



SCHOOL OF  
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## The Motherhood Penalty in China

An Empirical Study Based on China Family Panel Studies Data  
(2014-2018)

by

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The aim of this paper is to analyze the current situation of motherhood penalty in China by examining the effects of the number of children on women's wages. Based on data from the China Family Panel Studies (CFPS) from 2014 to 2018, this paper mainly uses a fixed effects model to conduct the study on the effects of the number of children on women's wages and income for Chinese women aged 18 to 55. The empirical results indicate that in balanced panel data, the number of children has a significant negative effect on both mothers' wages and income after controlling for human capital, marital status and job characteristics, with a significant decrease of 16.7% in the wage rate and a significant reduction of almost 532 yuan in monthly income. Further heterogeneity and robustness tests are also conducted to confirm the findings. The policy implementation part also suggests that measures should be taken to reduce the current motherhood penalty faced by Chinese women.

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# 1 Introduction

## 1.1 Background

According to the 7th China National Census, the total fertility rate of Chinese women of childbearing age is 1.3 in 2020, which was already at a low level. After the introduction of the comprehensive two-child policy<sup>1</sup>, there is a short-term rebound in fertility levels, followed by a gradual downward trend, but then staying at a low level. It is also the first time since the sixth census that China's fertility rate has fallen below 1.5. It seems that China is currently facing a serious issue of a so-called 'low fertility trap'. The demographic problems associated with declining fertility rates have drawn more attention to women's childbearing patterns, while the negative impact of childbirth on women's wages has rarely been studied. Therefore, it is of great importance to study the motherhood penalty in China in the current social context.

Motherhood penalty has been widely discussed in the field of gender wage gap. When analyzing within a family, a wage premium tends to exist for married or cohabiting men (Mamun, 2012), while this is not the case for women, especially those who are mothers. In fact, whether it is marriage or childbirth that leads to lower female wages is also discussed. Loughran and Zissimopoulos (2009) state that female wages fall after marriage but before birth, although the estimated impact of marriage on female wage growth would probably be smaller if it were not for the expectation of future childbirth. In addition to gender-related disadvantages, women tend to suffer more discrimination and disadvantages when motherhood is added. Women tend to devote more time and effort to child-rearing after giving birth, and are voluntarily or forcibly less committed to work, with lower labour market participation rates and lower wage incomes. Waldfogel's (1997) empirical analysis based on data from the National Longitudinal Survey of Young Women 1968-1988 finds that, after controlling for work experience, the negative effects of children on mothers' wages still exist, which is termed as "family penalty" by Waldfogel. Budig and England (2001) first analyze the wage penalty due to motherhood, stating that while the wage penalty for mothers could be partially explained by less work experience, approximately two-thirds of child penalties persisted after controlling for elaborate measures of work experience. Therefore, the motherhood of women can lead to a negative impact on their competitiveness in the labor

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<sup>1</sup> The two-child policy is a family planning policy in China that allows eligible couples to have a 'second child'. The overall implementation of the two-child policy began in 2015.

market, with further effects such as decreased wages and disadvantaged career development, which is known as the "motherhood penalty".

Although there has been much international discussion on motherhood penalty, local research on motherhood penalty in China remains very rare. In fact, being a mother in China may have a greater impact on the gender wage gap in the labor market, but the impact has not been studied much. Apparently, there is not a widespread awareness of this problem. Previous international studies generally agree that childbirth has a negative impact on women's wages, which is also considered to be a form of the motherhood penalty. According to the Report on China's Women's Development Plan (2011-2020) by the National Bureau of Statistics of China, the proportion of women employed in China in 2020 is 43.5%, so gender equality has not yet been achieved in terms of employment rates. In fact, Chinese women not only have to face increasing gender discrimination in the workplace (Zhang, 2004), but also suffer from motherhood discrimination, which makes the situation even worse. Although motherhood penalty has not been discussed much in the study of Chinese women, the "motherhood" as a characteristic of Chinese women has been paid more attention because of recent fertility policies. Baker (2010) mentions that women's employment 'choices' are influenced by family arrangements and attitudes about being a "good mother". For Chinese mothers, this perception is also deeply rooted, which may prompt them to compromise on their employment choices because of childbirth. In the context of low fertility rates, women's fertility issues are attracting more attention, making it even more important to study the motherhood penalty for Chinese women.

Social and cultural contexts also have an impact on the effects of motherhood penalty. The mainstream research on motherhood penalty remains focused on the United States and the Nordic countries, and it is worth noting that the welfare systems in these countries have an impact on the consequences of motherhood penalty. Cultural support for mother's employment reinforces the positive association between family policy and earnings in countries with different socio-cultural backgrounds, while a culture where men are seen as "bread-winners" is associated with a weaker association between family policy and mother's earnings (Budig, Misra and Boeckmann, 2012). The Nordic countries, for example, with generous childcare welfare policies, as well as a culture supportive of mothers returning to the workplace, have always been seen as representative of countries where women suffer less from the motherhood penalty. However, this is not the case in China. Jayachandran (2021) states that, among all the social norms that discourage female employment, the norm of women taking over the primary responsibility for housework and childcare is probably one of the most challenging to change. In fact, in traditional Chinese culture, the household income is still dominated by men and the stereotype of women as "housewives" is deeply rooted. The Fourth Survey on the Social Status of Chinese Women shows that 76.1%, 67.5% and 63.6% of children aged 0 to 17 are mainly taken care of by their mothers in daily life. As a result,

already facing greater gender discrimination in the workplace, Chinese mothers may experience an even greater disadvantaged situation.

## 1.2 Aim and Research Questions

The aim of this paper is to analyze the current situation of motherhood penalty in China by examining the effects of the number of children on women's wages. The first question this paper hopes to answer is whether motherhood penalty exists among Chinese women, and if so, how much? Secondly, what factors affect Chinese women's motherhood penalty, and how do the effects of penalty vary between groups? To answer these questions, this paper takes an empirical analysis approach by using OLS and Fixed-effect models to do regressions based on the data from the 2014-2018 China Family Panel Studies (CFPS) database of adult women. In the fixed effects model, the main dependent variables are the log of women's hourly wages and monthly income, the main explanatory variable is the number of children, while other control variables include marital status, human capital and job characteristics. To answer the second research question, this paper also presents a heterogeneous study to analyse the impact of motherhood penalty on women from different groups. To ensure the robustness of the findings, the paper further controls for the sample, for instance by using the number of children as a categorical variable in the regression. By analyzing the latest data and reaching more current conclusions, this paper aims to fill the gaps in previous local research on Chinese women's motherhood penalty, as well as to fill the research gap on motherhood penalty in developing countries.

## 1.3 Outline of the Thesis

This paper is divided into six chapters. Chapter 1 introduces the background of motherhood penalty in China and the concept of motherhood penalty, and further states the purpose of the study and the research questions. Chapter 2 introduces the theories and previous international research on motherhood penalty and develops a detailed discussion of the research on motherhood penalty in China. This chapter also mentions the research significance and hypotheses of this paper. Chapter 3 describes the data and methods used in this paper. Based on the data from the China Family Panel Studies (CFPS) from 2014 to 2018, this paper mainly uses a fixed effects model to conduct the study on the effects of the number of children on women's wages and income for Chinese women aged 18 to 55. In Chapter 4, "Empirical Results", this paper first focuses on the general effects of the number of children on mothers' wages. Next, by using heterogeneity tests, the paper further analyses the differences in the effects of motherhood penalty across groups, such as education level, employment type, management status, urban and household registration status. Besides, robustness tests are also conducted in this chapter by replacing the dependent variable with yearly income, changing

the independent variable "number of children" from a continuous variable to a categorical variable, and choosing a younger group as a sample. Chapter 5 discusses the effects of different support policies and personal choices in reducing the motherhood penalty. We first discuss the impact of maternity leave, followed by maternity insurance as an economic measure, and finally the impact of the personal choice to postpone childbirth on the motherhood penalty. Chapter 6 concludes with a review of the main findings of the paper and identifies the shortcomings of the paper.



## 2 Theory and Previous Research

### 2.1 Theory

#### 2.1.1 Human Capital

The accumulation of human capital and the role of experience are primary factors in the motherhood penalty. According to Mincer and Solomon (1974), working experience has a positive effect on earnings. Therefore, compared to non-mothers, mothers may lose the opportunity to accumulate more work experience or invest less in education and professional training because of childbirth and childcare. Staff and Mortimer (2012) state that work interruptions and education interruptions explain the residual wage gap between mothers and other women. Differences in human capital accumulation and work experience can result in wage differences between mothers and non-mothers, which in turn lead to “motherhood penalty”.

#### 2.2.2 Employer Discrimination

While women already suffer significant gender discrimination in the workplace, motherhood can even worsen this situation. Bergmann's (1974) study refers to the previous social system in which women were naturally fitted for a certain type of job and employers strengthened this perception, resulting in a general preference that led to discrimination against women in the workplace. Correll, Benard and Paik's (2007) study shows that women experience discrimination in recruitment as mothers and introduce the mechanism of status-based discrimination. They point out that while status characteristics are a personal attribute or role, being a mother is likely to be in a devalued position in the workplace. The results of the audit study also support their main hypothesis that mothers do suffer from discrimination in actual recruitment.

#### 2.2.3 Career Choices

Most studies agree that mothers are more likely to choose 'family-friendly' jobs to better care for their children, which are often part-time or temporary, resulting in low wages overall. Considering the job characteristics, Kalleberg et al. (2000) also find that mothers are more likely to work part-time, temporary or occasional jobs than non-mothers. Staff and Mortimer (2012) also state that while there may be mothers' own choices, employers may direct them to jobs that require fewer hours and lower wages. However, Budig and England (2011), after controlling for a range of indicators measuring the compatibility of work and motherhood, such as occupational gender ratio, the requirement for extra work, and the need for manual effort, find that the 'cost of motherhood' does not vary substantially, so that compensatory

differences might not be able to completely explain the wage differential between women who have had children and those who have not.

## 2.2 Previous Research

### 2.2.1 Motherhood Wage Penalty

A large number of studies have found that the number of children has a negative impact on a mother's wage and income. Budig and England (2001) find that, compared to non-mothers, the wage penalty for mothers having a first child, a second child and more than two children is 3%, 9% and 12% respectively. In their study of twins, Jacobsen, Pearce III and Rosenbloom (1999) also find that although the impact of unplanned childbearing on labor supply is temporary, it has a profound and lasting effect on women's wages, and the effect on women's earnings continued to increase between 1980 and 1990. Although Kahn, García - Manglano and Bianchi (2014) think that having only one child will not cause too much damage to the mother's wages, they also find that women with two children, the wage penalty is relatively low in their 20s and peaks in their 30s, while women with three or more children, the wage penalty peaks in their 40s. A case study by Aisenbrey, Evertsson and Grunow (2009) suggests that career disruption from childbearing is particularly significant in the US, where having an additional child markedly increases the risk of downward career mobility. Budig (2003) analyses the time sensitivity of fertility and finds that the number of preschool-age children discourages non-employed women from entering the labour market and increases the risk of full-time women exiting the labour market. Livermore, Rodgers and Siminski (2011) use panel data to study the impact of motherhood on women's wages and wage growth in Australia, finding that the unexplained motherhood wage penalty is found to be around 5% for one child, and 9% for two or more children.

In the studies of the long-term effects of motherhood penalty, Staff and Mortimer (2012) study the longitudinal data on 486 women aged 19 to 31 in Minnesota and noted that women's wages fell by about 0.5 per cent when their investment in human capital was cumulatively disrupted. Kahn, García - Manglano and Bianchi (2014) focus on the effects of children on women's career from a lifetime scale, finding that the influence of motherhood on a woman's career diminishes throughout the life course. What's more, they point out that in terms of career status, the negative impact of motherhood declines significantly between the ages of 30 and 40.

In the case of cross-national comparisons, Aisenbrey, Evertsson and Grunow (2009) compare the cases of three welfare states - Germany, Sweden and the USA - to analyse the short-term effects of childbirth on careers. They point out that in the US the time lag between childbirth and re-entry into the workforce is much shorter. For positions, mothers generally return to a position similar to the one they held before giving birth, but the career interruptions caused by childbirth still have a negative impact on career mobility, and excessive maternity leave increases the risk of downward career mobility.

### 2.2.2 Factors Influencing Motherhood Wage Penalty

Although it is known that all mothers cannot avoid the problem of motherhood penalty after the birth of their children, there still exist individual heterogeneity that shows different patterns in different groups of women. Education is one of the major factors influencing motherhood penalty. Loughran and Zissimopoulos (2009) find that marriage and childbirth have a greater negative impact on the wages of women with between 12 and 15 years of education than those with less than 12 years of education or more than 15 years, which indicates that mothers with higher levels of education are more likely to suffer less motherhood penalty. Staff and Mortimer (2012) point out that cumulative time spent in activities that do not involve human capital acquisition, such as non-attendance at school, is the single most important mediator of the motherhood wage penalty.

In addition to the education level, women's job characteristics and skills also have an important influence on the effect of motherhood penalty. Using data from 1968–1988 National Longitudinal Survey of Labor Market Experience of Young Women (NLSYW), Anderson, Binder and Krause (2002) find that high-skilled women face higher costs of exiting the labour market. Miller (2011) notes that college-educated women and women in advanced occupations are most advantaged by delayed childbearing, while it can also be argued that the economic rewards of delayed childbearing represent an effective penalty for early childbearing, and this group of women is more likely to be affected by greater motherhood penalty. It is also necessary to pay attention to the income and skill of women's pre-motherhood jobs, as these considerable variations can further influence the extent to which motherhood is penalized. Wilde, Batchelder, and Ellwood (2010) find that compared to low skill women, the cost of childbirth, especially early childbirth, is higher for high skill women. England et al. (2016) also find that among white women, those with high skills and high wages have the highest motherhood penalty per child, which can reach -10%. Buchmann and McDaniel (2016) examine the family wage gap for the advantaged group of highly educated professionals and find that over time, the size of the negative wage gap for mothers has declined in all professions. Moreover, in traditionally male-dominated professions, mothers experience positive wage differentials, as opposed to their counterparts in female-dominated professions, who continue to experience negative ones. While this finding suggests that motherhood penalties may vary considerably between industries, further examination is needed as this study has only focused on a specific group. What's more, looking at the structural characteristics of work, Yu and Kuo (2017) used fixed effects models to examine wage differences between mothers and non-mothers. The results show that when mothers are working in occupations with relatively low autonomy, high emphasis on teamwork and highly competitive pressures, they tend to experience greater motherhood penalty.

Mothers' own choices may also influence post-birth work choices, with mothers more likely to choose not to work full time in order to care for their children. Patrick, Stephens and Weinstein (2016) point out that family burdens associated with children push mothers towards self-employment, with younger children increasing the probability of not working and being self-employed but decreasing the probability of wage employment. However, this choice may increase the motherhood wage penalty. In a study of the gender wage gap in the UK, Costa, Joyce and Parodi (2020) find that working part-time after childbirth appears to hinder

women's wages. This is because the additional experience of working full-time leads to higher hourly wages, whereas the additional experience of working part-time does not.

Research on the impact of motherhood penalty among women of varied income levels is also a popular topic. Budig and Hodges (2010) consider the differential impact of motherhood penalty based on different income distributions and find that proportionally, having children imposes the greatest penalty on low-wage women. Cooke (2014) also finds in a comparative study of motherhood penalties in Australia, the United Kingdom and the United States that the penalty for mothers is relatively similar in the upper half of the income distribution in all three countries and diminishes as income increases. However, challenging the view of Budig and Hodges (2010), Killewald and Bearak (2014) argue that unconditional quantile regression models are more appropriate for analyzing the effect of income distribution on motherhood penalty, and reach a different conclusion that women in the middle of the wage distribution suffer larger motherhood penalty. Studying from a long-term perspective, Glauber (2018) finds that in the 1980s, the motherhood wage penalty is similar for women at all income levels, but in the early 2010s, upper-income women's motherhood wage penalty had been eliminated, while lower-income women were still experiencing motherhood penalty.

### 2.2.3 Motherhood Penalty in China

For a long time, a lot of research has been conducted in international studies on the causes and influencing mechanisms of motherhood penalty, but the studies tend to mainly focus on the cases of developed countries, such as the United States, while not much attention has been paid to developing countries. One of the reasons for choosing China as an example is that the Chinese economy has changed considerably over the last few decades, resulting in significant changes in the labor market as well, making it even more necessary to focus on the female human capital. Furthermore, as will be mentioned in the following analysis, the clear distinction between the public and private sectors in China leads to differences in the effects of motherhood penalty, which also makes China different from the Western cases.

Chinese women also suffer a significant loss of income due to childbirth. Yu and Xie (2014) find that the wage rate of Chinese women decreases by around 7% for having one child, and that this negative effect increases with the number of their children. Zhang's (2011) empirical study shows that for urban women in China, having an additional child decreases wages by 76%, significantly lowering the wage level. According to Liu and Lu (2018), there is a significant negative effect of childbearing on the wage income of urban women working in the public sector. For each additional child, the wage rate for female workers decreases significantly by 18.4% and the monthly income by 15.9%. Their finding suggests that the 'wage penalty' effect is still significant and widespread even among urban female workers in China's public sector, where job stability is relatively high and childcare benefit is relatively generous. Shen's (2020) empirical results, using a multilayer mixed effects model after controlling for family structure, education level and job characteristics, suggest that the net effect of motherhood penalty in China also increases over time. Over the 26-year period from 1989 to 2015, the average wage growth rate for mothers is 1.6% lower than that of non-mothers. In 1989, each additional child resulted in a 9.41% reduction in the female wage rate, while in 2015, each additional child resulted in a 17.47% reduction in the female wage rate. Besides, Yang (2019) introduces a new analytical framework, namely 'gender-motherhood

double tax' and states that there are three different mechanisms driven by 'double tax' at different points in job participation and at different stages of the life course: barriers to employment are mainly driven by gender-marital, disruptions in the workplace are driven by marriage-childbearing, and wages are driven by gender-childbearing. Women are therefore disadvantaged at different stages, and this disadvantage is exacerbated by their motherhood, resulting in the enormous pressure of "double tax" on women. Although current studies on motherhood penalty in China are rather limited, as the economy grows and more women enter the labor market, the motherhood penalty for Chinese women should receive more attention.

In terms of the sample selected, most Chinese research focuses on the motherhood penalty for urban women. Zhang (2011) analyzes a sample of urban women in China, finding that an increase in the number of children significantly reduces the labor supply, time input and wage levels of employed women. For example, having one more child reduces working hours of Chinese urban women by about 4.5 hours per week. Yang, Lu. and Ren (2016) analyze the impact of having two children on urban women using the data from the Chinese Women's Social Status Survey in response to China's two-child policy. They point out that the risk of family shock to work from a second child is greater than from a first child, and that the greater the number of children and the younger they are, the greater the risk of family shock. Besides, young urban women are twice as likely as their male counterparts to experience family shocks, so motherhood penalty is very evident under the implementation of China's two-child policy. Following the same mechanism, the latest three-child policy<sup>2</sup> in China should have a similar outcome, that women's career paths will be obstructed because of having more children. Furthermore, the increase in the number of children under the three-child policy will inevitably also lead to women suffering more and longer-term wage losses as mentioned in the previous section.

In China, the 'fertility wage penalty' effect also differs significantly between women with differential human capital. In an analysis of data from 1989-2015, Shen (2020) found that the lower the education level, the greater the motherhood penalty for women. However, the overall trend shows that the difference in motherhood penalty between women with high and low education levels is becoming smaller. Yu and Xie (2014) point out that for women with primary, lower secondary and upper secondary education, childbearing does not have a significant effect on their wage rate. For women with university education, there was a significant negative impact on wage rates, with each child reducing the wage rate of university-educated women by 38.7%. However, Liu and Lu's (2018) study shows that childbirth has a greater impact on less educated female workers, with each additional child resulting in a significant 26% reduction in the wage rate and 24.2% reduction in the monthly income level for women with only a high school education or below. This difference in findings may be related to the different groups of women selected, as Liu and Lu's (2018) focus only on urban women within the Chinese public sector.

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<sup>2</sup> The three-child policy, a family planning policy introduced in China in response to the aging population, means that a couple can legally have three children, and the policy began on May 31, 2021.

## 2.3 Research Significance

In summary, there is little local research on the motherhood wage penalty of Chinese mothers, so this paper attempts to fill the research gap. In terms of the selection of datasets, most of the previous empirical studies on motherhood penalty in China are based on the China Health and Nutrition Survey database (Zhang, 2011; Yu & Xie, 2014; Shen, 2020), or Survey of Chinese Women's Social Status (Huang, 2014; Yang, Lu & Ren, 2016). However, these two data sources do not provide more recent data, so this paper is based on the data from China Family Panel Studies (CFPS). The CFPS database provides the most recent data available from 2010 to 2020, allowing for the analysis of the latest situation of motherhood penalty in China. Considering the consistency and integrity of the data (the data for 2020 has not yet been fully updated), the three periods of data from 2014 to 2018 are used as panel data for the analysis in this paper, which can effectively observe the short-term effects of the motherhood penalty in recent years, while avoiding the bias caused by observing only cross-sectional data. Furthermore, some previous studies only restricted to specific groups of women, such as urban, state-owned, or young women in China (Yang, 2017; Liu & Lu, 2018; Zhang & Zhang, 2019), thus not representative of Chinese women's overall motherhood penalty situation. Therefore, this paper first chooses the sample of adult Chinese women aged 18-55 to generate a more comprehensive understanding of motherhood penalty in China, and later builds on the overall situation to develop a more specific analysis of different groups. Finally, for the empirical study, regarding the model used to estimate the effects of the number of children on women's wages, unlike some previous studies which used two-stage least squares (2SLS) method (Zhang, 2011; Liu & Lu, 2018), the fixed effects model used in this paper allows for a more robust identification of the effects of the motherhood penalty.

## 2.4 Hypothesis

Based on the previous theories and findings on motherhood penalty, the following hypotheses will be tested in this paper:

**Hypothesis 1:** The number of children has a negative effect on women's wages

The main prediction in this paper is that women with children have lower wage compared to women without children, and that this “wage penalty” may increases with the number of children.

**Hypothesis 2:** Motherhood penalty has a differential effect on different groups of mothers

**Hypothesis 2a:** The higher the mother's education level, the greater the negative impact of the number of children on wages

**Hypothesis 2b:** Compared to women working in the state-owned sector, the wages of women working in the private sector are more affected by the number of children

**Hypothesis 2c:** Compared to women without management positions, the wage of women in higher positions is more affected by the number of children

**Hypothesis 2d:** Compared to rural women, urban women are experiencing greater motherhood wage penalty

# 3 Data

## 3.1 Data Source

The database used in this research is the China Family Panel Studies (CFPS). Conducted by the Institute of Social Science Survey (ISSS) of Peking University, China, the studies cover a sample of 25 provinces, municipalities and autonomous regions across China and contains both individual level and family level data. The overall sample size is large, with detailed records of key variables such as employment and income, providing the foundation for the empirical research in this paper. The studies have been tracked since 2010, with a sample size of 16,000 households per period. The period is chosen because the format and variables of the questionnaires were basically settled from 2014, which guarantee the continuity and integrity of the data. In addition, as this is a tracking survey, individual changes over time can be observed and conclusions will be more representative. After processing missing values and data cleaning, the overall valid sample for this paper consisted of a sample of 8,804 Chinese women aged between 18 and 55 years old, including 3,249 observations in 2014, 1,941 observations in 2016, and 3,614 observations in 2018. In a further analysis of the balanced panel data for three periods, there are 852 observations, including 284 individuals. Finally, all the data are empirically analyzed by Stata.

## 3.2 Model

In this paper, ordinary least squares and two-way fixed effects regressions are used as the main models to analyze the effects of fertility on female wage rates in China. For each year of cross-sectional data, the paper uses OLS regression, while both OLS and fixed effects regressions are applied for the final panel data to test the hypotheses. Comparing the random effects model with the fixed effects model, the fixed effects model is superior for addressing the omitted variable bias due to the lack of control for the individual characteristics which are difficult to observe, and for contributing to more accurate conclusions based on panel data.

Following the classical Mincer equation and building on the literature review, the fixed effects model in this paper is set as follows:

$$\ln wage_i = \alpha_0 + \alpha_1 \text{childnumber}_i + \alpha_2 (\text{marriage control})_i + \alpha_3 (\text{human capital controls})_i + \alpha_4 (\text{job controls})_i + \text{year} + \text{province} + \varepsilon_i$$

In this model, the  $\ln wage$  is the log of hourly wage earnings,  $\text{childnumber}$  is the number of children a woman has in the sample, and  $\alpha_1$  here represents the effect of the number of



children on women's hourly wages. Among the remaining independent variables, the variable for marriage control is marital status, while human capital controls include education level, working experience and squared working experience. Job controls include job characteristics such as type of employment, management position and promotion. Lastly, year and province are controlled as dummy variables and  $\epsilon_i$  is the error term. Besides, in the OLS equation there are no controls for year or region. For both the OLS equation and the Fixed Effects equation, this paper adopts a stepwise regression approach to obtain the outcomes, which provide a better observation of the effects of different variables on wages.

### 3.3 Variables Descriptions

As the model above shows, the main dependent variable is log of hourly wage ( $\ln wage$ ) and the main explanatory independent variable is number of children ( $childnumber$ ) additionally, there are also control variables such as marital status, education level, working experience and occupational characteristics. The monthly income is a woman's monthly earnings after tax. In order to limit the extremes values in the data and reduce the impact of possible spurious outliers, this paper has winsorized the hourly wage, monthly income, monthly working hours and yearly income by using the `winsor2`<sup>3</sup> command in the Stata. Estimates without indentation will be presented in the appendix.

Since CFPS already has a variable of weekly working hours, this paper multiplies the weekly working hours by four times to generate a new variable of monthly working hours, getting the hourly wage and finally the dependent variable,  $\ln wage$ . The CFPS database each year includes multiple databases, so the data of the number of children is collected from the family databases by counting the number of children's `pid` (personal id) and generate a new variable, According to the CFPS user manual, people under the age of 16 are defined as juniors and people aged 16 and over are defined as adults. We therefore define the children here as being under 16 years old. Besides, the remaining variables are collected from the individual databases, after which the data were merged according to the individual code (`pid`) to obtain the aggregate dataset and the final panel dataset. The number of children is first regressed as a continuous variable. Additionally, this paper constructs the number of children as a new categorical variable (`child_cat`): no children (0), one child (1), two children (2) and three and more children (3), where no children is the control group.

Marital status, as an indicator of the marriage control in the model, is also expected to have an impact on women's wage. Marital status is set as a dummy variable, giving a value of 1 (with a spouse) if married or cohabiting, and 0 (without a spouse) if unmarried, divorced, or spouse deceased.

Education, experience and squared experience ( $exp^2$ ) are indicators of human capital measurement. The education variable is divided into three categories of junior high school

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<sup>3</sup> The `winsor2` command replaces all observations that are less than the 1% quantile or more than the 99% quantile with the 1% quantile or 99% quantile

and below (1), senior high school (2) and college and above (3) to measure the effect of education level on wages. Experience is a continuous variable and refers to an estimated number of years that an individual has been in the workforce since completing the highest education. Due to the lack of data on the working experience, this paper estimates the years of working experience by using the variables schooling and age. The calculation is that, for individuals with junior high school education or below (i.e., 9 years of education or less), their work experience is measured as:  $\text{experience} = \text{age} - 16^4$ , while for those with education above junior high school (i.e., more than 9 years of education), work experience is measured as:  $\text{experience} = \text{age} - \text{schooling years} - 6$ .

Another group of variables of employment, management and promotion are used as measures of job characteristics. The employment is a categorical variable representing the type of sector in which the individual works, set as follows: 1 for state-owned sector, 2 for private sector, and 3 for other sectors such as foreign companies. Management is a dummy variable, with 0 representing no management positions and 1 representing a sample with management positions. Promotion is also a dummy variable, where 0 is for no promotion track and 1 is for having a promotion chance.

In the panel data, in addition to individual fixed effects, time fixed effects and regional fixed effects are also included, specifically by setting two dummy variables for year and province.

Based on the official classification of China's provinces, this paper divides the three main regions according to the provinceid: East (1), Middle (2) and West (3), the reference group being the East. Fixed effects are included to reduce the bias of the OLS regression and to make the regression results more robust. Besides, control variables such as urban and household registration(hukou), both of which are dummy variables, are also included in the sub-group regressions. In the urban variable, 0 stands for rural residence and 1 for urban residence, while in the hukou variable, 0 stands for an agriculture household and 1 for a non-agriculture household.

The Table 1 below shows the explanations and statistical descriptions of all included variables in the unbalanced panel data. As can be seen in Table 1, the average hourly wage for women in the full sample is 15.88 yuan, the average monthly income is 2738.14 yuan, the average yearly income is 28088.59 yuan and the average number of children born is 1.05.

***Table 1 Descriptive Statistics for Variables Used in the Analysis: Panel Data (2014-2018)***

Variable	Descriptions	Obs	Mean	Std. Dev.	Min	Max
lnwage	log of hourlywage	8702	2.52	0.67	-2.19	5.70
hourlywage	after-tax hourly	8804	15.88	15.89	0.00	300.00

<sup>4</sup> According to the Chinese labor law, the minimum age to work is 16 years old.

	wage(yuan)					
monthly income	after-tax monthly income(yuan)	8804	2738.14	2536.99	0.00	80000.00
yearly income	after-tax income in past 12 months(yuan)	8804	28088.59	27006.77	0.00	800000.00
hours	monthly working hours	8804	199.67	65.32	28.00	392.00
childnumber	the number of children	8804	1.05	0.85	0.00	7.00
maritalstatus	current marital status	8804	0.77	0.42	0.00	1.00
education	educational level	8804	1.81	0.87	1.00	3.00
experience	estimated working experience(year)	8054	16.37	10.72	0.00	39.00
exp2	square of working experience	8054	382.76	402.15	0.00	1521.00
employment	type of employer	8804	1.85	0.57	1.00	3.00
management	whether have administrative/management position	8804	0.10	0.30	0.00	1.00
promotion	whether have promotion	8804	0.09	0.28	0.00	1.00
urban	urban area (Census Bureau's definition)	8804	0.67	0.47	0.00	1.00

hukou	current household registration status	8630	0.39	0.49	0.00	1.00
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**Table 2 Means and Standard Deviations for Variables Used in the Analysis by Motherhood Status: Panel Data (2014-2018)**

Variable	Non-mothers (N=2394)		Mothers (N=6410)	
	Mean	Std. Dev.	Mean	Std. Dev.
lnwage	2.63	0.66	2.48	0.67
hourlywage	17.21	15.31	15.38	16.08
monthlywage	2925.92	2348.62	2668.01	2600.55
hours	192.82	60.04	202.23	67.01
childnumber	0.00	0.00	1.44	0.65
maritalstatus	0.30	0.46	0.95	0.22
education	2.21	0.86	1.66	0.83
experience	6.20	6.42	20.15	9.47
exp2	79.61	198.95	495.56	400.33
employment	1.85	0.58	1.84	0.57
management	0.12	0.33	0.10	0.29
promotion	0.12	0.33	0.08	0.27
urban	0.64	0.48	0.68	0.47
hukou	0.36	0.48	0.41	0.49

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In addition, the Table 2 here gives statistical descriptions categorized by motherhood. Overall, in the total sample of three periods, the average hourly wage for women without children was

17.21 yuan per hour, higher than the 15.38 yuan per hour wage for women who have children. In terms of monthly income, the average after-tax monthly income for women who have no children is 2,925.92 yuan, higher than the 2,668.01 yuan for women who have had children. Table 2 shows that the total sample selected for this paper does show that having children has a negative impact on women's wages, providing a preliminary indication that the motherhood penalty does exist. In addition, women not having children also have a higher average educational level, and a higher proportion of having managerial positions and promotion pathway. These findings all point to the fact that women as mothers may face more disadvantaged career situations in the Chinese workplace. As Table 1 is only a basic summary, the effects of motherhood on women's wages will be discussed further below, controlling for other variables.

## 4 Empirical Results

### 4.1 Effects of Number of Children on Women's Wage

#### 4.1.1 Motherhood Wage Penalty: OLS models

Before we investigate the overall outcome estimated by the fixed-effect models, it also helps to start with cross-sectional data from different years. The same OLS models are used in Table 3 and Table 4, where the independent variable *childnumber* is a continuous variable and its regression coefficient represents the effect of the number of children on the hourly wage. In both tables, the panel data of the fourth and fifth columns include both year fixed effects and regional controls in the regressions. Besides, only the final model results including controls for marriage, human capital and job characteristics are presented here. The cross-sectional data in the first three columns of Table 3 all show that, same as for wage rates, in terms of separate years, an increase in the number of children has a significant negative effect on monthly income. After adding annual fixed effects and regional controls, the regression results of the full sample fixed effects model show that for each additional child, women's monthly income will significantly decrease by approximately 116 yuan. For the restricted sample, the decrease is even greater, with each additional child resulting in a significant decrease in monthly income of 170 yuan.

**Table 3 Effect of Total Number of Children (Continuous Variable) on Women's Monthly Income from OLS Models**

Year	2014	2016	2018	panel (unbalanced)	panel (balanced)
VARIABLES	monthly income	monthly income	monthly income	monthly income	monthly income
<i>childnumber</i>	-63.797** (-2.25)	-130.263** (-2.24)	-165.303*** (-3.35)	-115.716*** (-4.19)	-169.473* (-1.80)
<i>maritalstatus</i>	-88.562 (-1.61)	-93.783 (-0.87)	-88.779 (-0.88)	-49.663 (-0.94)	-291.568* (-1.80)
<i>education</i>	553.104***	507.650***	616.573***	477.995***	518.540***

	-22.22	-9.8	-13.53	-19.61	-6.3
experience	75.566***	95.324***	86.443***	76.283***	116.449***
	-9.23	-5.67	-5.93	-9.59	-4.34
exp2	-1.978***	-2.523***	-2.166***	-2.091***	-2.752***
	(-9.87)	(-6.05)	(-6.23)	(-10.75)	(-4.15)
employment	232.558***	214.878***	214.293***	181.571***	-81.903
	-7.17	-3.08	-3.69	-5.75	(-0.74)
promotion	383.830***	412.348***	348.176***	406.354***	308.705
	-5.92	-3.43	-2.89	-6.48	-1.46
management	656.391***	819.550***	844.934***	675.707***	926.379***
	-10.76	-6.32	-7.68	-11.45	-4.84
Constant	774.618***	777.634***	1,037.682***	481.391***	456.646
	-7.04	-3.43	-5.1	-4.32	-1.17
YEAR fixed effects				YES	YES
Regional controls				YES	YES
Restricted sample				NO	YES
Observations	8,054	1,748	3,213	8,054	807
R-squared	0.121	0.135	0.136	0.178	0.223

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 4 Effect of Total Number of Children (Continuous Variable) on Women's Hourly Wage(ln) from OLS Models**

Year	2014	2016	2018	panel (unbalanced)	panel (balanced)
VARIABLES	lnwage	lnwage	lnwage	lnwage	lnwage
childnumber	-0.050***	-0.063**	-0.073***	-0.044***	-0.103***

	(-2.68)	(-2.57)	(-4.44)	(-3.97)	(-2.80)
maritalstatus	0.05	-0.026	0.013	0.007	0.028
	-1.44	(-0.57)	-0.39	-0.32	-0.45
education	0.220***	0.286***	0.288***	0.280***	0.247***
	-14.1	-13.22	-18.91	-28.68	-7.67
experience	0.018***	0.031***	0.027***	0.024***	0.038***
	-3.47	-4.45	-5.61	-7.56	-3.61
exp2	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(-3.96)	(-4.51)	(-5.88)	(-7.87)	(-3.86)
employment	0.052***	0.016	-0.004	0.024*	-0.048
	-2.63	-0.53	(-0.21)	-1.88	(-1.09)
promotion	0.155***	0.105**	0.100**	0.120***	0.121
	-3.74	-2.12	-2.48	-4.72	-1.46
management	0.150***	0.194***	0.224***	0.180***	0.158**
	-4.03	-3.59	-6.12	-7.57	-2.12
Constant	1.791***	1.802***	1.970***	1.819***	1.728***
	-26.39	-18.91	-28.78	-42.09	-11.31
YEAR fixed effects				YES	YES
Regional controls				YES	YES
Restricted sample				NO	YES
Observations	3,093	1,704	3,164	7,961	800
R-squared	0.111	0.164	0.207	0.159	0.219

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

When we turn to investigate the effect of child number on women's wage rate, the motherhood wage penalty becomes more evident. The first three columns of Table 3 show the results of the OLS regressions for the cross-sectional data for the three years 2014, 2016 and 2018 respectively. The results show that each additional child reduces a woman's wage rate by a significant 5% in 2014, 6.3% in 2016, and 7.3% in 2018. In only four years between



2014 and 2018, the difference in wage rate reductions amounted to 2.3%, which initially suggests that the motherhood wage penalty is increasing during this period. Hypothesis 1 is initially proven, and Chinese women are suffering more and more motherhood penalty.

When it comes to the panel data, the results in the fourth column show a significant decrease of 4.4% in the women's wage rate for one more child. What can be seen is that for each higher level of education, the wage rate increases significantly by 28%, and for each one more year of working experience, the wage rate also increases significantly by 2.8%. Besides, variables of job characteristics also show a significant positive effect on the wage rate. The fifth column presents similar regression results for the balanced panel data, which is limited to a sample size of 800 observations. According to the results, for each additional child, the female wage rate is significantly decreased by 10.3%. This coefficient is larger than all four previous results, which may be the result of selective sampling, but since the sample in the balanced panel represents the same cohort of individuals over three years of tracking data, it is reasonable to assume that the wage penalty of motherhood for women is observed over time and is not a random effect in a single year. Similarly, the other control variables, including education and working experience, show significant positive effects in this regression, suggesting that after excluding the effects of human capital and job characteristics on wage rates, there is still a significant negative effect of motherhood on women's wage and hypothesis 1 is therefore further tested.

To sum up, Table 3 and Table 4 show similar results in terms of significance and direction, regardless of whether the dependent variable is wage rate or monthly income. Therefore, it is clear that the regression results for relationship between the number of children and monthly wages are not only explained by working hours, but also by the hourly wages. This finding provides a primary support for the Hypothesis 1 that the number of children has a negative effect on women's wages. However, it is important to note that the use of the OLS model alone may cause the problem of endogeneity and may not provide a perfectly accurate estimation of the relationship between the number of children and wages, so following research will be conducted by fixed effects models.

#### 4.1.2 Motherhood Wage Penalty: Fixed-effects Models

As mentioned earlier, the reason for choosing the fixed effects models is that the CFPS is a tracking database and fixed effects models can effectively reduce bias by controlling unobserved individual characteristics in the sample, which may affect both women's wage rates and their decision to give birth. More importantly, the fixed effects model provides offer a stronger identification, which also allows the model estimates to be closer to the causal effects. We believe that the balanced panel is more representative of the continuous effects of motherhood penalty on the same group of women. Therefore, in this section we will only present the regression results of the balanced panel data. The regression results for the unbalanced panel data will also be placed in the appendix for reference.

**Table 5 Effect of Total Number of Children (Continuous Variable) on Women's Monthly Income from Fixed-effect Models: Balanced Panel Data**

Model	M1			M2	M3	M4
	Net effect models of fertility			M1+marriage	M2+human capital	M3 +job characteristics
VARIABLES	monthly income	monthly income	monthly income	monthly income	monthly income	monthly income
childnumber	216.09	- 443.141***	- 430.316***	- 433.027***	- 544.871***	- 531.837***
	-1.56	(-3.71)	(-3.60)	(-3.60)	(-3.98)	(-4.02)
Observations	852	852	852	852	807	807
R-squared	0.003	0.217	0.22	0.221	0.251	0.254
Number of pid	284	284	284	284	280	280
Year fixed effects	NO	YES	YES	YES	YES	YES
Regional controls	NO	NO	YES	YES	YES	YES

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 5 above shows the stepwise regression results of the fixed effects model using monthly income as the dependent variable. The first three columns are net effect models of fertility, the difference being whether year fixed effects and regional controls are done. As can be seen in the third column, there is a significant negative effect of children number on women's monthly income, on the basis of year fixed effects and regional controls. For every additional child, a mother's monthly income drops significantly by 430 yuan. The effect of the motherhood penalty is further increased as can be seen in the fourth, fifth and sixth columns, after we sequentially add the control variables of marriage, human capital and job characteristics to the model. In the final model, which included all control variables, each additional child results in a significant decrease in the mother's monthly income of almost 532 yuan.

**Table 6 Effect of Total Number of Children (Continuous Variable) on Women's Hourly Wage (ln) from Fixed-effect Models: Balanced Panel Data**

Model	M1		M2		M3	M4
	Net effect model of fertility			M1+marriage	M2+human capital	M3+job characteristics
VARIABLES	lnwage	lnwage	lnwage	lnwage	lnwage	lnwage
childnumber	0.071	-0.153**	-0.158***	-0.160***	-0.168***	-0.167***
	-1.05	(-2.57)	(-2.68)	(-2.69)	(-2.89)	(-2.91)
Observations	842	842	842	842	800	800
R-squared	0.002	0.141	0.145	0.151	0.178	0.179
Number of pid	284	284	284	284	280	280
YEAR fixed effects	NO	YES	YES	YES	YES	YES
Regional controls	NO	NO	YES	YES	YES	YES
Restricted sample	YES	YES	YES	YES	YES	YES

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Following a similar step, the regression results with the dependent variable being the log of the hourly wage are presented in Table 6. The results in Table 6 show that the negative impact of motherhood on monthly income that we find above is not only explained by the number of working hours but is also strongly related to the wage rate. Motherhood has a significant negative impact on women's wage rates. The wage rate of mothers decreases significantly by 15.8% for each additional child, based on year fixed effects and regional controls. After adding the marriage control, the loss of the mother's wage rate reached 16%. After the inclusion of control variables for human capital and job characteristics, the motherhood wage penalty effect is basically stable. In the final model, the mother's wage rate falls significantly by 16.7% for each additional child. However, since there are only 800 observations in the balanced panel data, this significant result may be subject to selectivity, but it still provides an indication that Chinese mothers are being heavily penalized for their motherhood.

These results are also consistent with previous studies. Yu and Xie (2014) find that after controlling for variables such as human capital, job characteristics and family factors, the

motherhood penalty remains, with every child decreasing the wage rate of Chinese women by around 7%. After controlling for family structure, education level and job characteristics, Shen (2020) also finds that the motherhood penalty in China in 2015 appears as a 12.77% decrease in the wage rate for each additional child. These results all suggest that the effect of childbearing on wages persists after controlling for marital status, human capital and occupational characteristics, revealing that the motherhood penalty has become a non-negligible phenomenon in China.

## 4.2 Heterogeneity Tests

The full-sample OLS models and fixed effects models in the last section have largely examined the negative impact of childbirth on women's wages, while in this section will further analyze the effects of motherhood penalty on different women groups with different education levels, employment type, management status, as well as urban and household status.

### 4.2.1 Education Level

In the previous literature review, education level is proven to be one of the most important factors influencing motherhood penalty. As can be seen from the results in Table 7, childbirth has a very significant negative impact on women with senior high school or less education, with the group of women with the highest level of education being senior high school being the most affected, showing a significant 42.5% decrease in wage rates for each additional child. However, for women with college or higher education, the effect of childbirth on the wage rate is not significant. While in the case of monthly income, the negative effect of childbirth on all three groups of women was highly significant. The high school group remains to suffer the most severe motherhood wage penalty, with women's monthly income dropping by almost 813 yuan for each additional child, followed by the college group, with a reduction of nearly 550 yuan. The results in Table 7 indicate that when comparing the junior high school group with the senior high school group, the higher the level of education, the more severe the motherhood penalty is, but when the education level is higher, the wage penalty is slightly reduced. Yet women in the college group still face heavier motherhood penalty than women in the junior high school group. Therefore, the effect of educational attainment on motherhood wage penalty may not be considered linear in this sample. Looking into the average number of children in all three groups, it is also found that women in the college group have the fewest average number of children, at roughly 0.52, which might be one of the possible reasons for the overserved insignificant motherhood penalty effect in the college group. Although Hypothesis 2a is not entirely valid, it provides us with an interesting direction.

**Table 7 Effect of Total Number of Children (Continuous Variable) on Women's Wage from Fixed-effect Models, by Education Level**

Education level	junior high school and below	senior high school	college and above	junior high school and below	senior high school	college and above
VARIABLES	lnwage			monthly income		
childnumber	-0.060*	-0.425**	-0.124	-344.682***	-813.064***	-549.812**
	(-1.66)	(-2.24)	(-1.43)	(-3.98)	(-3.00)	(-2.10)
All other variables controlled						
YEAR fixed effects				YES		
Regional controls				YES		
Restricted sample				YES		
Observations	375	168	257	378	169	260
R-squared	0.208	0.238	0.279	0.187	0.261	0.377
Number of pid	140	73	98	140	73	98

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The findings here are consistent with the outcomes of some previous studies. The finding of Anderson, Binder and Krause (2003), for example, suggests that although better educated women may hold jobs that demand more efforts, college-educated mothers do not actually face any penalty for having children. In addition, Loughran and Zissimopoulos (2009) find that marriage and childbirth have a greater negative impact on the wages of women with between 12 and 15 years of schooling than those with less than 12 years or more than 15 years of schooling. However, they do not explain this effect in detail. Aisenbrey, Evertsson and Grunow (2009) provide an insight that higher education has a positive effect on women's return to the workplace and then can effectively reduce the negative effects of childbirth. Thus, the promoting effect of education on women's return to the workplace may be one of the reasons why the sample group with college education and above is not significantly affected by the motherhood penalty. We assume that more educated women get more stable jobs, so

that childbirth brings less risk of career interruption and therefore has less effect on wages. In addition, as more educated women are regarded as with more human capital, they are more competitive in the job market compared to less educated mothers, which is one of the possible reasons why the motherhood wage penalty is not as significant as other groups. However, more specific mechanisms in the above conclusions require further data for analysis.

In fact, there is no conclusive evidence about the impact of Chinese women's education level on the motherhood penalty. Based on data from the China Health and Nutrition Survey ("CHNS") from 1993 to 2006, Yu and Xie (2014) suggest that childbirth has a greater negative impact on the wage rates of highly educated women than those of less educated women. Shen (2020) reaches the opposite conclusion, based on data from a longer period (1989-2015), that in the long run, the lower the educational level, the greater the motherhood penalty. While the finding of Liu and Lu (2018) is partly similar to the results of this paper, stating that the 'fertility-wage' elasticity is significantly greater for women with relatively low education levels, and that the wage rate is significantly lower by 26% for women with high school education or less, while the effect of penalty for mothers with higher education is relatively neutral. After all, there are various reasons for the different conclusions regarding the impact of education level on motherhood penalty, possibly because of different data sources and also different classifications of the observations. However, in general, we maintain the view that higher education (e.g., college and above) can moderate the motherhood penalty for Chinese women.

#### 4.2.2 Employment type

Apart from the obvious factor of education, we expect that differences in the work sectors will also have an impact on the effects of motherhood penalty, as working in the state-owned sector is considered to have higher job stability and more benefits in China. The results in Table 8 prove that women working in the private sector suffer the most severe and significant motherhood penalty in terms of wage rates, with a significant 14.8% decrease in wage rates for each additional child. The effect of the motherhood penalty for mothers working in the state-owned sector is not significant for either hourly wage or monthly income, as expected. This finding is consistent with the findings of Shen (2020), who examines long-term data (1989-2015) and shows that the effect of motherhood penalty in the non-state sector is larger than in the state sector across all years, and that the gap between the two becomes increasingly wider over this period. In general, women working in the state-owned sector have longer maternity leave and more benefits and job stability than in the private sector, so although childbirth can have an impact on these mothers, the effect is not that significant as other groups. The results in Table 8 confirm Hypothesis 2b, that the wages of women working in the private sector are more affected by the number of children than those in the state-owned sector.

**Table 8 Effect of Total Number of Children (Continuous Variable) on Women's Wage from Fixed-effect Models, by Employment Type**

Employment	state-owned	private	other	state-owned	private	other
VARIABLES	lnwage			monthly income		
childnumber	-0.104 (-0.74)	-0.148* (-1.94)	0.008 (-0.07)	-258.064 (-0.56)	-379.210*** (-3.12)	-1,959.045*** (-3.21)
All other variables controlled						
Observations	168	565	67	169	568	70
R-squared	0.21	0.228	0.844	0.313	0.359	0.838
Number of pid	91	241	50	91	242	53

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### 4.2.3 Management Status

Concerning job characteristics, we also believe that management positions also contribute to the effects of motherhood penalty, as the cost of time out of former position is greater with higher management positions. The results in Table 9 confirm Hypothesis 2c, that women in higher positions are more negatively affected by the number of children than women without management positions. For each additional child, the wage rate of mothers without management positions drops significantly by 10 %, while among mothers with management positions the rate drops by a remarkable 30 %. This negative impact is also apparent in the monthly income. This finding is also consistent with our hypothesis that the motherhood wage penalty is more severe in the group of women who hold higher positions. Although at this point there are not enough data to study it in depth, we still believe that the number of children has an impact on the long-term career development of mothers, as the interruption in work experience that comes with childbirth may reduce their competitiveness in the workplace.

**Table 9 Effect of Total Number of Children (Continuous Variable) on Women's Wage from Fixed-effect Models, by Management status**

Management status	no	yes	no	yes
VARIABLES	lnwage		monthly income	
childnumber	-0.100**	-0.298*	-465.486***	-1,220.70

	(-2.04)	(-1.76)	(-3.48)	(-1.06)
All other variables controlled				
Observations	718	82	725	82
R-squared	0.167	0.565	0.254	0.617
Number of pid	274	60	274	60

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### 4.2.4 Urban and Household Registration

Although regions have been controlled in the models, urban and household registration status are also worth concerning. As shown in Table 10 below, urban mothers experience more significant and severe motherhood wage penalty than the rural ones. For urban mothers, each additional child will result in a significant drop in monthly income of almost 660 yuan. In contrast, an increase in the number of children of rural mothers has no significant effect on their wages. Similar finding applies when looking through the household registration status(hukou), with non-agricultural mothers suffering more severe motherhood wage penalty than their agricultural counterparts, with a decrease of 352 yuan in wage for the agricultural group and a decrease of 832 yuan in the non-agricultural group. Therefore, Hypothesis 2d is also tested true that urban women experience greater motherhood wage penalty than rural women.

**Table 10 Effect of Total Number of Children (Continuous Variable) on Women's Monthly Income(yuan) from Fixed-effect Models, by Urban and Hukou Status**

VARIABLES	urban area		hukou	
	rural	urban	agricultural	non-agricultural
	monthly income			
childnumber	-196.153	-659.264***	-352.209**	-832.137***
	(-0.66)	(-3.56)	(-2.59)	(-2.97)
All other variables controlled				
Observations	225	582	463	333
R-squared	0.207	0.287	0.248	0.312
Number of pid	104	223	176	127

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1



## 4.3 Robust Tests

Following the full sample regressions and heterogeneity tests, this section is going to conduct robustness tests to add more details to confirm our conclusions. The next four groups of robustness tests, respectively based on yearly income, number of children as a categorical variable, younger sample group, and the effect of number of children on promotion opportunities, aim to find more specific links between the number of children and women's wages and career progression.

### 4.3.1 Yearly Income

In previous analyses, we used log of hourly wage and monthly income as dependent variables, both of which lead to similar conclusions. To further strengthen the reliability of the findings, a stepwise regression here is presented with the yearly income as the dependent variable. The last column in Table 11 shows the final model including all control variables, year fixed effects, and regional controls. The yearly income is the after-tax income including all salaries, bonuses, cash benefits and allowances. The results here show that the number of children has a significant negative effect on women's yearly income. There is a significant reduction in a woman's yearly income of over 3,800 yuan for each additional child. This is consistent with our previous findings, suggesting that regardless of which indicator is used as a measure of wages, childbirth has a significant negative impact on women's wages and that the penalty for motherhood suffered by Chinese women is objective.

**Table 11 Effect of Total Number of Children (Continuous Variable) on Women's Yearly Income (yuan) from Fixed-effect Models (Balanced Panel Data)**

Model	M1	M2	M3	M4	M5	M6
VARIABLES	yearly income	yearly income	yearly income	yearly income	yearly income	yearly income
childnumber	6,303.722***	- 2,640.353*	- 2,447.159*	- 2,561.515*	- 3,896.887**	- 3,806.929**
	-3.11	(-1.82)	(-1.68)	(-1.81)	(-2.17)	(-2.14)
All other variables controlled						
Observations	852	852	852	852	807	807
R-squared	0.011	0.194	0.205	0.214	0.251	0.26
Number of	284	284	284	284	280	280

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note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### 4.3.2 Categorized Children Number

The main explanatory variable, the number of children, has been a continuous variable in previous analyses. In this case, a stepwise regression of the fixed effects model with the number of children as a categorical variable is used to examine the precise effect of different numbers of children on mothers' wage rates. The first column in Table 12 shows the net effect of fertility, and the last three columns, which step in control variables, all show a significant and consistent result. In the final model, the one-child group suffer a 26% wage penalty in comparison with the non-children group, while the two-child group suffers a 34% wage penalty. The largest wage penalty is seen in the group with three or more children, with a loss of 76% in wage rate. We assume this result may be related to China's fertility policy that the two-child policy officially started in 2015 and later the three-child policy started in 2021. However, the sample years in this paper are between 2014 and 2018, and the number of women who have three or more children is rather small, so the social pressures and family burdens on this group can be even heavier. A higher number of children also indicates that women take more career interruptions and have less work experience than women in the same age group. Frequent childbearing also increases employment instability. Although there lack empirical studies on the relationship between the number of children and employer discrimination, we predict that mothers with more children are likely to experience more discrimination in the labour market. Ejrnæs and Kunze (2013) develop the concept of negative selection, implying that employers then overestimate the loss of female employees from career breaks, suggesting that if a mother decides to return to work, she might receive a disproportionate underpayment due to statistical discrimination. As a result, the cycles of fertility interruption may exacerbate this systemic discrimination. These may explain why mothers with three or more children bear the most severe wage penalties, but more long-term longitudinal micro data are required for further research.

**Table 12 Effect of Total Number of Children (Dummy Variable) on Women's Hourly Wage (ln) from Fixed-effect Models (Balanced Panel Data)**

Model	M1	M2	M3	M4
Number of children (reference group: no children)	Net effect model of fertility	M1+marriage	M2+human capital	M3+job characteristics
one child	-0.219* (-1.70)	-0.254* (-1.93)	-0.262** (-2.24)	-0.260** (-2.30)
two children	-0.273*	-0.307**	-0.337**	-0.339**

	(-1.93)	(-2.13)	(-2.51)	(-2.52)
three or more children	-0.703**	-0.676**	-0.767**	-0.759**
	(-2.18)	(-2.13)	(-2.15)	(-2.09)
Observations	845	845	803	803
R-squared	0.168	0.175	0.203	0.205
Number of pid	284	284	280	280
YEAR fixed effects			YES	
Regional controls			YES	

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### 4.3.3 Younger Age Group

In reference to Sun (2021), a younger women group is re-selected for regression in this model in order to test the robustness of the primary model. The age of the selected sample is between 20 and 35 years old, this is because 20 years old is the legal age of marriage for Chinese women and the possibility of women giving birth increases significantly from this year onwards. The age group 20 to 35 can also be considered as the age when women have the highest willingness to have children, and it is assumed here that women in this group are most significantly affected by childbirth. Therefore, this paper considers that it is preferable to choose this age group for the robustness analysis to study the short-term shock to women's wages caused by childbirth. The results for the unbalanced panel and panel data are presented in Table 13, where the dependent variables include the log of hourly wages and monthly income so as to fully observe the effects on wages and income between women groups of different wage and income.

**Table 13 Effect of Total Number of Children (Continuous Variable) on Women's Wage from Fixed-effect Models, Age Group: 20 - 35 years old**

VARIABLES	unbalanced panel data		balanced panel data	
	lnwage	monthly income	lnwage	monthly income
childnumber	-0.110***	-262.953***	-0.199**	-643.822***
	(-2.75)	(-2.94)	(-2.18)	(-3.43)
All other variables				

controlled				
Observations	4,375	4,441	486	490
R-squared	0.194	0.28	0.222	0.329
Number of pid	3,250	3,280	191	191
YEAR fixed effects		YES		
Regional controls		YES		

---

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The first two columns of Table 13 present the regression results for the unbalanced panel data, that between 2014 and 2018, the number of children has a significant negative impact on both wages of the young women group. For each additional child, the wage rate for young women reduces significantly by 11%. This is a doubling of the decline compared to the 5.5% decline in the previous full sample regression. Columns 3 and 4 indicate that the wage rate for young women falls significantly by almost 20% for each additional child in restricted sample, compared to 16.7% in the all-age sample. In terms of monthly income, the decreases in young women's monthly income are both significantly greater than ones in full sample, suggesting that young women suffer the heaviest motherhood wage penalty among all age groups. This is because the age at which they are most likely to have children is also a critical stage in their careers, when career interruptions caused by childbirth are more likely to result in a considerable decline in wages.

A further point to note, however, is that childbirth brings more than a loss of wages to young women; it also includes a decrease in labor force participation, which can further lead to reduced work experience and lower wages. According to Kahn, García-Manglano and Bianchi (2014), the effect of having children reduces female labor force participation is greatest when women are younger and is eliminated at ages 40 and 50. Zhang and Zhang (2019), defining young Chinese women as those aged 20 to 44, also find that each unit increase in the number of children leads to a 11% decrease in the probability of young women's labor force participation. Thus, in this section, by selecting a younger sample, we find that the effect of motherhood penalty is more evident, which is also in consistent with the general findings.

#### 4.4.4 Promotion

On the basis of the previous analysis, in addition to considering the effects of childbirth on women's wages, this section seeks to provide a simple analysis of the impact of the number of children on women's career development. In general, promotions lead to higher positions for women, which consequently increase their wages, so it would be meaningful to further analyze the effect of the number of children on wages using promotion opportunities as a mediating variable. Here we create a binary variable “promotion”, representing the promotion opportunities of the sample in the last 12 months, where 0 represents no promotion or there is

no higher level for promotion in this job, and 1 represents an administrative or technical or both promotions achieved. After regressing the panel data through a logistic model, it appears that for each additional child, the chances of a woman in the full sample (N=8804) gaining a promotion decreases significantly by 36.3%. Employer discrimination and reduced working hours are potential causes of lost promotion opportunities, but further research is needed to examine the mechanisms by which the number of children affects promotion opportunities, and here is only a rough estimate. Nevertheless, it can be preliminarily assumed that childbirth has a negative impact on women's career development other than wages, but it is not yet clear whether this effect is short-term or long-term.

# 5 Policy Implications

## 5.1 Results Labour Guarantee: Maternity Leave

Traditional theories suggest that the career interruptions associated with childbirth result in a reduction in work experience, which leads to a wage disadvantage for mothers. Many studies have therefore concluded that reducing the length of work interruptions is effective in reducing the effect of motherhood penalty. Waldfogel (1998) suggests that the overall gender pay ratio for young women could rise by 7 percentage points, from 77% to 84%, if all young women had insurance and used it to return to their employers after the birth of child. Mari and Cutuli (2021) evaluate a reform policy to encourage faster re-entry of new mothers into the labor market in Germany in the late 2000s finding that the wage prospects of new mothers improved, partly because of a reduction in the interruption of work. Aisenbrey, Evertsson and Grunow (2009) also point out that in Germany the legal maternity leave period is very long, however the longer the break, the greater the risk of switching to a new job. Although excessive time out can have a negative impact on women's re-entry into the labor market, the Swedish case study by Aisenbrey, Evertsson and Grunow (2009) shows that the higher the level of welfare and the longer the maternity leave, the later the negative effects of time out on career start. Misra, Budig and Boeckmann (2011) also point out that maternity leave as a work-reduction policy can have a positive impact if the leave is of a moderate length but can have a trade-off effect if it is longer. Halldén, Levanon and Kricheli-Katz's (2016) state that for women with different skills, generous paid maternity leave not only contributes to gender equality in labour force participation rates, but also reduces motherhood penalty. Budig, Misra and Boeckmann (2016) also find that a moderate length of leave maintains the labour market attachment of mothers to achieve a lower motherhood wage penalty. Along with maternity leave for mothers themselves, Andersen (2018) tests the impact of the extent of leave taken by fathers relative to that of mothers in the Danish example and finds that fathers' leave reduces the gender wage gap within households by increasing mothers' wages. Therefore, the advantages of paid maternity leave could be seen as universal and are replicable across different groups of women. In summary, we believe that a reasonable maternity leave institution can also have a positive effect on reducing the motherhood penalty for Chinese women.

## 5.2 Economic Measure: Maternity Insurance

Budig and England (2001) argue that in order to promote equity in employment, reasonable public policies should be developed to eliminate gender discrimination and reduce the cost of childbirth to mothers. Here we suggest that in China, maternity insurance could be seen as an

effective mean of reducing motherhood penalty. Since women must face interruptions in their work during childbirth, it is necessary to consider the effectiveness of financial support during this period to reduce motherhood penalty. Felfe (2012) points out that the wage gap between women with and without children amounts to 9.3% when staying with the former employer and 24.3% when changing employers. It is therefore assumed that if the employer offers better maternity insurance coverage, mothers are less likely to change jobs for childbearing, and the wage penalty is also reduced. Huang (2014) analyzed the buffering effect of social support on reducing career disruption, using the proportion of birth costs reimbursed as an indicator of maternity insurance support. Huang (2014) finds that the proportion of women who are reimbursed for the cost of childbirth at the time of birth has a significant impact on career interruption, with women who are fully free or reimbursed only 55.5% as likely to experience career interruption as those who are fully self-funded. Thus, financial support has a clear effect on reducing the likelihood of career interruptions for women caused by childbirth and local government should also try to improve maternity insurance policies and the level of maternity allowances.

### 5.3 Personal Choice: Postponing Childbirth

In order to mitigate the effects of motherhood penalties, women themselves need to consider the trade-off between work and childbirth. As Loughran and Zissimopoulos (2009) point out that, a small decline in wage growth at a relatively young age could lead to a significant decline in lifetime earnings, postponing the childbearing age may therefore ease the wage penalty for women. Wilde, Batchelder, and Ellwood (2010) also state that high skill women are more likely to delay childbearing or even not have children for a better career. Miller's (2011) study shows that delaying motherhood increases working hours and wages, which in turn increases occupational earnings, as well as post-motherhood wage rates. This is reflected in a 9% increase for each year of delay, a 3% increase in wages and a 6% increase in working hours. As a result, it is likely that more women tend to spontaneously choose to have children later to mitigate the effects of the motherhood penalty, which will be reflected in a future trend towards a later age of childbearing. It is also possible that Chinese women will choose not to have children or to have fewer children in order to respond to the adverse effects of the current three-child policy.

## 6 Conclusion

In conclusion, based on the review of previous literature, this paper generally confirms the existence of motherhood penalty among Chinese women through an empirical analysis of CFPS data from 2014 to 2018. In terms of the relationship between the number of children and women's wages, results from both separate years and panel data (balanced or unbalanced) in the OLS regressions and Fixed-effect models all show a significant negative correlation. The regression results of the Fixed effects model support Hypothesis 1 that there is a significant negative impact of the number of children on women's wages with a significant decrease in both women's wage rates and monthly income. In the balanced panel data with restricted sample, each additional child is accompanied by a significant decrease of 16.7% in the wage rate and a significant reduction of almost 532 yuan in monthly income. A further narrowing of the sample to a younger group (women aged 20 to 35) leads to a more severe wage penalty. Hypothesis 2 is also confirmed that the number of children has a differential penalty effect on different groups of women. Women with high school education level suffer the most significant and severe wage penalty, while the effect is not significant for women with college or higher education level. Women working in the state-owned sector endure the least penalty relative to women in other employment types. Urban women with non-agricultural hukou and in higher positions are subject to greater wage penalty. Besides, the motherhood wage penalty is also reflected in women's yearly income. After all, this study finds that Chinese women are experiencing significant motherhood penalty. This issue needs more attention and the government should focus on addressing this issue in future policy formulation.

Although this paper seeks to provide a comprehensive analysis of adult women's motherhood penalty in China, there are still some limitations. For example, for the key explanatory variable, the number of children, We do not divide children more specifically by their gender or by groups of children in different age groups, which may also affect women's wage and income in different ways. For example, it could be assumed that children under 6 years old might have a greater impact on their mothers' wages. Besides, this paper mainly uses Fixed Effects models and some of the OLS and Logit models for estimation, however, it does not use the instrumental variables approach to address the issue of endogeneity as there may still be some endogeneity between the number of children and mothers' wages, which can be explored in future studies. Finally, due to the limitations of the CFPS database, only three years, 2014, 2016 and 2018, have been selected for the panel data regression analysis in this paper, so we only analysis the short-term effects of the motherhood penalty here. If there is a database with a larger time span, we would be able to study more about both the short-term and long-term effects of motherhood penalty. Therefore, all the above issues require more further research.



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# Appendix

*Appendix Table 1 Descriptive Statistics for Variables Used in the Analysis: Panel Data (2014-2018) (before winsorization)*

Variable	Descriptions	Obs	Mean	Std. Dev.	Min	Max
lnwage	log of hourlywage	8672	2.53	0.69	-2.19	7.82
hourlywage	after-tax hourly wage(yuan)	8804	17.10	36.68	0.00	2500.00
monthly income	after-tax monthly income(yuan)	8804	2738.14	2536.99	0.00	80000.00
yearly income	after-tax income in past 12 months(yuan)	8804	28088.59	27006.77	0.00	800000.00
hours	monthly working hours	8804	199.84	66.80	0.40	672.00
childnumber	the number of children	8804	1.05	0.85	0.00	7.00
maritalstatus	current marital status	8804	0.77	0.42	0.00	1.00
education	educational level	8804	1.81	0.87	1.00	3.00
experience	estimated working experience(year)	8054	16.37	10.72	0.00	39.00
exp2	square of working experience	8054	382.76	402.15	0.00	1521.00
employment	type of employer	8804	1.85	0.57	1.00	3.00
management	whether have administrative/ management position	8804	0.10	0.30	0.00	1.00
promotion	whether have promotion	8804	0.09	0.28	0.00	1.00
urban	urban area (Census Bureau's definition)	8804	0.67	0.47	0.00	1.00
hukou	current household registration status	8630	0.39	0.49	0.00	1.00

note:\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

*Appendix Table 2 Effect of Total Number of Children (Continuous Variable) on Women's Monthly Income from Fixed-effect Models: Unbalanced Panel Data*

Model		M1	
Net effect model of fertility			
VARIABLES	monthly income	monthly income	monthly income
childnumber	446.520***	-69.766	-63.713
	-6.54	(-1.11)	(-1.02)
maritalstatus			
education			
experience			
exp2			
employment			
promotion			
management			
2016.year		336.916***	336.063***
		-7.35	-7.33
2018.year		909.707***	899.152***
		-20.23	-20.06

2.province			-67.247
			(-0.17)
3.province			959.825***
			-3.6
Constant	2,198.991***	2,291.024***	1,820.120***
	-30.83	-36.49	-7.99
Observations	8,804	8,804	8,804
R-squared	0.014	0.175	0.182
Number of pid	6,252	6,252	6,252
Year fixed effects	NO	YES	YES
Regional controls	NO	NO	YES
	M2	M3	M4
	M1	M2	M3
	+marriage	+human capital	+job characteristics
VARIABLES	monthly income	monthly income	monthly income
childnumber	-51.023	-182.905***	-178.833***
	(-0.81)	(-2.74)	(-2.68)
maritalstatus	-104.839	-292.867***	-292.313***
	(-1.09)	(-2.84)	(-2.85)
education		9.145	-2.959
		-0.06	(-0.02)
experience		52.058	48.765
		-0.98	-0.91

exp2		-3.677***	-3.651***
		(-5.56)	(-5.50)
employment			107.771*
			-1.84
promotion			53.459
			-0.52
management			210.841**
			-2
2016.year	338.451***	548.135***	564.129***
	-7.39	-4.86	-4.94
2018.year	904.128***	1,266.234***	1,281.608***
	-19.93	-6.57	-6.56
2.province	-54.587	-112.734	-108.974
	(-0.14)	(-0.29)	(-0.28)
3.province	969.739***	949.705***	963.550***
	-3.71	-3.34	-3.47
Constant	1,876.579***	2,535.596***	2,354.981**
	-8.06	-2.61	-2.38
Observations	8,804	8,054	8,054
R-squared	0.182	0.203	0.207
Number of pid	6,252	5,696	5,696
Year fixed effects	YES	YES	YES
Regional controls	YES	YES	YES

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note:\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



*Appendix Table 3 Effect of Total Number of Children (Continuous Variable) on Women's Hourly Wage (ln) from Fixed-effect Models: Unbalanced Panel Data*

Model	M1		M2	M3	M4	
	Net effect model of fertility			M1 +marriage	M2 +human capital	M3+job characteristics
VARIABLES	lnwage	lnwage	lnwage	lnwage	lnwage	lnwage
childnumber	0.156***	-0.02	-0.018	-0.021	-0.056*	-0.055*
	-5.28	(-0.70)	(-0.66)	(-0.75)	(-1.92)	(-1.86)
maritalstatus				0.02	-0.018	-0.018
				-0.44	(-0.38)	(-0.38)
education					0.099*	0.094
					-1.71	-1.63
experience					0.026	0.025
					-1.34	-1.29
exp2					-0.001***	-0.001***
					(-4.10)	(-4.00)
employment						0.01
						-0.39
promotion						0.039
						-1.09
management						0.063
						-1.57
2016.year	0.134***	0.133***	0.133***	0.133***	0.174***	0.176***
	-5.9	-5.88	-5.87	-5.87	-3.98	-4.02
2018.year	0.310***	0.308***	0.307***	0.307***	0.363***	0.366***
	-17.09	-16.99	-16.86	-16.86	-5.33	-5.37
2.province		0.089	0.086	0.086	0.064	0.067

			-0.42	-0.41	-0.3	-0.32
3.province			0.245	0.243	0.219	0.227
			-1.47	-1.46	-1.27	-1.33
Constant	2.358***	2.386***	2.234***	2.223***	2.078***	2.058***
	-76.01	-84	-15.64	-15.19	-5.79	-5.69
Observations	8,702	8,702	8,702	8,702	7,961	7,961
R-squared	0.01	0.121	0.122	0.123	0.142	0.144
Number of pid	6,208	6,208	6,208	6,208	5,653	5,653
Year fixed effects	NO	YES	YES	YES	YES	YES
Regional controls	NO	NO	YES	YES	YES	YES

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note:\*\*\* p<0.01, \*\* p<0.05, \* p<0.1