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POPULATION POLICY AND ITS INFLUENCES ON FEMALE LABOR SUPPLY: EVIDENCE FROM CHINA

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ABSTRACT

To evaluate the effects of population policy on labor supply in China, using the longitudinal data of the China Health and Nutrition Survey (CHNS) from 1989 to 2015, this paper investigates the influences of the total number of children and parity on the Chinese female labor supply including both participation in work (decision to work or not work) and employment status (to become an irregular worker or regular worker). The fixed effects model, the random effects model, and the instrumental variables method are used to address the heterogeneity and the endogeneity problems. The results show that as the total number of children increases, the probability of the mother becoming a regular worker may decrease, and the negative influence for the later births is greater than for the first birth. However, the influences of the total number of children and parity on women's participation in work are small. Additionally, the employment status of women in urban area and highly educated women are more likely to be influenced by higher parities.

Contribution/ Originality: The paper contributes the first logical analysis which uses two kinds of indices to investigate effects of both the total number of children and the marginal effects of different parity on female labor supply in China. In addition, the female labor supply is examined from two perspectives: participation in work (decision to work or not work), and employment status (decision to become an irregular or regular worker) in this study.

1. INTRODUCTION

The total fertility rate in China has fallen below the population replacement rate for nearly three decades and the proportion of elders in the population is unbalanced. To address this problem, the Chinese government abolished the one-child policy and implemented a set of new population policies, including the selective two-child policy in 2013 and the universal two-child policy in 2015. It is expected that these population policies will affect the women' childbearing decisions, and as a result, they may affect the parity composition of births (In this paper parity means the number of live births a woman has had in the past). According to the annual report of National Bureau of Statistics (NBS), although the fertility rate in 2017 was lower than in 2016, there occurred a significant change in newborn parity, and the proportion of second births has been greater than first births in recent decades (Geng and Peng, 2018).

Decisions about childbearing and the number of children may in the long term greatly affect the women's labor supply. A woman with many children usually spends more time on homemaking, and consequently is likely to reduce her working hours. A number of studies have suggested that having more children negatively affects the women's labor supply (Jones, 1982; Hofferth, 1984) and it is found that the marginal effects vary by parity (Abendroth *et al*., 2014).

Compared with other countries, the female labor force participation rate (FLFPR) in China has been relatively high, no doubt, because the Chinese government enforced a set of policies to promote female labor force participation in the public sector (e.g. government organizations, state-owned enterprises) during the planned economy period (Pan, 2002; Ma, 2011). However, with the progress of market-oriented reform, the FLFPR has decreased. It should be noted that as the number of regular workers has decreased, the number of irregular workers has increased. For example, the proportion of female irregular workers increased from 33.9% in 1996 to 68.6% in 2010 (Zhang and Hu, 2017). The wage level and fringe benefits for irregular work are lower than for regular work, and social security is poor for the irregular workers (Ma, 2008;2009;2011; Wu, 2009) but women can work with more flexible work schedules that may enable them to care for their children. Therefore, irregular work is a way to address the work-family conflict problem (Zhang and Li, 2017).

Implementation of the universal two-child policy may present a new challenge for work-family balance. Women with two or more children may have more family responsibilities and a higher risk of career interruption than women with only one child, therefore the probability of exiting the labor market or becoming an irregular worker may be higher for women with more children. From the perspective of labor demand, firms may reduce the recruitment of married women who will bear (or have borne) two or more children to reduce the potential turn-over cost, which may aggravate discrimination against women in the workplace, and increase the proportion of women who are irregular workers or do not work outside the home.

It is important to understand the influence of the number of children on the female labor supply in China so that the effects of the implementation of the universal two-child policy in the long-term can be evaluated. The published studies use two types of indices for the number of children. The first index uses the total number of children as a continuous variable and examines the impact on female labor supply (Rosenzweig and Wolpin, 1980; Jones, 1982; Waite *et al*., 1985; Joshi, 1990; Angrist and Evans, 1998; Oláh, 1998; Taniguchi, 1999; Takeuchi, 2004; Ma, 2007; Zhang, 2011; Abendroth *et al*., 2014; Yang and Guo, 2017). The second index uses the categorical variables of the number of children to distinguish the influence of the number of children on female labor supply according to differing parity (low parity, high parity) (Abendroth *et al*., 2014). A number of relevant studies have been conducted for Europe and the United States using both types of indices but there are few empirical studies for China. Most studies of this element of society and economy in China only examine the aggregated effect of the total number of children on their mothers' participation in work, working hours and wage rate (Zhang, 2011; Yu and Xie, 2014; Yang and Guo, 2017). However, less is known about the influence of different parities on the Chinese women's labor supply. Moreover, the study of the influence on the employment status (regular work or irregular work) is minimal for China. This study can fill these blanks. The main contributions of this study are as follows: firstly, this study uses two kinds of indices to investigate effects of both the total number of children and the marginal effects of different parity on female labor supply in China. Secondly, the female labor supply is examined from two perspectives: participation in work (decision to work or not work), and employment status (decision to become an irregular or regular worker). These results provide new evidences for China. It is expected that the results will provide insight about the influence of the universal two-child policy in China.

2. LITERATURE REVIEW

2.1. Empirical Study Results for Parity and Female Labor Supply

The results of the empirical study may be summarized as follows. For the influence of the total number of children on female labor supply, Zhang *et al.* (2018), Angrist and Evans (1998) indicate that a higher number of children negatively affects women's career. Oláh (1998), Takeuchi (2004) and Ma (2007) find that a higher number of young children aged from 0 to 3 years old negatively affects women's participation in work. The endogeneity problem between female labor supply and childbearing is addressed by Angrist and Evans (1998). Taniguchi (1999) estimates a fixed-effects model using the data of NLS 1968-1988, and finds that the childbearing penalty on female labor supply is greater for women with more children. Yu and Xie (2014) utilize the CHNS data to make an empirical study: they find the childbearing penalty on wage becomes greater with the increase in the number of children.

Some studies use the instrumental variables (IV) method to address the endogeneity. The instrumental variables include unexpected birth or childlessness (twin-births, sterility and the use of in vitro fertilization) (Rosenzweig and Wolpin, 1980; Lundborg *et al.*, 2017) and the cost of childbearing (the cost and availability of contraception) (Rosenzweig and Schultz, 1985). Variables based on fertility preference and traditional culture are also used. For instance, Angrist and Evans (1998) exploit sibling sex mix status as an instrumental variable for the observed parental preference for a mixed sex composition of children. Chun and Oh (2002) consider the preference for male children in Korea, and use the sex status of the first birth as an instrumental variable of the number of children. Zhang (2011) applies the instrumental variable method and the Heckman two-step method, and finds that the number of children significantly reduces the urban women' labor supply, working hours, and lowers the wages. Moreover, Cain and Dooley (1976), Smith-Lovin and Tickamyer (1978), Waite and Stolzenberg (1976) and (Cramer, 1980) use the religious attitude, ideal family size, the number of siblings, and population density in the community as instrumental variables, and they find that the number of children negatively influences women's participation in the labor market.

The published empirical study results for the effects of differing parity (the first birth, the second, and subsequent births) on the female labor supply, are not clear. For example, Abendroth *et al.* (2014) argue that the marginal effect of the second and the later births is usually smaller than for the first child and the negative influence of childbearing on occupational position is greater for the first child. Joshi (1990) uses cohort data and finds that the marginal effect for the first child is three times that for the later births, he suggests that it is important to distinguish the influence of different parities. Lundborg *et al.* (2017) divide the influence of childbearing on the female labor supply into two kinds of effects: the intensive fertility margin (to bear or not bear) and the extensive fertility margin (the number of children), and find that in the short term the extensive margin effect is greater than the intensive margin effect, while in the long term the difference between these two kinds of margin effects is not significant. Contrary to most of previous research, Jones (1982) points out that a higher parity (two or more children) positively affects the female labor supply. He indicates that although the total number of children may negatively affect the female labor supply, the household with the second child or more children may face higher costs that might motivate women to enter the labor market again to obtain more income.

To survey the studies for China, after the implementation of the universal two-child policy empirical studies particularly focus on the influence of the birth of the second child on female labor supply and working career. However, most of those studies focus on theoretical discussion and description. For example, Xu (2018) uses the data for the childbearing period survey in Suzhou, and shows that about 50 percent of women answered that the second child has reduced the opportunity for promotion, decreased her wage and fringe benefits, or even led to demotion or termination of contract. Zhang and Zhang (2017) apply factor analysis and hierarchical regression analysis and find that the universal two-child policy negatively affects wages and fringe benefits, increases the possibility of exit from the labor market, and increases the possibility of entering the irregular work.

To summarize the influence of the birth of the second child on female labor supply from a labor demand perspective, Xu (2018) discusses how the universal two-child policy may exacerbate discrimination against women in the workplace. Employers may fear the labor turnover cost of hiring a woman who may in the future resign or ask for maternity leave for the birth of a second child. Thus, firms may decrease employment and reduce promotion and training opportunities for women. From the labor supply perspective, Yang and Guo (2017) find that the birth of a second child may lead to a second career interruption that may terminate work. These studies suggest the influence of number of children on Chinese female labor supply but there is little empirical research to test their findings. This study provides new empirical evidence.

2.2. Empirical Studies about the Influence of Parity on Irregular Work

The labor supply comprises participation in work (to work or not work) and employment status (to become a regular worker or an irregular worker). This paper considers the influence of parity on these two types of labor supply situations, particularly analyze the irregular work.

Most irregular workers may work part-time or with a flexible work schedule that accommodates the demands of pregnancy and childcare. For developed countries, Bardasi and Gornick (2000) use international data for five developed countries (Canada, Germany, Italy, the UK, and the US) to carry out an empirical study. They find that the likelihood of becoming a part-time worker is greater for women with children than for women without children. Drobnic *et al.* (1996) find that in Germany women are more likely to return to part-time work during the childbearing period. Zhang and Wang (2017), Shikata and Ma (2006) and Ma (2008;2009) find in Japan the probability of becoming an irregular worker is greater for a woman with younger children and for women with more children.

Some published studies about China explore the influence of childbearing on irregular work based on descriptive statistical results and descriptions. For example, Zhang and Hu (2017) argue that irregular work can be expected to be a way to reduce work-family conflict, therefore a woman who plans to be pregnant or has younger children is more likely to work as an irregular worker. The number of female irregular workers has increased with the progress of market-oriented reform, and the development of the Internet information industry. Ding and Shi (2016) argue that during the childbearing period women have to take on more family responsibility and the work-family conflict leads to mothers exiting the labor market.

When women are not willing to exit the labor market for some reason, such as insufficient household income, or to avoid work or career interruption, they may choose irregular work (Rosenfeld and Birkelund, 1995). Xu (2018) argues that because irregular work is more flexible, female irregular workers are less likely to give up work than female regular workers. Zhang and Wang (2017) employ the correlation analyses based on the CGSS (Chinese General Social Survey) data, and find that the likelihood of entering irregular work is greater for women with more children.

Some published studies argue that a mothers' decision to do irregular work is involuntary, a forced choice, as the wage level is lower, the fringe benefit is less, the social security is poorer and the chance of promotion is less than for regular workers. Ma (2008;2009), Huang *et al.* (2017) and Chen (2018) indicate that the labor market in China is segmented into the regular and irregular work sectors, and discrimination against women prevents women entering the regular work sector. However, empirical studies on the impact of parity on women's irregular work in China is minimal.

3. DATA AND METHODOLOGY

3.1. Models

Due to the nature of the longitudinal data, this study uses fixed effects and random effects models to conduct analysis. Considering the fact that childbearing and female labor supply could be influenced by unobserved

variables, including fertility preference, traditional culture, et cetera, the fixed effects model can exclude the bias of time-invariant unobserved variables, therefore yielding more effective estimation and it is estimated by Equation 1:

$$\ln\left(\frac{p_{it}}{1-p_{it}}\right) = \gamma_0 + \gamma_1 C_{it} + \sum \gamma_{xk} X_{kit} + a_i + u_{is} \quad (1)$$

Where $ln\left(\frac{p_{it}}{1-p_{it}}\right)$ denotes the dependent variables, including participation in work and becoming an irregular worker. i indicates individuals, t is the wave of the survey, C is the total number of children or each parity, X_k represents control variables. The effect of the independent variables on the female labor supply is denoted by γ_1 and the effect of each control variable is denoted by γ_{xk}. In addition, a_i is an unobserved time-invariant individual effect and u_{is} is the error term.

This study also employs the random effects model to estimate the results, and the Hausman test is applied to evaluate the validity of the two estimations. The random effects model can address the unobserved heterogeneity problem but because the labor supply may also affect parity (adverse causal relation between the female labor supply and childbearing), the endogeneity problem may remain in the results. For example, if a woman expects she will not obtain more income from the labor market or she expects the likelihood of becoming a regular worker or of promotion is lower in the future, she may invest more time in her family by bearing more children. To address the endogeneity problem the instrumental variable method is used. Based on the findings of previous research and the available data from CHNS, this study uses the sex of the first child as the instrumental variable of the total number of children. Two factors explain how the sex of the first child may affect parity: firstly, the "one and a half-child" policy has implemented since 1982, allowing the parents in rural regions (the individuals with rural registrations) in some provinces to have a second child if their first child was a daughter. Therefore, if the first child is a girl, the probability of having a second child may be higher. Secondly, the gender preference for boys in Chinese traditional culture means that when their first child is a girl, they may have a second child in the hope of obtaining a boy (Li, 1998; Ming, 2002; Bi, 2003;2004). However, the influence of sex of the first child on the female labor supply is smaller, which means it may be exogenous to the female labor supply. Thus, the sex of the first child can be utilized as an instrumental variable of the number of children. The specification of the instrumental variable model is shown by Equation 1 and Equation 2:

$$x_i = \pi_0 + \pi_1 Z_i + \sum \rho_{ik} C_{kit} + u_i \quad (2)$$

$$y_i = \beta_0 + \beta_1 x_i + \sum \lambda_{ik} C_{kit} + \varepsilon_i \quad (3)$$

$$\text{Corr}\ (\varepsilon, Z) = 0$$

$$\text{Corr}\ (u, Z) \neq 0$$

Equation 2 is the first-stage of instrumental variable method, where Z is the instrumental variable which is the sex of the first child. Equation 3 denotes the second-stage regression. y_i is the dependent variables of female labor supply (participation in work; employment status), x_i is the total number of births of woman i. C_k is the control variables. μ_i and ε_i are error terms.

This study also employs the instrumental variable method to estimate the marginal effects of having additional children, namely the intensive fertility margin (when the total number of children is more than one). [1]

3.2. Data and Variable Settings

The data for this study was drawn from the China Health and Nutrition Survey (CHNS) from 1989 to 2015. CHNS is a nationwide longitudinal survey conducted by the Carolina Population Center at the University of North Carolina and the National Institute for Nutrition and Health (NINH, former National Institute of Nutrition and Food Safety) at the Chinese Center for Disease Control and Prevention (CCDC). The survey used a multistage, random cluster process to draw samples in 15 provinces and municipal cities (Beijing, Liaoning, Heilongjiang, Shanghai, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, Guizhou, and Chongqing) that vary substantially in geography, economic development and government public resources. Three of them were added after CHNS 2011 and three more provinces joined after 2015. This study uses data from 10 waves, including the most updated data in 2015. CHNS provides extensive information about fertility and pregnancy history as well as basic social demographic and employment information that enable the empirical analysis in this study.Two dependent variables are constructed as follows: firstly, a dummy variable equals to 1 when a woman is working, and equals to 0 when she is not in employment. Secondly, a dummy variable equals to 1 when a woman is an irregular worker, and equals to 0 when she is a regular worker. In this study, irregular work is defined by the employment position of occupation as in the CHNS questionnaire (Lv, 2005; Wu, 2009; Zhang *et al*., 2018). Irregular workers comprise self-employed workers with no employees (including farmers), temporary workers, paid family workers or unpaid family workers. Regular workers comprise self-employed workers who employ others, workers who work for others or work in units (enterprises or organizations) as a permanent employee or workers with a long-term labor contract.

In order to analyze both the accumulated effect of the total number of children and the marginal effects for various parities, this study uses two types of independent variables. Firstly, the total number of children is operationalized as a categorical variable (0=childless, 1=having one child, 2= having two or more children), which is used in most previous studies (Jones, 1982; Abendroth *et al*., 2014). Secondly, two types of fertility marginal effects are considered. The first is the extensive fertility margin that indicates the influence of the decision about bearing or not bearing children on the labor supply. It is dichotomized as a dummy variable (1=having child, 0=childless). The second is the intensive fertility margin, which indicates the influence of an additional child on the labor supply. It is constructed as a set of categorical dummy variables (one child, two children, three and more children dummy variables), which is obtained by using the married women with children subsamples. This analysis can be used to evaluate the opportunity cost for different parity groups. Different covariates are used to control other influences on the female labor supply. First, at the individual level, according to human capital theory (Becker, 1964; Mincer, 1974) an individual's wage level is determined by human capital such as education, years of experience, and health; wage level is one of the important determinants of the labor supply. On the other hand, education and training experiences also influence people's attitudes towards childbearing. Therefore, this study uses the years of schooling, age and age-squared as the proxy variables of human capital. The decisions about labor supply and childbearing vary by ethnicity group and the rural/urban household registration status. Thus, ethnicity (Han=0; other ethnicity=1), and household registration (*Hukou*) type (urban=0; rural=1)[4] are controlled.

[1]The sex of the first child could not become the IV for the dummy variable on whether having child or not. In previous studies, in vitro fertilization was exploited as an IV of extensive fertility margin Lundborg, Plug and Rasmussen (2017) but the information cannot be obtained from the CHNS. Thus this study does not analyze the extensive fertility margin effect using the IV methods.

[4] The urban and rural groups are distinguished based on the household registration (*Hukou*). However, it is possible that people who have rural *Hukou* take on non-agricultural jobs, especially work in urban areas as migrant workers.

Second, at the household level, Douglas (1934) and Arisawa (1956) indicate that women's labor supply behaviors are not only influenced by the wage rate in the labor market,[5] but also affected by the income of their husband and other family members. Hence, the annual household income (excluding the woman's own income) is included in the model. In addition, living with parents may increase the household income as well as the availability of childcare support, but it might also generate new consumption for the household and the demand for elder care. It seems that living with parents will influence women's decisions on labor supply and childbearing (Del Boca *et al.*, 2004). Additionally, there are gender differences in terms of childcare responsibilities - mothers will be more involved in taking care of young children than fathers - and therefore two dummy variables are used in our models: the living-with-mother dummy and the living-with-father dummy. Third, based on the labor market segmentation hypothesis (Piore, 1970) the behaviors of workers are shaped by the characteristics of labor market. Therefore, a variety of work unit dummy variables are used to control the influence of labor market segmentation on female labor supply. Fourth, the selective two-child policy was implemented in 2013 and in order to control the effect of population policy, the policy implementation dummy variable is used (after 2013=1; before 2012=0).

Finally, the culture and the economic development level may differ in each region and hence, four region dummy variables (Eastern Region; Central Region; Western Region, and Northeast Regions) are included in the control variables to capture the regional disparity.

Given that this study focuses on the effect of the number of children and parity on the female labor supply, we only analyze women who are likely to have children and work. Considering the tradition of birth within marriage and the legal age of marriage in China, married women aged from 20 to 52 years old are selected as our sample and the total number of observations is 29,401. Table 1 presents the descriptive statistics.

Table-1. Descriptive statistics.

	All sample		One child		Two children and more		
Variable	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**p-value**
Labor participation	0.78	0.42	0.78	0.42	0.79	0.40	0.004
Irregular worker	0.62	0.48	0.42	0.49	0.79	0.41	<0.001
Age	38.70	8.06	36.26	8.28	40.81	7.23	<0.001
Han ethnicity	0.87	0.29	0.90	0.29	0.86	0.35	<0.001
Rural Hukou	0.62	0.48	0.45	0.50	0.80	0.40	<0.001
Schooling years	7.30	4.09	9.23	3.48	5.72	3.87	<0.001
Eastern Region	0.24	0.43	0.32	0.47	0.18	0.38	<0.001
Central Region	0.34	0.47	0.26	0.44	0.41	0.49	
Western Region	0.24	0.43	0.19	0.39	0.29	0.45	
Northeast Region	0.17	0.38	0.23	0.42	0.12	0.33	
0-3 years old	0.18	0.38	0.20	0.40	0.15	0.36	<0.001
4-6 years old	0.12	0.33	0.14	0.34	0.11	0.31	
7-14 years old	0.32	0.47	0.30	0.46	0.33	0.47	
Non-child or child aged over 14 years old	0.38	0.49	0.35	0.48	0.41	0.49	
Have at least a boy	0.74	0.44	0.59	0.49	0.88	0.33	<0.001
First child is boy	0.48	0.50	0.41	0.49	0.54	0.50	<0.001
Husband income (per thousand RMB)	33.48	59.12	42.85	63.35	25.40	53.93	<0.001
Living with mother	0.04	0.19	0.06	0.23	0.02	0.15	<0.001
Living with father	0.03	0.17	0.04	0.20	0.01	0.12	<0.001
Observations	29,401		13,294		15,408		

Notes: (i)The sum of the women who have one child and two or more children is not equal to the total number of observations. This is because we do not list the results for childless group because the sample of this group is limited. (ii)p-value in this table indicates the significance of the difference of each variable in the group of one child and two or more children.

[5] In this study, we use the variable of human capital (education and age) as the proxy of women's income.

4. RESULTS

4.1. Results Based on the Fixed Effects and the Random Effects Models

Table 2 summarizes the results of the impacts of the number of children on female labor supply by the fixed effects and random effects models for the total samples. Model 1 and Model 3 are the estimations by the fixed effects models[6]. Model 2 and Model 4 present the estimations by the random effects models. The Hausman test results indicate that the fixed effects model is preferred. The results based on the fixed effects models are summarized as follows.

Table-2. Impacts of the number of children on the female labor supply.

	Model 1	**Model 2**	**Model 3**	**Model 4**
	Fixed-effects	**Random-effects**	**Fixed-effects**	**Random-effects**
Variable	Labor participation (Odds Ratio)	Labor participation (Odds Ratio)	Irregular work (Odds Ratio)	Irregular work (Odds Ratio)
The number of children (reference group= one child)				
No child	1.189	1.319	0.705	1.123
	(0.329)	(0.295)	(0.260)	(0.344)
Two children	0.657***	0.862**	1.666**	2.227***
	(0.106)	(0.0606)	(0.336)	(0.230)
Three or more children	0.449**	1.896***	5.780***	4.287***
	(0.140)	(0.185)	(2.259)	(0.662)
Observations	13,866	21,637	6,998	16,079
Hausman test		433.61		1246.27
		(<0.01)		(<0.01)

Notes: (i) ***p<0.01, **p<0.05, *p<0.10. (ii)The covariates in the random effects model include women's age, the age squared, household registration status, years of education, region, the age of the youngest child, the type of working unit, household income, co-residency with mother, co-residency with father, after the implementation of selective two-child policy (after 2013 dummy variable). In the fixed effects model, only time-varying variables, including the women's age and age squared, the age of the youngest child, the household income, after the implementation of selective two-child policy (after 2013 dummy variable) are used. Due to the limitation of the length of the paper, Table 2 does not present the results of the other control variables. If it is needed, please contact the author.

First, the results of Model 1 suggest that compared with women who only have one child, the women without children are more likely to enter into the labor market, but the coefficient is not statistically significant. The result indicates that having one child may not lead to a reduction in participation in the labor market. Compared with women who have one child, the possibility of participation in the labor market is 34.3% lower for those with two children and 55.1% lower for those with three or more children. The results suggest that the increased childbearing responsibilities encourage women to exit from the labor market.

Second, the results of Model 3 show the relationship between the number of children and the likelihood of becoming an irregular worker. Compared with the women with only one child, the possibility of becoming an irregular worker will increase 66.6% for women with two children. The possibility is also higher for women with three or more children.

These results can be explained by following reasons. First, based on human capital theory, having more children requires longer hours of childcare, which may limit the time investment in women's own human capital. Also, the existing human capital may depreciate when women have more children because their skillset might become out of date during their career interruption, which may reduce the chance of women entering regular work. Second, while women are having their second child or higher parity, the grandparents who can take care of children become older. As their health declines, the elders may cease childcare support and they may need to be cared by

[6] The fixed effects model could not estimate the effects of time-invariant variables. To consider that in the conditional fixed effects logistic regression model, when the dependent variable is a dummy variable, it may lead to a considerable sample loss, we only utilize the women's age, women's age squared, the age of the youngest child, whether having a boy, after 2013 dummy variable and the household income in these analyses.

their daughters, thereby increasing the middle_aged women's family responsibilities and discouraging them to return to work. Especially in rural China, where the traditional attitude that "the man is for work and the woman is for family" remains, family responsibilities may be heavier for women with two or more children. Thus, women with more children tend to reduce their participation in work and more likely to choose irregular work, which can be thought as a kind of family-friendly work.

Table 3 summarizes the results of the intensive marginal effects and the extensive marginal effects by the fixed effects and random effects models. Model 1 and Model 3 show the extensive marginal effects, and Model 2 and Model 4 present the intensive marginal effects. The main findings are as follows. First, the results of Model 1 and Model 3 suggest that the extensive marginal effects of childbearing (whether or not to have children) on the female labor supply is not statistically significant. For Chinese women, whether having children might not affect their participation in work (see Model 1), and the likelihood of becoming irregular workers (see Model 3). These results indicate that the extensive marginal effects of childbearing on the female labor supply are small in China. On the contrary, the results show that both the possibility of participation work and the likelihood of becoming an irregular worker are greater for women with more children, and the influence of the second or higher parity is greater than for the first child. It is indicated that the intensive marginal effect of childbearing on employment status (to become an irregular worker or regular worker) is significant in China.

These results may be explained as follows. In contrast to Japanese women whose labor force participation rate by age groups curve remains M-shaped, it is common in China to have one child and fewer Chinese women stop their working career due to childbearing. Thus, only having one child may not significantly influence women's participation in the labor market. However, women with more children have to take on more childcare and housework, which may reduce their hours of paid work in the labor market and increase the likelihood of entry into the irregular work.

Table-3. Impacts of parities on the female labor supply.

	Model 1	**Model 2**	**Model 3**	**Model 4**
Variable	Extensive margin effect (Odds Ratio)	Intensive margin effect (Odds Ratio)	Extensive margin effect (Odds Ratio)	Intensive margin effect (Odds Ratio)
	Labor force participation		Irregular work	
Extensive margin effect (reference group= childless women)				
Having child	1.219		0.786	
	(0.297)		(0.264)	
Intensive margin effect (reference group= having one child)				
Having two children		0.668**		1.822***
		(0.119)		(0.409)
Having three or more children		0.480**		6.525***
		(0.163)		(2.728)
Observations	13,866	13,866	6,998	16,079

Note: see Table 2.

4.2. Results Based on the Instrumental Variables (IV) Method

Table 4 displays the results from the instrumental variables (IV) model. We use the sex of the first child as an instrumental variable for the number of children. The Hausman test indicates an endogeneity problem and shows the need to use the instrumental variables method. We report the results produced by the instrumental variables method as follows.

In the first stage of Model 1 to Model 4, the coefficients of the instrumental variables are all positively statistically significant, which indicates that if the first child is a girl, women tend to have second or more births.

The results of the second stage regression suggest that although the number of children does not significantly affect women's decision to work or not work, it may increase the likelihood of becoming an irregular worker. The likelihood of becoming an irregular worker for the total women sample, including the women with or without children, may increase 23.6% with the birth of one additional child. For the samples of only the women with children the likelihood of becoming an irregular worker may increase 40.9% when having one additional child. The results based on the instrumental variables methods are consistent with the results in Table 3. The conclusion that the extensive marginal effects of childbearing are significant is again confirmed.

Table-4. Impacts of the number of children and parities on female labor supply (IV method).

	Model 1		**Model 2**		**Model 3**		**Model 4**	
Variable	Labor force participation				Irregular work			
	First stage	All women	First stage	mothers	First stage	All women	First stage	mothers
The sex of the first birth (IV)	1.969***		1.466***		1.901***		1.430***	
	(0.0250)		(0.0110)		(0.0279)		(0.0118)	
The number of children		1.029		1.075		1.236***		1.409***
		(0.0383)		(0.0863)		(0.0720)		(0.173)
Observations	21,522	21,522	15,914	15,914	15,985	15,985	12,383	12,383
Hausman test		101.68 <0.000		483.07 <0.000		227.67 <0.000		466.81 <0.000

Note: see Table 2.

4.3. Sensitivity and Robustness Checks: The Results for Different Groups

The labor supply may differ for various groups. For example, the labor supply may vary by household registration (*Hukou*) types and educational level. To consider these heterogeneities between various groups, the analysis is conducted within a set of subsamples. The main findings are as follows.

4.3.1. Results for the Rural Group and the Urban Group in China

The rural group and urban group differ in the preference for family size; the gender of the child; the timing of marriage, and childbirth and they differ for informal childcare support and public childcare provision (Zhang, 2011). During the economic system transition period, the labor market was segmented by the household registration (*Hukou*) system, and the employment and wage gap between the rural group and the urban group endures. The rural-urban gap may in part arise from the human capital gap, but discrimination against migrants in the labor market is also a major factor (Meng and Zhang, 2001; Messinis, 2013; Ma, 2018).

Thus, it can be thought that the impact of the number of children and parity on women's labor supply might differ by these two groups. Based on the questionnaires, we define the rural group as those with rural registration including both rural residents and migrants, and the urban group is defined as urban residents (with urban *Hukou*).

Table 5 presents the estimation of the two groups using the instrumental variable method. In particular, Table 5 reports the results of the effect of the number of children on the female labor supply for the total women sample (including the women with and without children). Table 6 reports the results of intensive marginal effects for women with at least one child. The result of Table 5 and Table 6 are consistent, the main findings are summarized as follows.

Table-5. Impacts of the number of children on the female labor supply for the rural group and for the urban group (Total Samples).

Variable	Urban				Rural			
	Labor force participation		Irregular work		Labor force participation		Irregular work	
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
The sex of the first child (IV)	2.330***		1.901***		1.850***		1.780***	
	(0.0442)		(0.0279)		(0.0299)		(0.0323)	
The number of children		0.906		1.310***		1.129**		1.221**
		(0.0545)		(0.109)		(0.0549)		(0.0960)
Observations	7,994	7,994	5,666	5,666	13,528	13,528	10,319	10,319
Hausman test		267.65 <0.000		222.32 <0.000		205.66 <0.000		294.61 <0.000

Note: see Table 2.

Table-6. Impacts of parities on the female labor supply for the rural group and for the urban group (women with at least one child).

Variable	Urban				Rural			
	Labor force participation		Irregular work		Labor force participation		Irregular work	
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
The sex of the first child (IV)	1.833***		1.886***		1.394***		1.362***	
	(0.0241)		(0.0304)		(0.0299)		(0.0323)	
The number of children		0.885		1.502***		1.276***		1.391**
		(0.0763)		(0.173)		(0.115)		(0.212)
Observations	7,830	7,830	5,537	5,537	13,293	13,293	10,129	10,129
Hausman test		253.34 <0.000		215.46 <0.000		221.46 <0.000		285.28 <0.000

Note: see Table 2.

First, the results in the Table 5 indicate the influence of the number of children on participation in the labor market is not statistically significant for the urban group, which is consistent with the results using the total samples (see Table 3) but the effect is statistically positive for the rural group. Concretely, for rural women, when compared with women with one child, the likelihood of participation in work is 27.6% higher for the women with two or more children. It may be because the household income of rural group is lower and the public social security benefits are less than the urban group. Therefore, having more children may increase the household financial burden which may force women to participate in work to increase income (Yang, 2011).

Second, the results show that the number of children positively affect the likelihood of the mother entering irregular work for both the urban group and the rural group. Comparing the coefficient values between these two groups, it is found that the effect is greater for the urban group than for the rural group. When discrimination against women with children persists in the regular work sector, it may be more severe for the urban women. Thus, the decrease in opportunity of entering regular work may force urban women to work in the irregular work sector.[7]

4.3.2. Results by Education Level Groups

It is thought that highly educated women have higher human capital and they may have more promotion opportunities and earn higher income, but they may face higher costs for career interruption and lose their place on

[7] In the rural group, only the migrant workers who do non-agricultural work choose to become regular workers or irregular workers, therefore the subsample for the rural group who do not work as farmers is used in the analyses. These results are consistent with Table 6. These results are not included in this paper due to limitation of its length. We can send these results on request.

the career ladder. To examine the heterogeneous effects due to education, analysis is conducted among people of different education levels. Given the nine-year compulsory education system in China, the sample is divided into two subgroups: the middle and high education group (junior high school or above), and the low education group (lower than junior high school). Table 7 reports the estimates for the total sample and Table 8 presents the results for women with at least one child.

It is shown that although the influences of both the number of children and parity on the participation in work are not statistically significant, the likelihood of becoming an irregular worker is higher for women with higher parity, and is greater for the middle and high-education group than for the low-education group. Based on the economic theory and hypotheses described in Section 2, the results can be explained as follows. Before they have children, highly educated women are more likely to do regular work that requires more involvement in work. The work-family conflict may be more severe for the middle and highly educated women if they have more children. Namely, the childbearing penalty may be greater for the middle and highly educated women than less educated women.

Table-7. Impact of the number of children on female labor supply for the low-education and for the middle and high-education groups (total samples).

Variable	Low-education group				Middle- and high-education group			
	Labor force participation		Irregular work		Labor force participation		Irregular work	
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
The sex of the first child (IV)	1.938***		1.843***		2.436***		2.389***	
	(0.0298)		(0.0321)		(0.0469)		(0.0527)	
The number of children		1.049		1.238***		1.029		1.484***
		(0.0439)		(0.0840)		(0.0747)		(0.143)
observations	16,328	16,328	12,080	12,080	5,768	5,768	4,448	4,448
Hausman test		272.60 <0.000		414.99 <0.000		105.15 <0.000		139.58 <0.000

Note: see Table 2.

Table-8. The impact of different parities on female labor supply for the low-education and for the middle and high-education groups (women with at least one child).

Variable	Low educational level group				Middle and high educational level group			
	Labor force participation		Irregular work		Labor force participation		Irregular work	
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
The sex of the first child (IV)	1.447***		1.404***		1.878***		1.881***	
	(0.0107)		(0.0321)		(0.0469)		(0.0527)	
The number of children		1.114		1.444***		1.037		1.729***
		(0.0843)		(0.181)		(0.111)		(0.238)
observations	16,038	16,038	11,846	11,846	5,606	5,606	4,323	4,323
Hausman test		258.58 <0.000		405.47 <0.000		104.37 <0.000		134.09 <0.000

Note: see Table 2.

4.3.3. Results for the New Definition of Irregular Worker

As the definition of irregular work may affect the estimation results, a new dependent variable for the irregular worker is generated for sensitivity test. More specifically, the irregular worker group is defined as self-employed workers (including farmers, self-employed employers with employees, and self-employed workers without

employees), temporary workers, paid family workers, and unpaid family workers. A regular worker is defined as a worker for another person or for a unit (enterprise, company or organization) as a permanent employee, or a worker with a long-term labor contract. The new dependent variable equals to 1 if the woman is an irregular worker and equals to 0 if she is a regular worker. The results with the new dependent variable are consistent with those in Table 2, Table 3 and Table 4. It suggests that the main findings are robust regardless of the different definitions of irregular work.

5. CONCLUSION

Using the longitudinal data of CHNS, this paper investigates the effect of the number of children on the female labor supply (both participation in work and becoming an irregular worker). The fixed effects model and instrumental variables (IV) method are used to address the unobserved heterogeneity and endogeneity problems. The main findings and policy implications are as follows.

First, the results show that a higher number of children may negatively affect female labor supply. This negative influence is greater for employment status (to become an irregular worker) rather than for participation in work (to work or not work). In particular, women with more children tend to enter irregular work. These results can be explained by the life cycle hypothesis, the human capital theory and features of the labor market in China. The childbearing period usually coincides with the early career development period and this has an adverse effect on the development of human capital. Mothers with more children have to invest more time in unpaid family work, and reduce the paid work they do. Thus, there is a trade-off between women's career development and family responsibilities. It is found that even though for developed countries, the marginal effect of conceiving the first child is larger than for the higher parities (Waite *et al.*, 1985; Joshi, 1990; Abendroth *et al.*, 2014; Lundborg *et al.*, 2017) in China it is greater for the subsequent births. This can be explained by the differences in population, family and employment policies, the cultural gender roles, and the labor market. Comparative studies of working mothers across nations would be a fruitful field for future research.

Three important factors influence Chinese mothers to choose often poorly rewarded irregular work. First, with the progress of labor market reform and the improvement in education, women may have more opportunities to work. Although progress has been made, labor market segmentation, social norms, such as "men for work, women for family" endure, and discrimination against women in the labor market may increase the probability of women becoming irregular workers (Ding and Shi, 2016). From the demand side, the irregular work sector is easier to enter and the working time is more flexible, therefore it is viable for mothers to balance work and family, especially those with more children.

Second, the increase in the supply of irregular workers may result from the changes in the structure of the economy that create new kinds of irregular work. For example, it is expected that new jobs related to online shopping and SOHO (small office and home office) may provide new opportunities for women to become irregular workers.

Third, since the implementation of the universal two-child policy, more women might have a second child. Women with two or more children have to invest longer hours in childcare and housework than mothers with one child. Higher household consumption due to larger family size means they need an income. However, compared to regular jobs, choosing irregular work is more practical because it usually allows them more flexibility to balance work and childcare than a full-time job.

However, the wage level is usually lower and the social security benefits are more limited for irregular work than for regular work. Most irregular workers are not eligible for the higher level of social security, including public pension and public healthcare insurance. The wage and social security gaps between women in regular work and in regular work may enlarge inequality in China. Moreover, the gender gap is wider in the labor market due to the correlation between irregular work and motherhood. This is because the universal two-child policy might

further strengthen the "statistical discrimination" of employers, which makes it harder for women to develop a career or find and keep a regular job and have to become an irregular worker.

The findings are highly relevant for current population and labor policy in China. The effects of the implementation of the universal two-child policy should be evaluated from a long-term perspective. It is essential to provide better childcare support in order to sustain women's employment and to increase the fertility rate. The Chinese government should invest in increasing access to good public childcare services for children aged from 3 to 6 years old, and initiate high-quality daycare services for infants aged from 0 to 3 years old.

Sharing the responsibility of childcare and other homemaking duties with husbands or other family members may increase the female labor supply and improve the quality of the labor supply in the long term. Developed economies, such as Japan and Northern Europe, implement a set of policies, including introducing paternity leave and increasing the provision of high-quality childcare by the communities and governments, providing models to China in terms of supporting women to contribute to the economy. Implementation of these policies can be expected to increase the fertility rate in the long-term, slower the rate of population ageing and increase the economic productivity from higher labor force participation rate.

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