job, father's years of education and job, mother's years of education and job, family income, etc.

Table 3 the effect of women's average years of education on the fertility quantity

	Total children	Boy	Girl
Women's years of education	-0.032***	-0.047***	0.015***
	（0.002）	（0.002）	（0.002）
Women's job	0.000	-0.000	0.000
	（0.000）	（0.000）	（0.000）
Husband's years of education	-0.025***	0.017***	-0.042***
	（0.002）	（0.002）	（0.002）
Husband's job	-0.000	-0.000	-0.000
	（0.000）	（0.000）	（0.000）
Father's years of education	0.002	0.000	0.002
	（0.002）	（0.002）	（0.003）
Father's job	-0.000	-0.000	-0.000
	（0.000）	（0.000）	（0.000）
Mother's years of education	-0.009***	-0.004*	-0.004*
	（0.002）	（0.002）	（0.003）
Mother's job	-0.000	-0.000	-0.000
	（0.000）	（0.000）	（0.000）
Family income	0.000	0.000	0.000
	（0.000）	（0.000）	（0.000）
Order of$(birth-1979)$	Yes	Yes	Yes
Dummy of birth	Yes	Yes	Yes
Dummy of region and year	Yes	Yes	Yes
Constant	1.959***	0.958***	1.001***
	（0.287）	（0.229）	（0.298）
Number	5661	5661	5661
R^2	0.329	0.197	0.127

Note: the robust standard error is shown in brackets. ***p＜0.01, **p＜0.05, *p＜0.1.

Figure 4 is obtained by local polynomial estimation. Among them, the horizontal axis is $(birth-1979)$and the vertical axis is the average years of education of women, the number of total children, boys and girls respectively.

Figure 4 reflects women's average years of education and fertility quantity born around 1979intuitively. Generally speaking, the later women's birth year, the more their average years of education, and the less children they give birth to. However, with the external shock of college enrollment expansion policy, the increase in women's average years of education and the decline in the total fertility quantity has accelerated, which shows that this exogenous policy has a significant impact on them. It further proves that we use this exogenous policy as identification strategy is feasible.

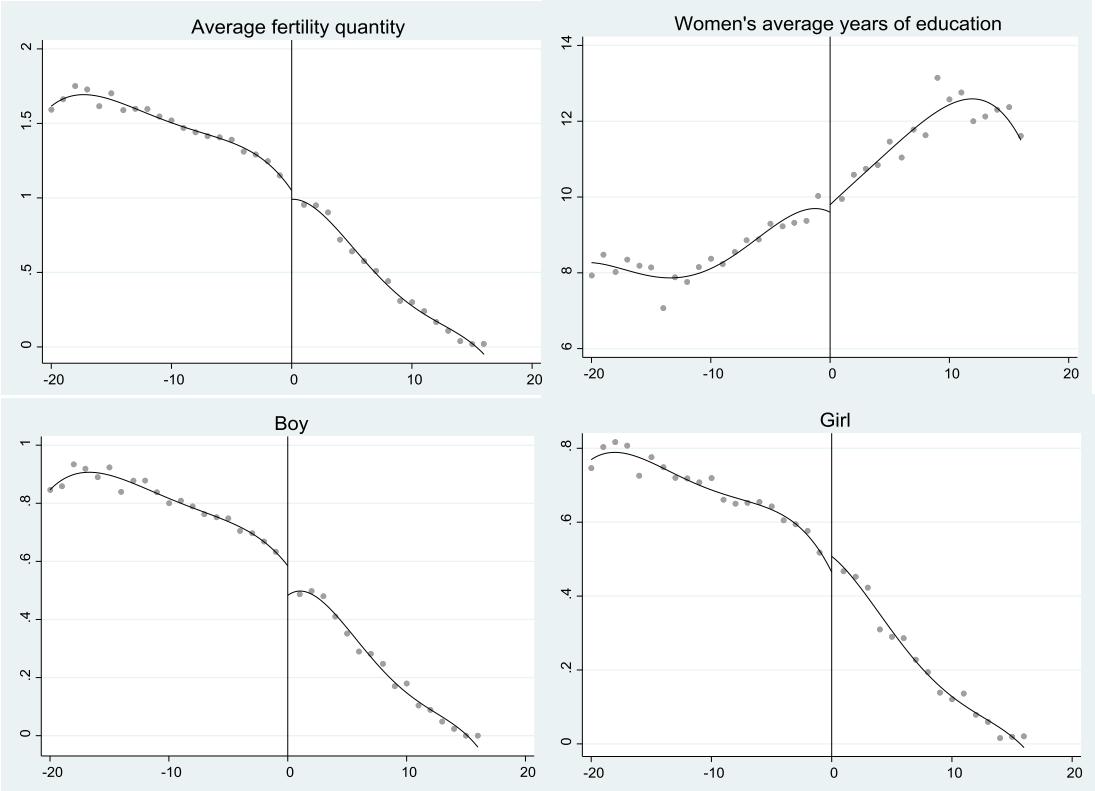


Figure 4 the effect of increased education on fertility quantity

5. Mechanism discussion

Based on the above empirical results, the increase in the average years of education of women caused by the 1999 college enrollment expansion policy has significantly reduced the fertility quantity. We intend to examine the mechanism of inhibitory effect from three aspects in this part: age of first marriage and unmarried rate, number of boys, and contraceptive rate.

5.1 Age of first marriage and unmarried rate and unmarried rate

The extension of women's years of education inevitably directly postponed the time to enter marriage. The survey data shows, as women's years of birth are later, the average age of first marriage is larger. Delaying marriage means delaying the first child. Subject to physiological conditions, the increase in the age of first child will lead to a decline in total number of births throughout the whole life. In addition, the increase in the years of education for women reduces the probability of entering marriage and increases the unmarried rate. Higher-educated women prefer to pursue their self-value, while pregnancy and fertility more or less would interrupt their profession. Then they would be cautiously to enter marriage, even chose to be unmarried throughout their life. Even if higher-educated women choose to marry, they will choose less fertility to reduce the negative influence in their career.

5.2Number of boys

As shown in previous regression results, the increase in women's years of education has led to a decrease in the number of births, which is largely performed as the decrease in the number of boys. The number of girls even behaved as an increasing trend after adding some control variables into the regression.

Due to the rigid demand for men in production in the farming era, people gradually prefer to nurture boys in China. Even in modern times, because of the advantage for men in obtaining a job or raising salary, therefore raising a boy is more attractive for a family, considering the cost and benefit of raising a child.

However, in recent years, the education of women has continued to improve and even surpassed that of men. At the same time, with the improvement of women's employment conditions and wages in job hunting, women's status in family has improved, thus women are more initiative to decide their fertility quantity. The improvement of

women's employment environment has changed cost-benefit analysis for families of raising girls. Women's sense of self-identity has also been strengthened significantly. Therefore, the increase in women's years of education has an overall effect on the suppression of fertility quantity. It behaves as a negative effect on boys and a positive effect on girls.

5.3 Contraceptive rate

Some feminists at home and abroad regard the expanded use of condoms as one of the signs of women's independence and advancement. Under the strict family planning policy, Chinese women are forced to be executed sterilization operations, whose physical comfort and health are largely ignored. Later, the widespread use of condoms provides safe and reliable measures to control fertility.We combine the data of condoms-using in *China Population and Employment Statistical Yearbook*with survey data and regress, the results show that the improvement of women's education has a significant positive impact on condom use. The widespread use of this contraceptive measure effectively provides women with the protection of controlling pregnancy and fertility, so the total fertility quantity is effectively reduced.

6. Conclusion

The improvement of women's education has actually affected their marriage and childbirth decision-making as well as the fertility quantity in terms of ideology and economic benefits. We incorporate the external impact of the college expansion enrollment in 1999 into the identification strategy, and analyze the impact of continuous increase in women's education on fertility quantity. Besides, we examine the mechanism through the first marriage time and unmarried rate, the number of boys and the contraceptive rate. The research results show that: on the one hand, the increase in women's years of education squeezes out the time of marriage and childbirth, which leads to a significant increase in the average age of women entering marriage and reduces fertility quantity inthe women's lifetime.On the other hand, the decrease of fertility quantity led by the increase in women's average years of education is more behaved as the decrease of boys; after adding some control variables into the regression, the increase in women's years of education even has a positive effect on the number of girls. Third, women's years of education is continuously improving, leading to the awakening of women's self-protection and self-consciousness. In the choice of contraceptive methods, the use of condoms has been significantly increased, and the willingness offertility has been controlled more effectively, which has led to a decline in fertility quantity.

The above conclusions, on the one hand, in the context of the deepening of China's population aging, provide a new perspective on the decline in fertility quantity from the perspective of women's years of education, enriching the interpretation of population aging; on the other hand, considering the fertility quantity from the perspective of women's years of education provides a more adequate explanation of the continued decline in fertility quantity and enriches the research on the changes betweenwomen's education and fertility. The conclusions above enlightened that women themselves should weigh education and marriage, as well as fertility. Besides, we should provide more child care services organized by government or social organizations, which can help workers, especially female workers, to balance work and family.

References

Duan Jihong, Su Huashan, Zhang Cheng.The influence of childbearing cost on the willingness to bear children[J].Contemporary Finance,2020(01):17-26.

Zhao Menghan.The influence of women's education level and marriage pattern on the willingness to give birth to the second child[J].Journal of Demography,2019,41(03):16-27.

Yang Zhenyu, Zhang Cheng.The impact of education deepening on the age of first marriage and the number of births: a quasi-experimental study based on the implementation of the Compulsory Education Law[J].Population and Development,2018,24(01):18-32+42.

Yan Chengliang.Delayed Retirement, Intergenerational Rearing and Birth Rate[J].World Economy,2018,41(06):152-172.

He Mingshuai,Yu Miao.Family per capita income, intergenerational social mobility and willingness to bear children[J].Labor Economics Research,2017,5(05):117-140.

Liu Hao.The impact of college enrollment expansion on the age of first marriage in my country: An analysis based on census data[J].Population and Economy,2016(01):19-28.

Shao Cen. Educational Expansion and Gender Difference in Educational Access (1978-2008)[J].Youth Research,2015(02):10-19+94.

ZhaiZhenwu,ZhangXianling,JinYongai.Analysis of the Demographic Consequences of Immediately Fully Liberalizing the Second Child Policy[J].Population Research,2014,38(02):3-17.

Yu Jia,XieYu.The impact of childbirth on the wage rate of women in my country[J].Population Research,2014,38(01):18-29

Zhang Zhaoshu,ChenQi.The expansion of college enrollment and the gender equality of higher education opportunities: an empirical analysis based on the data of the China Comprehensive Social Survey (CGSS2008)[J].Sociological Research,2013,28(02):173-196+245.

Chen Wei, Jing Yongai.The differences and influencing factors of Chinese women's fertility willingness and fertility behaviors[J].Journal of Demography,2011(02):3-13.

Feng Xiaotian.Second Childbearing: An Analysis of the Willingness of "Double Alone Couples" and Related Factors[J].Social Sciences,2010(05):58-66+188-189.

Sun Kuili.Analysis on the Influencing Factors of Rural Women's Childbearing Desire[J].Journal of Demography,2010(03):20-24.

Zheng Zhenzhen,LiYuzhu,LiaoShaohong.Research on fertility costs and benefits under low fertility level——A survey from Jiangsu Province[J].China Population Science,2009(02):93-102+112.

Guo Zhigang.China's low birth rate and its influencing factors[J].Population Research,2008(04):1-12.

Zhou Fulin.Research on the Childbearing Willingness of Urban and Rural Residents in my country by Age, Gender and Educational Level[J].Northwestern Population,2005(04):12-14.

Gu Shengzu, Chen Lai.Urbanization Effect and Reproductive Sex Preference[J].China Population Science,2005(03):30-37+95.

Chen Wei, Shi Mei.Re-study on the Influencing Factors of Chinese Women's Fertility: An Empirical Analysis of Eastlin Model[J].China Population Science,2002(02):49-53.

Ali F R M., Gurmu S. The impact of female education on fertility: a natural experiment from Egypt[J]. Review of Economics of the Household, 2016.

Gary S. Becker, T. Nigel. Human capital and the rise and fall of Families[J]. Journal of Labor Economics,1986,4(3):S1-S39.

Gary S. Becker, Elisabeth M. Landes, Robert T. Michael. An Economic Analysis of Marital Instability[J]. The University of Chicago Press,1977,85(6).

Gary S. Becker, H. Gregg Lewis. On the Interaction between the Quantity and Quality of Children[J]. The University of Chicago Press,1973,81(2).