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The effect of the abolition of the one-child policy on fertility decisions for women under 45 in China

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Abstract

This study adopts multiple linear regression and the concept of difference in differences analysis to investigate the effect of fertility behavior on having a second child after the one-child policy was abolished, in different groups of females. Using 11 datasets published by the China General Social Survey from 2003 to 2018, this study investigated the effect on female with different geographical residential status (urban/rural), and on female with different higher education background. This study showed that the effect of policy change on fertility behavior is larger on females residing in urban areas from pre-policy-change period to 2017. Such effect emerged immediately after the policy change but this study cannot confirm that such difference would be insignificant after 2017 with existing data. This study also showed that the effect of policy change on fertility behavior on female with higher education background had a lag to emerge. With existing data, this study cannot confirm that the effect is larger on female without higher education background. Future analysis is needed after the publication of latest datasets.

Introduction

With the burden of a large population base, China had implemented the one-child policy in 1980 which each nuclear family can give birth to no more than one child, to enhance the quality of the nation's modernization process through the population control at a macro scale (Gu et al., 2007). From 1980 to 2019, a general trend of reduction was found in the Chinses fertility rate, but three slight increases occurred in 1981, 1989, and 2017 (Wang, Fan, and Guo, 2021). The policy successfully reached its primary goal of controlling population growth that the fertility rate dropped from 2.74 in 1979, right before the policy was implemented, to 1.65 in 2013 (World Bank, 2022). The policy implementation reached a side benefit of altering traditional gendered work division in China (Fong, 2022). Females were traditionally considered to be responsible for domestic work while males are considered to be the money owner. The one-child policy largely relieved the burden of childbearing and caring and created opportunities for females to engage in paid employment. Also, by having a single child, the investment on each child is increased which improved the overall quality of labor in the longer term.

However, various social issues, including labor shortage, reduction of comparative advantage, aging population, large dependency ratio, low fertility trap, and a deficient in the national pension and insurance system, will rise or have been rose consequently due to the continuous low fertility rate in China. It raised serious concerns for researchers and policymakers that the shortage of labor force and the imbalance of the pension system may occur consequently.

A continuous shortage of labor supply may occur due to the aging population. Zuo and Yang (2010) suggest that the aging population is also likely to have a negative impact on investment demand, labor demand, and consumption in the local economy which might diminish the "low price labor" benefits of comparative advantage. The large demand for labor-intensive manufacturing in China may shift to other even cheaper developing economies like Thailand and Vietnam.

WHO (2022) estimates that 28% of the total population would age over 60 years old by 2040 in China. The aging population accelerates the increase in the old age dependency ratio from 7.9% in 1980 to 19.7% in 2020 (United Nations, 2010; National Bureau of Statistics of China, 2021), creating a rising financial and caring burden for the working-age population and pressure for medical system in China. Without the support and work division from the siblings, each Chinese couple needs to take care of four elderlies and one kid, even eight great grandparents. Such burden may discourage individuals from having more kids to avoid additional family expenditure. The fertility rate, therefore, remains low and reinforces the aging population. Consequently, a low fertility trap is created, as suggested by Lutz and Skribekk (2005): the lower the fertility in near future, the stronger the power of negative forces in the longer-term future. It is also suggested that such negative forces are composed of: 1) an economic mechanism that stronger cut in welfare state and reduction in economic growth in longer term caused by low fertility will result in low optimism and high aspiration and therefore even lower fertility; 2) the expectations and norms of the younger generation that are formed by what they observe during their socialization process, that their ideal family size was largely affected by the family size of the previous generation (Lutz and Skribekk, 2005). It is particularly challenging for China to escape the low fertility trap that the vast majority of the younger generation grew up within and observed the single-child nuclear families and their ideal family size is strongly reinforced.

The sex ratio was distorted and the male infants rose significantly. A considerable number of sex-selective abortions were chosen by many to ensure their only child is a boy, who can, according to the traditional concept, continue the family line. A gender ratio of 1.07, indicating 7 more boys per 100 girls, resulted consequently for the cohort born between 1991 to 2005 (Li, Yi, and Zhang, 2011).

Moreover, the aging population creates issues and deficits in the Chinese pension system. The existing pension scheme can hardly ensure sufficient funding for the aging population and is suffering from deficits in most social areas (Cai and Cheng, 2014). The insecurity and uncertainty of pension supply may further affect the investment and consumption confidence of individuals and increase the average propensity to save. Economic development is therefore inversely affected. To act against the pension deficit, China initiated the attempt to gradually increase the retirement age (Xinhua, 2021). However, the increase may lead to other social issues including reduced employment opportunities for the younger generation, reduced level of happiness, and worsened physical conditions (König, Lindwall and Johansson, 2019).

These considerable social issues served as the main motivations for China to end the one child policy, which was largely loosened from 2013; and 2013 is considered as the time when the one-child policy was officially ended. However, the relaxation of the birth policy had a limited effect on boosting the fertility rate that, according to Chinese President Xi Jinping (2015), only 15.4% of couples that are eligible to have a second child chose to do so. It is therefore essential to consider the factors behind the stagnant fertility rate after the relaxation of the one-child policy. This paper investigated the effect of the abolition of the one-child policy on fertility decisions for women under 45 in China and found that the improvement in fertility rate is larger for females residing in urban areas within each province, and the improvement in fertility rate may be larger for females without higher education background, which are yet to be confirmed. Such pattern can be utilized by researchers and policymakers to accurately identify the reasons for the low fertility rate among different social groups and then adjust, design, and implement policies accordingly.

Literature review

This section will begin with a general review of the impact after the abolish of the one-child policy. The effect of one-child policy on females' fertility decisions will be followed afterwards. A review and discussion of other factors, including education level, residential area, and provinces, that affect the fertility decisions will be made afterward. Finally, this paper will summarize the key results and identify the research gaps within the existing literature.

Various quantitative studies made important contributions relate to the one-child policy. Firstly, several scholars found significant but limited impact of the relaxation of the one-child policy on improving imbalanced sex ratio, low fertility rate, and the aging population in two most developed cities, Beijing and Shanghai. Secondly, traditional concepts and social norms on gender preferences, gender work division, old-age insurance, and quality versus quantity of childbearing have changed subject to the implementation of the one-child policy. Thirdly, there existed variations of the reactions of the one-child policy among each province. A trend can be found that in economically more developed provinces, individuals have more voluntary acceptance of the one-child policy. Finally, the effect of education on fertility is controversial and there exist different opinions regarding such effect.

1. The relaxation of the one-child policy

There exists limited literature regarding the socioeconomics impact after the relaxation of the one-child policy. In their qualitative analysis of fertility and economic trend after the relaxation of the policy, Jia et al. (2020) found that proportion of household chose to have additional or more children rose by more than 2.5% from 2013 to 2015, rose by over 5% from 2015 to 2017. They suggested such improvement are too small to offset the overall trend of aging population. While the relaxation improved the quantity of population, it also generates differences on the quality of the population. Qin, Zhuang, and Yang (2017) suggested that the relaxation may slow down, or reduce the accumulation of human capital per capita among younger-aged population. A policy level attention and prevention are strongly needed. Tang et al. (2022) assessed the impact of another vital drawback of the policy, the distorted sex ratio after the lift of the policy. Through their quantitative analysis of 133,358 live births in Shanghai, they found that the relaxation of the policy lead to a small reduction, from 1.1 to 1.05, in the existing unbalanced sex ratio at birth. Similarly, Liu and Liu (2020) also assessed city level impact of the relaxation. They found that the trend of low birth rate and aging population will be improved in Beijing and called for additional policies to further boost the fertility rate.

2. The one-child policy and social norm

In his quantitative and qualitative analysis of rural China, Zhang (2007) suggests individuals have complied with the one-child policy in the 1990s instead of actively resisting it at the beginning of it. He argues that instead of child-rearing, mutual obligation, intergenerational independence, and self-reliance are considered the new insurance against aging. Likewise, Nie and Wyman (2005) conducted qualitative research in one of the most urbanized cities in China, Shanghai, and found a similar pattern from resistance to acceptance. They suggested that from being forced to accept the policy in 1979, individuals of the new generation in Shanghai have internalized the policy, consider fertility as a choice, instead of a necessity, and believe that having a single child is the best choice if they choose to raise their child properly.

One child policy not only affected fertility behavior but also challenged traditional gender division and kinship in China. Singleton daughters in urban areas were more invested by their parents and are responsible for offering financial and physical support to their parents in the longer term without competing with their brothers (Fong, 2002). Such change largely reduces the traditional Chinese belief that the daughters are no longer part of their original family after marriage and it is, therefore, unnecessary to 'overinvest' in daughters. Fong also suggests that the role of the mother in the family also changes to a great extent that low fertility allows them to be involved in paid employment and prove the filiality to offer financial support for their parents.

3. Fertility pattern and residential area

However, the level of acceptance of the one-child policy was not universally phenomenal in China, considering the nation's scale and actual implementation of policy and resultant mechanism, regulations, punishment, and supporting infrastructure. There existed considerable variations among residential areas, particularly by geographical status (urban/rural) and political divisions (provinces, autonomous cities, two Special Administrative Regions). Culture and socioeconomic environments varied to a great extent across the different residential areas due to the vast area and unbalanced economic development in China. A one-child certificate refers to a document that would be awarded to partners who only have one kid and promise not to have more. Cooney, Wei, and Powers (1991) found an increase in resistance to the certificate, in their study in Hebei province, a less urbanized and agriculture-dependent province in China, that the only 11.3% of women accepted the certificate from 1984 to 1988, compared with 16% during 1980-1984. The number of certificate holders that violated the certificate and gave birth to a second child grew by 37%. The rural area often valued male kids more because male kids would help more in terms of manual farming and other physical work of production. Thus, in rural areas, the sex of the firstborn was the most important contributing factor that affected the acceptance of the one-child certificate. Many would choose to have more children until one was male, and due to personal briefs and economic pressure, a few would even abandon the first child who was female at the risk of violation of both the policy and law. Zhang and Li (2017) found a significant positive impact of fertility culture, particularly the fertility norm of inheriting the family line, on the local fertility rate and higher gender ratio. They suggested that in the traditional concept, the Chinese have a desire to inherit their family lines and such inheritance can only be achieved by boys. The traditional concept also considers females mainly responsible for giving birth to boys. Such concept contributes to both rising fertility rate for females, and the phenomenon of gender selection that females may choose to abort the female fetus to make sure the first child is a boy. The traditional culture is especially valued in certain provinces and is incorporated into official classification and propaganda. Murphy (2004) found that in rural areas in Jiangxi province, the state institutions followed the local family norms and introduced the category of "daughter-only household" into the official classification of the household. The category is often used to describe the difficulty. Such concept classification enhanced gender selection before birth and increased the willingness and probability for individuals to have more children, to have one, or more boys.

Likewise, the fertility behavior in Shaanxi Province, an economically less developed province was also strongly affected by the gender of kids (Jiang et al., 2016). However, instead of having a second child if the firstborn was a girl, they suggest that women with son preference tended to conduct sex-selective abortion. The actual fertility rate was, therefore, lower than the fertility intentions for females. On the other hand, the quantitative analysis conducted in Jiangsu province, one of the most economically developed provinces in China, exhibited different patterns of fertility behavior. Zheng et al. (2009) found a low fertility norm in Jiangsu province that the average fertility rate for couples eligible for having two kids was as low as 1.31 children. A similar trend was found by Chen et al. (2009) that the total fertility rate dropped from around 3.3 in 1980 to 1.5 in 2005 in their study in Guangdong province, one of the most affluent provinces in China.

4. Fertility choice and education

Various studies found a considerable impact of education on the fertility choice of females. A study in Russia found a delay in the childbearing age in females with higher education backgrounds, with no signs of reduction in fertility rate (Billingsley, 2011). She suggests that the postponement in childbearing was largely determined by the rewards for labor force participation. Using demographic and health surveys from 26 countries, Martin (1995) confirms such impact and argues that the effect of education on fertility is conditional based on cultural context, social structure, stage of fertility transition nationally, and socioeconomic development. The impact of education is stronger in societies with more economic development and a higher literacy rate. Indeed, females with higher education backgrounds may participate in higher-paid employment and the opportunity cost of fertility is higher.

However, various studies showed different results on education and the age of firstborns. A quantitative study conducted in Guangdong province by Lan and Kuang (2016), holds different opinions that the overall education impact on fertility appears mainly on women within two age groups, 25-29 and 40-44, and such impact is relatively low. Edwards (2002) had similar arguments through his study in the US that there exists limited effect of educational attainment on the age of the firstborn.

The literature reviewed above all made important contributions, but there exist certain gaps and limitations. For instance, there exists limited literature focusing on the fertility trend in both the pre and post-period of the one-child policy. Most of the analysis was constrained within the period of the one-child policy, and the post-policy fertility change is still under-investigated. Also, most existing studies conducted analyses based on one specific province or city, and there lacks a national-level study on fertility rate. An overall picture of fertility trends across the country is yet to be completed. This essay will fill these gaps using quantitative analyses.

Hypothesis:

This essay aims to fill in the gap in the existing literature by identifying the change in fertility patterns before and after the abolition of the one-child policy. By introducing provinces and geographical status, this essay will narrow the change in fertility in each province of China for easier cross-comparison. Therefore, this following analysis aims to confirm the following hypothesis:

1. **The improvement in fertility will be larger for females in the urban area in each province.** The practice of having more than one child has been continued in rural areas despite the implementation of the one-child policy. As suggested by Cooney, Wei, and Powers (1991), male children are considered an important help in manual farming and physical production in the longer term in rural China. A considerable amount of the rural population lives in villages composed of the patrilineal group (clan). Individuals have closer social interaction and are exposed more to the traditional norms and culture, for instance, son preference (Murphy, Tao, and Lu, 2011). Such preference may lead to higher fertility. Also, individuals in rural areas have lower access to medical insurance and pension system, which leads to higher demand for individuals for children to take caring responsibility in old age (Kane and Choi, 1999). Moreover, since, 1989, the one-child policy has already been relaxed in the rural area that couples with a female first child are allowed to have a second child after several years (White, 1991). Therefore, the effect

of the abolition of the one-child policy will mainly appear on the female in urban areas in each province. Also, there may be a lag between then change in policy and change in fertility behavior, that this essay does not expect the fertility behavior to rise right after the policy relaxation. Females in urban area with fertility intention may take longer to plan and prepare for childbearing.

2. **The improvement in fertility will be larger in females with a lower education background.** Females with higher education backgrounds are more likely to engage in higher-paid employment which makes their opportunity cost of having an additional child higher than females without higher education background. Females with higher education backgrounds prefer the 'quality' side in the 'quantity-quality tradeoff' of child education: offering more resources to a fewer number of children (Li and Liu, 2022). Also, females with higher education have more information and better access to contraception which reduce the possibility of unplanned pregnancy. Wang (2011) supported the argument that females with higher education levels tend to have a higher probability of condom usage and other shorter-term contraception methods. Therefore, females with higher education backgrounds are less likely to have voluntary or involuntary pregnancies. The effect of the abolition of the one-child policy will be lower on females with a lower education background as their opportunity cost of having an additional child is lower. This effect may take longer period to emerge as Billingsley (2011)

suggests education mainly causes postponement on fertility behavior. For female without higher education background, their fertility postponement would be comparably shorter and their fertility rate would be larger for female with higher education background in latter years.

3. **Hypothesis extension: there exist provincial differences in the improvement of fertility.** The level of per capita income and social norms vary across provinces. Therefore, the opportunity cost of having an additional child differs. For instance, the average income for individuals working in non-private urban units in Beijing is 178178 Yuan per year, while that in Anhui province is 85854 Yuan per year (China Statistical Year Book, 2021). The opportunity cost of having an additional child is twice as high in Beijing than in Anhui. Therefore, females who reside in Beijing may be less likely to have a second child after the policy was abolished. Also, cultural norms differ across provinces. Some provinces value the inheritance of family more, for instance, Jiangxi province, as suggested by Murphy (2004). These provinces may tend to have more children after the one-child policy was abolished. The opportunity cost of not having an additional child may be larger: females may experience urges and pressures from family members and relatives and may encounter peer pressure of having a newborn boy. Moreover, when having a second child became a common phenomenon, the female could experience workplace discrimination. Employers may find a higher likelihood for females

with one child to apply for maternity leave and therefore offer females less promotion and employment opportunities. In this case, the opportunity cost of having additional costs may be smaller for females, as before they forgo the promotion opportunities for childbearing, they are unqualified for the opportunity first.

Data

This essay uses data drawn from the China General Social Survey (CGSS), a national-level continuous survey project conducted by Renmin University of China and Hong Kong University of Science and Technology. It is conducted every one or two years to systematically investigate the change in individual and group level wellbeing, social relationships, and social networks for civilian adults aged 18 and above in China. From the first publication in 2003 to the latest publication in 2018, CGSS now has 11 datasets collected in 2003, 2005, 2006, 2008, 2010, 2011, 2012, 2013, 2015, 2017, and 2018. All of them will be included and analyzed in this essay. The CGSS adopts three different sampling frames and designs for surveys between 2003-2006, 2008, and 2010-2018.

The 2003-2006 datasets used a multi-stage stratified design. The study 1) selected 125 PSU (county level); 2) selected 4 SSU from each PSU (town level); 3) selected 2 TSU from each SSU (village level); 4) selected 10 households from each TSU; 5) selected 1 eligible adult from each household as the respondent. The PSUs are classified into five strata: 1) Shanghai, Beijing, and Tianjin; 2) Urban Chongqing and the 26 capital cities of each province; 3-5) the eastern, middle, and western regions. The 2008 dataset used a similar design but experimentally removed stratum 2 of the 2003-2006 period in response to the out to date sampling frame due to radical societal change in China. The post 2010 datasets adopt a similar design but included a bigger sample size. Samples are all weighted by population size in each stratum and the proportion of the total quantity of samples in each stratum. Full details of the datasets can be found on the official website of CGSS (Renmin University of China, 2022).

The selected samples for this study are females between 18-45 every year the data being collected. 45 is considered a reasonable age that most females under 45 are able to change their fertility behavior to have an additional newborn in response to the policy change. To deal with value missingness on fertility rate, geographical residential status, marriage, and or higher education background, this essay dropped these values. Table 1 lists the definition of variables and key descriptive information of the datasets. The dependent variable is a dummy variable that indicates whether the female participant has two or more kids and is shown as the 'Two_or_more_kids' variable. Having 0 or 1 child can be considered as the fertility behavior restricted by the one-child policy while having 2 or more children indicates the fertility behavior different from the regulation of the one-child policy. The outcome variable indicates whether individuals change their fertility behavior after the abolition of the policy.

‘Urban’, ‘Married’, ‘College_and_above’, and ‘Province’ are four independent dummy variables that represent geographical status, marital status, higher education acceptance, and residential area of every participant. The ‘Urban’ variable came from the ‘Hukou Status’ variable in the dataset directly. It is a type of local household registration indicating whether the individual resides in urban or rural areas in China. These independent variables will interact with the variable 'post_2013', representing whether the data is collected after the abolishment of the one-child policy to investigate the interaction effect of pre/post policy abolition and these dependent variables. To investigate a more detailed effect on fertility by the independent variables every year, this study encoded data collected from 2013, 2015, 2017, and 2018 as 1, 2, 3, 4, and data collected before 2013 as 0 into the categorical variable ‘post_2013_ year name’. The variable also interacts with the dependent variables to investigate the year-specific effect.

Table 1: Variable definition and summary

Variables	Definitions	Mean	S.D.
Two_or_more_kids	1: have two or more kids; 0: have 0 or 1 kid	0.305	0.46
Urban	1: Urban status; 0: Rural status	0.465	0.499
Married	1: Married; 0: Unmarried, Divorced, Widowed	0.808	0.394
College_and_above	1: Holds college and above degree; 0: Holds below college degree or no degree	0.237	0.425
post_2013	1: Data collected after 2013; 0: Data collected before 2013		
post_2013_year name	1: data collected in 2013; 2: data collected in 2015; 3: data collected in 2017; 4: data collected in 2018; 0: data collected before 2013		
Province	The province participant resides		
Weights	The survey sampling weights assigned to each participants		
Number of observations	22843		

Methodology

This section used a combination of multiple linear regression analysis as ordinary Least Squares (OLS) regression to test each hypothesis. A difference in difference strategy was also adopted to compare the fertility behaviors before and after the one-child policy change for different groups, namely females residing in urban areas& rural area, and female with & without higher education background. Such approach reveals that which groups are more likely to be affected by the policy change. The interaction effect is adopted because it helps explain the changing relationship between the outcome variable, fertility behavior, and dependent variables by the third variable, pre/post-policy year. The hypothesis can therefore be examined more thoroughly. The analysis began with a simple OLS regression investing the interaction effect of pre/post period ('post_2013') and the independent variables. This allows this research to have a straightforward examination of the interaction effect, that the change in fertility behaviors were higher in certain groups when changing from pre policy period to post policy period. Without adding controls, the result will have higher external validity. Other controlled variables were added to build multiple linear regression models to more precisely identify the within-province effect of the policy, control for variables that may potentially confound estimates of the effect of the policy, and improve the internal validity of the regression. It also helps to identify the variables that also affect fertility behavior. To tackle the effect on fertility in each year specifically and find the time fixed effect of fertility, the categorical variable of the year ('post_2013_year name ') was used to replace the simple pre/post time variable and repeat the analysis. Such approach helps to exhibit the size of the interaction effect on each specific year as some impacts on fertility rate may experience lags as a certain period is required for individuals to adjust their fertility behavior, while some impacts on fertility rate may quickly emerge and persist for the first few years but diminish gradually.

1. **Fertility and geographical residential area**

To address the effect of the geographical residential area on fertility behavior, this study will begin with fitting a simple multiple linear regression model with the interaction effect of the dummy variable of year and geographical residential status. Control is not added for the first model. Table 2 shows the result of the regression. The p-value of the regression showed that except for the time variable, post_2013, all other predictors are statistically significant for the 95% confidence level. The parameter of interest of this model is the coefficient for the interaction effect, 0.042. This signifies the amount of change in fertility behavior of urban women in response to the change in policy compared to that of rural women. It indicates the percentage difference in change in fertility rate between women in the urban areas and the rural areas.

A more complex multiple linear regression was introduced afterward, bringing the controlled variables: higher education, marital status, and province. The fixed effect of provinces was brought into the regression to control for the differences that can or cannot be observed across each province, for instance, culture and custom. Anhui Province is used as the reference for comparison of the change in fertility behavior in other provinces. The parameter of interest in this case is also the coefficient for the interaction term. It captures the same effect as stated above, but controlled for higher education, marital status, and provinces. It indicates the percentage difference in change in fertility rate between women in the urban areas and the rural areas within each provinces, when their higher education background, marital status, and province were kept constant.

Table 2: Interaction effect of post_2013 and urban, with and without control

	Dependent variable:	
	two_or_more_kids	
	Without control	With control
Post_2013	0.008	0.043***
	(0.008)	(0.008)
Urban	-0.327***	-0.245***
	(0.007)	(0.007)
College_and_above		-0.140***
		(0.008)
Married		0.237***
		(0.007)
Post_2013: Urban	0.042***	0.063***
	(0.013)	(0.012)
Constant	0.454***	0.235***
	(0.005)	(0.016)
Observations	22,811	22,811
R^2	0.115	0.233
Adjusted R^2	0.115	0.232
Residual Std. Error	0.434 (df = 22807)	0.405 (df = 22774)
F Statistic	988.016*** (df = 3; 22807)	191.887*** (df = 36; 22774)
Note:		*p**p***p<0.01

Note 2: The controlled variables include provinces, marital status, and higher educated background. For layout reason, coefficients of provinces are hidden

To find the specific effect on fertility each year, the categorical variable of the year was used to replace the original dummy variable to investigate the time fixed effect. Such approach controls for the systematic differences between the observed units of time that are either observed or unobserved (Gosser and Moshgnar, 2020). The simple multiple linear regression without control was firstly fitted, referring to the left part of table 3. Except for the interaction effect of 2018 and urban, all variables are statistically significant. The parameter of interest of this model is the coefficients for the interaction effect of geographical residential area and each categorical year. This indicates the amount of change each year in fertility behavior of urban women in response to the change in policy compared to that of rural women while also examining in which years, it can be concluded with confidence that there exist differences in change in fertility behavior If the interaction term is statistically significant, it indicates the percentage difference on change in fertility rate between women in the urban area and rural area from the last data collection year to this year.

The controlled variable of higher education, marital status, and provinces are then added to the regression, referring to the right part of table 3. Similarly, the parameter of interest in this model is also the coefficient for the interaction effect. They serve the same function but investigate the within provinces differences, while controlling for the higher education background, marital status, and province additionally.

Table 3: Interaction effect of post_2013_year name and urban, with and without control		
	Dependent variable:	
	two_or_more_kids	
	Without control	With control
Post_2013_2013	-0.120***	-0.074***
	(0.013)	(0.012)
Post_2013_2015	-0.080***	-0.035**
	(0.015)	(0.014)
Post_2013_2017	-0.054***	0.005
	(0.011)	(0.010)
Post_2013_2018	0.128***	0.136***
	(0.014)	(0.013)
Urban	-0.340***	-0.261***
	(0.007)	(0.007)
College_and_above		-0.136***
		(0.008)
Married		0.231***
		(0.007)
Post_2013_2013:Urban	0.070***	0.102***
	(0.020)	(0.019)
Post_2013_2015:Urban	0.043*	0.079***
	(0.023)	(0.022)
Post_2013_2017:Urban	0.096***	0.118***
	(0.017)	(0.016)
Post_2013_2018:Urban	0.030	0.024

	(0.025)	(0.023)
Constant	0.472***	0.250***
	(0.005)	(0.016)
Observations	22,811	22,811
R^2	0.127	0.239
Adjusted R^2	0.127	0.237
Residual Std. Error	0.431 (df = 22801)	0.403 (df = 22768)
F Statistic	369.304*** (df = 9; 22801)	169.847*** (df = 42; 22768)
Note:		*p**p***p<0.01

Note 2: The controlled variables include provinces, marital status, and higher education background. For layout reason, coefficients of provinces are hidden

2. Fertility and higher education

The second part of the regression was created to investigate the effect on fertility by education background. The dummy variable of the year was adopted firstly. The multiple linear regression showing the interaction effect of year dummy and higher education is made firstly without adding control. This was shown as the left part of tale 4. The parameter of interest is the coefficient for the interaction effect. This signifies the amount of change in fertility behavior of women with a higher education background in response to the change in policy compared to that of women without. It indicates the percentage difference in change in fertility rate between women with and without higher education.

The control of geographical residential status, marital status, and provinces were then added to form a new regression, showing the interaction effect with higher internal validity. This regression is shown in the right part of table 4. The parameter of interest in this case is also the coefficient for the interaction term. It captures similar effect within each provinces as stated above, but controlled for geographical residential status, marital status, and provinces. It indicates the percentage difference in change in fertility rate between women with and without higher education background, when their geographical residential status, marital status, and province were kept constant.

Table 4: Interaction effect of post_2013 and higher education, with and without control

	Dependent variable:	
	two_or_more_kids	
	Without Control	With Control
Post_2013	0.120***	0.082***
	(0.008)	(0.007)
College_and_above	-0.316***	-0.116***
	(0.009)	(0.009)
Urban		-0.229***
		(0.006)
Married		0.239***
		(0.007)
Post_2013: College_and_above	-0.041***	-0.056***
	(0.014)	(0.013)
Constant	0.362***	0.223***
	(0.004)	(0.016)
Observations	22,811	22,811
R^2	0.093	0.232
Adjusted R^2	0.092	0.231
Residual Std. Error	0.440 (df = 22807)	0.405 (df = 22774)
F Statistic	775.723*** (df = 3; 22807)	191.558*** (df = 36; 22774)
Note:		*p**p***p<0.01

Note 2: The controlled variables include provinces, marital status, and geographical residential status. For layout reason, coefficients of provinces are hidden

Finally, to examine the effect of higher education on fertility each year, the year dummy was replaced with the categorical variable of year to examine the time fixed effect. The multiple linear regression model was firstly fitted without control, as shown in the left part of table 5. The parameter of interest is the coefficients for the interaction effect of higher education background and each categorical year. This indicates the amount of change each year in fertility behavior of women with higher education in response to the change in policy compared to that of women without. It also examines in which years there exist differences in change in fertility behavior. If the interaction term is statistically significant, it shows the percentage difference in fertility rate change between women with and without higher education background from the previous data collection year to this year.

The control variable of geographical residential status, marital status, and province are then added to form a controlled multiple linear regression, as shown in the right part of table 5. Likewise, the parameter of interest in this model is also the coefficient for the interaction effect. They serve the same function but investigate the effect within province, while controlling the geographical residential status, marital status, and province additionally.

Table 5: the interaction effect of higher education and post_2013_year name, with and without control

	Dependent variable:	
	two_or_more_kids	
	Without control	With control
Post_2013_2013	-0.035***	-0.043***
	(0.012)	(0.011)
Post_2013_2015	0.011	0.001
	(0.014)	(0.013)
Post_2013_2017	0.108***	0.057***
	(0.011)	(0.010)
Post_2013_2018	0.214***	0.170***
	(0.013)	(0.012)
College_and_above	-0.318***	-0.120***
	(0.010)	(0.010)
Urban		-0.230***
		(0.006)
Married		0.235***
		(0.007)
Post_2013_2013:College_and_above	0.022	0.032
	(0.023)	(0.021)
Post_2013_2015:College_and_above	-0.022	-0.015
	(0.026)	(0.024)
Post_2013_2017:College_and_above	-0.021	-0.022
	(0.018)	(0.017)
Post_2013_2018:College_and_above	-0.051*	-0.129***
	(0.029)	(0.027)
Constant	0.366***	0.232***
	(0.004)	(0.016)
Observations	22,811	22,811
R^2	0.099	0.237
Adjusted R^2	0.099	0.236
Residual Std. Error	0.438 (df = 22801)	0.404 (df = 22768)
F Statistic	279.548*** (df = 9; 22801)	168.332*** (df = 42; 22768)
Note:		*p**p***p<0.01

Note 2: The controlled variables include provinces, marital status, and geographical residential status. For layout reason, coefficients of provinces are hidden

It is worth noticing that there exists a clear limitation of the year as a categorical variable. There exists an unevenly spaced time series. The first three years, 2013, 2015, and 2017 were collected every two years but the fourth year, 2018, was collected only one year after 2017. Moreover, the two year interval between 2013 and 2017 can hardly capture the change in fertility behavior in 2014 and 2016. Although some scholars used certain forms of certain methods, for instance, linear regression to transform unevenly spaced time series into equally spaced ones, certain biases that are hard to quantify may arise (Eckner, 2014). Moreover, the fertility rate in the post-2013 period is comparatively more volatile. Referring to figure 6, it experienced a drastic increase from 2013 to 2015, followed by a reduction in 2017 and a smoother increase in 2018. Such volatility improves the difficulty of transforming to an equally spaced time series while minimizing the biases.

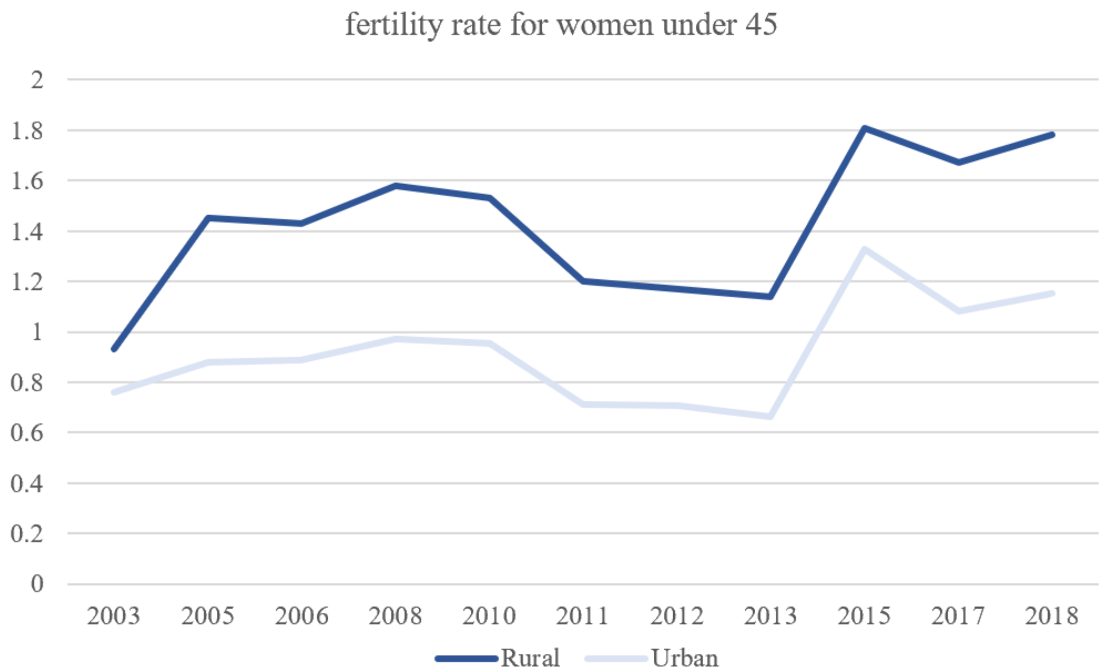

Figure 6

Summary and discussion

Table 7: Summary: multiple linear regression with year as dummy variable

	Geographical residential status				Higher education background			
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coefficient	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Interaction effect of time and ____	0.042***	0.013	0.063	0.012	-0.041***	0.014	-0.056***	0.013
Controls								
Higher education background	NO		YES		NO		NO	
Marital Status	NO		YES		NO		YES	
Geographical residential status	NO		NO		NO		YES	
Province	NO		YES		NO		YES	
Adjusted R^2	0.115		0.232		0.092		0.231	

1. Year as dummy variable

The multiple regression analysis results are summarized in table 7 (year as a dummy variable), and table 8 (year as categorical variable).

1.1 Fertility behavior and geographical residential status

Referring to table 7, model 1 shows the size of the interaction effect of the year as dummy variable and geographical residential status on fertility behavior without adding control. The adjusted R square for model 1 is 0.115, indicating that 11.5% of the variation in the dependent variable, the fertility behavior, can be explained by the regression model. Although the value is relatively low, the coefficient of all independent variables is statistically significant, suggesting a valid relationship between the variables. The coefficient for the interaction term is 0.042. It shows that when the one-child policy was abolished, the probability of having two or more kids is 4.2% higher for urban women than for rural women. After including controlled variables, the adjusted R square rose to 0.232, suggesting that 23.2% of the variation in the dependent variable can be explained by the regression. The inclusion of controlled variables in model 2 also increased the difference between women in urban and rural areas to 6.3% within provinces. It indicates that policy effect captured by interaction increases in size with controls. Overall, model 1 and model 2 confirm the hypothesis that the improvement in fertility is larger in females in the urban area.

1.2 Fertility behavior and higher education background

Model 3 shows the size of the interaction effect of the year as dummy variable and higher education background on fertility behavior without controls. The adjusted R square is 0.092, suggesting that 9.2% of the variation in the dependent variable can be explained by the regression. As the coefficient for all the independent variables is statistically significant, the relationship between the variables can be confirmed. The coefficient of the interaction effect reveals that when the one-child policy was abolished, the probability of having two or more kids is 4.1% lower for women with higher education backgrounds than for women without. Model 4 introduced controls to the regression and increased the difference to 5.6%, and increase the adjusted R square to 0.231. As both of the interaction effects are statistically significant, model 3 and 4 confirms hypothesis 3 that the fertility improvement is larger in females with lower educational background, in other words, without college and above degree.

Table 8: Summary: multiple linear regression with time as categorical variable

	Geographical residential status				Higher education background			
	Model 5		Model 6		Model 7		Model 8	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Interaction effect of time and ___ year 1	0.07***	0.02	0.102***	0.019	0.022	0.023	0.032	0.021
Interaction effect of time and _______ year 2	0.043*	0.023	0.079***	0.022	-0.022	0.026	-0.015	0.024
Interaction effect of time and ___ year 3	0.096***	0.017	0.118***	0.016	-0.021	0.018	-0.022	0.017
Interaction effect of time and _______year 4	0.03	0.025	0.024	0.023	-0.051*	0.029	-0.129***	0.027
Controls								
Higher education background	NO		YES		NO		NO	
Marital Status	NO		YES		NO		YES	
Geographical residential status	NO		NO		NO		YES	
Province	NO		YES		NO		YES	
Adjusted R^2	0.127		0.237		0.099		0.236	

2. Year as categorical variable

2.1 Fertility behavior and geographical residential status

Referring to table 8, model 5 shows the interaction effect of geographical residential status and time fixed effect. The adjusted R squared is 0.127, suggesting that 12.7% of the variation of the dependent variable can be explained by the regression. The result is slightly higher than the regression considering year as dummy variable, as the regression can be better fitted by separate years. It shows that an increase in the probability of having two or more kids is 7% higher for urban women than rural women from the pre-policy period to 2013, 4.3% higher from the pre-policy period to 2015, and 9.6% higher from the pre-policy period to 2017. The coefficient from the pre-policy period to 2018 is not statistically significant and therefore this essay cannot reject the null hypothesis that there is no difference in fertility behavior for females living in the rural area and urban areas when changing from the pre-policy period to 2018. Instead, this essay suggests such a difference occurs from the pre-policy period to 2017. This may be because most females in urban areas with fertility behavior chose to bear children during the four-year period after the policy was abolished. Other females in urban areas may not have such strong fertility intentions which leads to statistically insignificant differences on fertility behavior in 2018. The coefficients of the interaction term rose when the controls are added to the regression. Referring to model 6, the increase in the probability of having two or more kids is 10.2% higher for urban women than rural women from the pre-policy period to 2013, 7.9% higher from the pre-policy period to 2015, and 9.6% higher from pre-policy period to 2017 within provinces. The adjusted R square rose to 0.237. The coefficient from the pre-policy period to 2018 was still not statistically significant and the null hypothesis cannot be rejected. In general, the result can partially prove hypothesis 2 that the improvement in fertility will be larger for females in urban areas from 2013 to 2017, but found the gap between the relaxation of policy and larger increase in fertility for females in urban areas to be false. Instead, the increase for females in urban area was shown immediately.

2.2 Fertility behavior and higher education background

However, when treating year as categorical variable, the result experienced a considerable shift. Model 7 exhibits the interaction effect of higher education background and time fixed effect. The adjusted R square is 0.099, suggesting only less than 10% of the variation of the dependent variable can be explained by the regression. The interaction effect in 2013, 2015, and 2017 (Year 1, 2, and 3) are not statistically significant and only 2018 is statistically significant. Model 8 introduced controls into the regression but the interaction effect remains mostly insignificant. It is hard to conclude whether hypothesis 2 can be proved or disproved at this stage as the differences started to emerge in 2018, and 2018 is the last time interval in this analysis. This essay cannot confirm whether the trend continued in post-2018 period. However, the result did exhibit a positive signal that effect of higher education background emerged after a few years of the one-child policy was abolished.

Table 9: Provincial difference in fertility behavior

	Post_2013 and higher edu	post_2013 and urban	post_2013_year name and urban	post_2013_year name and higher edu
Beijing	-0.059***	-0.062***	-0.063***	-0.060***
	-0.019	-0.019	-0.019	-0.019
Chongqing	0.137***	0.139***	0.145***	0.140***
	-0.024	-0.024	-0.024	-0.024
Fujian	0.033	0.034	0.036*	0.033
	-0.022	-0.022	-0.022	-0.022
Gansu	0.127***	0.130***	0.133***	0.127***
	-0.023	-0.023	-0.023	-0.023
Guangdong	0.061***	0.063***	0.064***	0.061***
	-0.018	-0.018	-0.018	-0.018
Guangxi	0.002	0.005	0.008	0.001
	-0.02	-0.02	-0.02	-0.02
Guizhou	0.022	0.022	0.02	0.017
	-0.021	-0.021	-0.021	-0.021
Hainan	0.202***	0.203***	0.202***	0.198***
	-0.047	-0.047	-0.047	-0.047
Hebei	-0.013	-0.011	-0.008	-0.012

	-0.02	-0.02	-0.02	-0.02
Heilongjiang	-0.133***	-0.131***	-0.130***	-0.134***
	-0.019	-0.019	-0.019	-0.019
Henan	0.147***	0.148***	0.147***	0.146***
	-0.018	-0.018	-0.018	-0.018
Hubei	0.029	0.03	0.033*	0.029
	-0.019	-0.019	-0.019	-0.019
Hunan	0.075***	0.078***	0.081***	0.075***
	-0.019	-0.019	-0.019	-0.019
Inner Mongolia	-0.009	-0.008	-0.008	-0.008
	-0.032	-0.032	-0.032	-0.032
Jiangsu	-0.073***	-0.072***	-0.067***	-0.072***
	-0.019	-0.019	-0.019	-0.019
Jiangxi	0.185***	0.185***	0.188***	0.188***
	-0.02	-0.02	-0.02	-0.02
Jilin	-0.116***	-0.115***	-0.114***	-0.116***
	-0.02	-0.02	-0.02	-0.02
Liaoning	-0.105***	-0.108***	-0.107***	-0.103***
	-0.02	-0.02	-0.02	-0.02
Ningxia	0.304***	0.306***	0.310***	0.308***
	-0.028	-0.028	-0.028	-0.028
Qinghai	0.041	0.044	0.049	0.048
	-0.038	-0.038	-0.038	-0.038
Shaanxi	0.049**	0.050**	0.054***	0.051***
	-0.02	-0.02	-0.02	-0.02
Shandong	-0.071***	-0.069***	-0.068***	-0.071***
	-0.018	-0.018	-0.018	-0.018
Shanghai	-0.049**	-0.051**	-0.051**	-0.049**
	-0.021	-0.021	-0.021	-0.021
Shanxi	0.059***	0.058***	0.059***	0.059***
	-0.022	-0.022	-0.022	-0.022
Shenzhen	0.174***	0.176***	0.088*	0.111**
	-0.048	-0.048	-0.049	-0.049
Sichuan	-0.056***	-0.054***	-0.050**	-0.054***
	-0.02	-0.02	-0.02	-0.02
Tianjin	-0.045*	-0.043*	-0.046*	-0.042*
	-0.024	-0.024	-0.024	-0.024
Xinjiang	0.136***	0.141***	0.143***	0.132***
	-0.038	-0.038	-0.038	-0.038
Xizang	0.113	0.117	0.118	0.107
	-0.166	-0.166	-0.165	-0.165

Yunnan	0.133***	0.135***	0.133***	0.130***
	-0.02	-0.02	-0.02	-0.02
Zhejiang	-0.110***	-0.109***	-0.103***	-0.107***
	-0.02	-0.02	-0.02	-0.02

3. Provincial level difference

Table 9 summarized the coefficient for the fixed effect of each province in models 2, 4, 6, and 8. It shows the percentage difference in having two or more kids in other provinces compared to Anhui. For instance, the probability of having two or more kids is around 6% lower in Beijing than in Anhui. The fixed effect of most provinces, except for Fujian, Guangxi, Guizhou, Hebei, Hubei, Inner Mongolia, Qinghai, and Xizang is statistically significant. Also, the incorporation of provincial fixed effect into the regression increased the adjusted r squared, indicating that the regression can better explain the dependent variable within province. The extended hypothesis can be partially proved that when the regression is extended to the national level, its adjusted r-squared would be lower because there exist cross-provincial variations on fertility behavior.

Conclusions:

The decreasing fertility rate has been a concern globally. The average fertility rate dropped from 2.69 in 1960 to 1.65 in 2019 in the UK, from 3.65 in 1960 to 1.7 in 2019 in the US, from 2 in 1960 to 1.36 in Japan, and from 2.52 in 1960 to 1.5 in 2019 in Russia (World Bank, 2022). In China, the fertility rate stays far below the replacement level in the recent 30 years, even after the relaxation of the one-child policy. It caused various social, economic, and political issues that the government and scholars paid special attention to. For instance, the increased burden of individuals of working age, the reduction of the comparative advantage of cheap labor caused by the shortage of labor supply, and the deficit of pension and medical insurance system. Moreover, a low fertility trap is likely to happen in Chinese society, pulling down the fertility rate even further. It is therefore essential to investigate the changes in fertility behavior after the relaxation of the one-child policy among the different social groups. A more delicate set of policies can be implemented to target specific groups, to tackle the obstacles to making fertility decisions. A cross-comparison of fertility choice and behavior in other countries can be conducted to learn from the group-specific pro-birth policy of other countries.

This essay investigated the effect of the abolition of the one-child policy on fertility decisions of Chinese women under 45, measured by higher education background and geographical residential status. It aims to help policymakers and researchers to identify groups whose fertility choices are less affected by the abolishment of the one-child policy. Using several multiple regression analyses and the concept of difference in difference analysis, I found females residing in urban areas had higher improvement in fertility decisions compared with those in rural areas from the pre-policy period to 2017. This maybe because a significant number of urban females with fertility intentions chose childbearing in the four-year period right after the policy was relaxed. Such hypothesis needs further confirmation after the publication of new datasets. With existing data, however, it is hard for this essay to conclude the effect caused by higher education background on fertility decisions of females. One possible explanation for this may be that higher education background takes longer to affect the fertility choice of women. As suggested by Billingsley (2011), higher levels of education lead to the postponement of fertility. It is possible that the postponement of fertility for females without higher education background gradually ended and the effect of higher education background started to take place in 2018, as the coefficient for the coefficient in 2018 is statistically significant. This essay also found provincial-level differences in fertility decisions. Using Anhui province as the reference, the differences of most other provinces are statistically significant, indicating variation in fertility decisions among provinces. It is unsurprising that in most provinces and municipalities with high levels of socioeconomic development, for instance, Beijing, Shanghai, Jiangsu, Tianjin, and Zhejiang, the fertility rates are lower than in Anhui. However, for the two of the most developed areas in southern China, Guangdong, and Shenzhen, the fertility rate is higher than in Anhui province.

There exist various limitations of this research. Firstly, the CGSS dataset this essay use has not yet released the most up-to-date datasets and the analysis cannot shed light on the post-2018 fertility behavior. The effect of higher education background on fertility delay cannot be fully proved. Future works are needed after the publishment of the latest datasets of CGSS. Also, the CGSS study is not conducted based on equal time intervals. Some are conducted every one year, while others are conducted every two years which leads to the ignorance of the fluctuations between the two years. Bias is likely to happen due to the unequal time interval.

Secondly, this essay failed to include independent variables that may have a large impact on fertility behavior, for instance, the gender of the first child, because of uncontinuous availability of related data in the CGSS dataset. Wang (1996) suggested that it is significantly more likely for women with a female first child to have a second child sooner than those with a male first child. Similarly, Chen (1993) suggested that a larger proportion of women with one or two girls did not adopt contraception compared with those with boys. The questionnaires for the CGSS datasets are adjusted for every data collection year. The question regarding the gender of the firstborn was, unfortunately, missing for a considerable number of years. To ensure consistency, this essay left out the variable of the gender of the firstborn. Also, the household total income may be an important independent variable that affects the fertility decisions of females. It is also found to be inconsistent due to the adjustment in the questionnaire. In some years, the data covers the income from employment of the interviewees and that of their partner, while the data covers the total income annually of the interviewees, but left out that of their partner. Such inconsistency left a considerable obstacle for this research to have a compatible definition of household income. Therefore, this essay strongly suggests future research to investigate the effect of gender of the firstborn and total household income on the fertility behavior of females, when a more consistent data source can be adopted.

Thirdly, there exists a clear limitation of the independent variable 'Urban' in that it uses the type of Hukou registration as the indication of the geographical residential area. The possibility of population movement, for instance, keeping their rural hukou type but moving to the city, is ignored. Also, the selection has the possibility of missing out on new birth from females aged over 45. Although it is hardly possible for this study to design a comprehensive methodology that takes into account the temporary and longer-term migration between urban and rural areas when defining geographical status for individuals, this study fund a way to clearly address the research questions.

The findings can provide certain inspiration to policymakers. Firstly, although the improvement in fertility rate is 9.6% higher for females in urban areas than in rural areas in 2017, there still exists large gaps in the fertility rate. Referring to figure 6, the fertility rate for females in urban areas is 1.1 while that for females in rural areas is 54.5% higher. Such a gap may be gradually reduced by a reduction in housing prices. Individuals in urban areas may have higher burdens on housing prices due to increased land prices and reduced per capita living space. According to the National Bureau of Statistics (2020), the per capita living space in urban areas is 39.8 square meters in urban areas compared with 48.9 square meters in rural areas. Secondly, a possible delay in fertility for women with higher education backgrounds and lower fertility choices for more socioeconomically developed provinces may be caused by the higher opportunity cost of childbearing. Females may encounter a loss of promotion opportunities and higher wage reduction from childbearing. These concerns may be mitigated by 1) the introduction of paternity leave, and 2) the introduction of detailed and well-monitored regulations ensuring rights and payment during and after pregnancy for females.

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