Mothers' non-farm work, women's empowerment and multidimensional child poverty: evidence from rural China

Xiaoyu Cheng

School of Economics, Zhejiang University of Finance and Economics, Hangzhou, China

Qingqing Liu

Zhejiang Research Institute, Zhejiang University of Finance and Economics, Hangzhou, China, and

Xinxin Wang

School of Economics, Zhejiang University of Finance and Economics, Hangzhou, China

Abstract

Purpose – The objective of this study is to analyze whether rural mothers who participated in non-farm work (PNFW) can lift their children out of multidimensional poverty by enhancing women's empowerment in the context of China.

Design/methodology/approach – This study uses nationally representative data, the rural sample of China Family Panel Studies 2018–2020, which includes specific children's questionnaires. The AF method is used to measure multidimensional poverty among children aged 3–15 years. Local rainfall shock is employed as an instrumental variable (IV) for women's PNFW choice and IV estimation is performed.

Findings – (1) Rural mothers' PNFW significantly alleviates their children's poverty and reduces deprivation in multiple dimensions, especially in education and living conditions. Compared to mothers who stay in farm work, children with mothers who participate in non-farm work are less likely to be deprived of multidimensional poverty. (2) Improved women's empowerment is the mechanism by which the rural mothers' PNFW lift their children out of poverty. Rural mothers who have a non-farm job have higher intrahousehold bargaining power and self-esteem, probably favoring children in family resource allocation and providing better parenting, thus reducing the deprivation of their children.

Originality/value – Unlike existing research that focuses on increased income and decreased companionship for children, this study provides novel evidence that engaging in non-farm work can empower rural mothers, reducing their children's multidimensional poverty.

Keywords Women empowerment, Non-farm work, Multidimensional child poverty, Rainfall shock

Paper type Research article

1. Introduction

Ending child poverty and promoting gender equality are two goals of the United Nations Sustainable Development Goals (SDGs). The fact is that children are still one of the most vulnerable groups (Ge *et al.*, 2018). In 2022, 333 million children worldwide lived in extreme poverty, accounting for more than half of those living in extreme poverty (Salmeron-Gomez *et al.*, 2023). Living in poverty means children are deprived of adequate nutrition, education, or healthcare, hindering their physical and cognitive development, moreover,

these effects persist into their adulthood (Baranov *et al*., 2020). Therefore, tackling child poverty can not only improve children's well-being but also help accumulate long-term human capital.

Children's poverty and development are significantly influenced by the availability and allocation of household resources. Much gender-related research suggests that when women control household resources, it is more beneficial to children's health, education, and future labor outcomes compared to when men control them (Imai *et al*., 2014; Holland and Rammohan, 2019). This is because mothers often play a more central role in child-rearing (Li *et al*., 2021; Bai *et al*., 2022) and tend to allocate more resources to children than fathers do (Carlson *et al*., 2015). However, women in developing countries often lack control over family resources due to persistent inequality in economic opportunities, education, health (Holland and Rammohan, 2019), hindering child development.

Women participating in non-farm work (PNFW) holds potential to empower women and alleviate child poverty. As the largest developing country worldwide, China has witnessed rapid growth in its service economy within a post-industrial society, creating substantial economic opportunities for women. In 2022, 71% of the working-age female population participated in the labor force, which is higher than in most developing countries [1]. Recently, an increasing number of rural women have gained access to non-farm work. Official data indicate that 110 million rural women engaged in PNFW in 2023 [2]. Mothers' PNFW may enhance women's empowerment and consequently improve children's well-being through two pathways: First, rural mothers earning autonomous income from PNFW can strengthen their intrahousehold bargaining power (Carlson *et al*., 2015), enabling greater influence over family resource allocation. Given that mothers tend to prioritize child-related expenditures (Doss, 2013), enhanced bargaining power allows more resources to be directed toward children when resources are limited. Second, employment expands mothers' social networks in the workplace, elevating self-esteem and facilitating scientific parenting practices alongside improved family environment (Laursen and Collins, 2009). However, previous studies predominantly focus on either reduced maternal companionship or increased household income (Wu, 2020; Li *et al*., 2021; Bai *et al*., 2022), overlooking the potential well-being benefits for children stemming from increased women empowerment of mother's PNFW.

This study aims to examine whether rural mothers' PNFW can lift their children out of poverty by empowering women. The empirical analysis uses the 2018 and 2020 rural sample of China Family Panel Studies (CFPS). Firstly, we measure multidimensional poverty among children aged 3–15 years by the AF method (Alkire and Foster, 2011). Secondly, we employ rainfall shock as an instrumental variable (IV) for mothers' non-farm work choices and perform shift-share IV estimations to establish causality. Thirdly, we empirically examine the mechanism of women's empowerment by exploring the two dimensions of intrahousehold bargaining power and self-esteem, that is, whether women's PNFW can alleviate multidimensional child poverty by women's empowerment.

We offer two main contributions to the literature. Firstly, this paper offers novel evidence that PNFW among rural mothers mitigates child poverty through women's empowerment pathway. Different from previous studies that focus on the separation of children or the income effect of maternal migration (Wang, 2013; Li *et al*., 2021; Bai *et al*., 2022), this paper focuses on the improved women's empowerment from mothers' PNFW on child development. Secondly, previous child poverty-related studies take the family as a whole and discuss the family characteristics, such as the parental characteristics (Leu *et al*., 2016; Ge *et al*., 2018) or the number of siblings (Fonta *et al*., 2020), ignoring the negotiation and bargaining within the family. We contribute to the literature by focusing on the effects of intra-family bargaining power and the self-esteem of mothers on child poverty.

2. Literature review and conceptual framework

2.1 Literature review

2.1.1 Child poverty. Child poverty is a complex concept. In 1989, the United Nations Convention on the Rights of the Child stipulated that the rights of children include four areas: survival, development, participation, and protection. Based on children's rights, United Nations Children's Fund (UNICEF) defines children in poverty as those who "experience deprivation of material, spiritual and emotional resources to survive, develop and grow, and are unable to enjoy their rights, realize their full potential or participate fully and equally in social activities" (UNICEF, 2005). The Childhood Poverty Research and Policy Centre define child poverty as "children and young people grow up without access to the resources – economic, social, cultural, material, environmental and political – that are essential for their well-being and potential". Almost all definitions of child poverty point out that child poverty is multifaceted.

The widely adopted approach in identifying poverty is to measure an individual's income or consumption below a certain standard. Similarly, child poverty is often calculated based on the family's income, which children share (Lewit *et al.*, 1997; Roelen, 2017). However, the monetary approach has two main drawbacks in identifying child poverty. First, it ignored the allocation of resources within the family, thereby making some poor children invisible when they are living in non-poor households. Second, it fails to adequately consider children's needs for non-market goods, such as the basic public services of water and sanitation, especially which disproportionately affect children's growth and development within the household (Minujin *et al.*, 2006; Roelen, 2017).

Given the drawbacks of the monetary approach, many studies focus more on the multidimensional approach (Alkire *et al.*, 2019; Gao and Wang, 2022). Built on Sen's capacity poverty theory, capabilities refer to the substantive freedom of individuals to choose a life that they have reason to value (Sen, 1993, 2001), Alkire and Foster (2011) developed the Multidimensional Poverty Index (MPI) or the AF method to measure the multidimensional aspects of poverty. This method can not only reflect multiple aspects of child poverty but also show the breadth and depth of child poverty, thereby has been widely used to measure multidimensional poverty among children (Qi and Wu, 2019; Alkire *et al.*, 2019; Gao and Wang, 2022).

2.1.2 Family and child poverty. The complexity of child poverty challenges the traditional anti-poverty strategies, while the family has great potential in addressing child poverty. The family has a great influence on children's development because children, especially minor children, are vulnerable and susceptible to their living environment. Whereas the majority of research on child poverty frequently discusses more factors outside the family, such as public cash transfer (Azevedo and Robles, 2013), the "hukou" policy in China (Wang, 2022), and other child protection policies. Some research on the effect of family on child poverty has focused mainly on family characteristics. They found that different family characteristics, such as income and education (Leu *et al.*, 2016; Ge *et al.*, 2018) and the number of siblings (Fonta *et al.*, 2020), will have different child development outcomes. Some studies have found that caregivers' characteristics, such as job stability (Kim and Nandy, 2018) and educational level (Fonta *et al.*, 2020), have a prominent influence on children's health, nutrition, and education (Ge *et al.*, 2018; Fan *et al.*, 2020). However, previous studies tend to take the family as a whole and discuss the effect of family characteristics on child poverty, ignoring the bargaining and decision-making within the family.

2.1.3 Mother's non-farm work participation and child development. Recently, gender-related research has frequently suggested that women controlling family resources are more favorable to the well-being of children than men (Imai *et al.*, 2014; Holland and Rammohan, 2019). However, women still face inequality in economic opportunities, education, health, and a lack of control over family resources (Holland and Rammohan, 2019), especially in developing countries. In many developing countries, rural women usually have to withdraw from the labor market and participate in farming work (PNW) after giving birth. Meanwhile,

due to usually having no land rights (Wang, 2022), rural mothers find it hard to obtain equal economic returns from agriculture. Consequently, they have low access to family resources.

Compared with other developing countries, rural mothers in China have more opportunities to participate in non-farm work. It is well known that China's economy has grown rapidly in recent years, creating many non-farm jobs and attracting substantial rural labor participation. In 2022, about 108 million rural women in China participated in non-farm employment, accounting for 36.6% of total migrant workers [3]. With a growing number of rural mothers with PNFW, the effect of maternal migration and PNFW has been extensively discussed in previous studies (Wang, 2013; Wu *et al.*, 2019; Li *et al.*, 2021; Bai *et al.*, 2022). Some studies have found that rural mothers' PNFW causes separation and left-behind children problems, hindering children's development in nutrition (Wang, 2013), cognitive function (Bai *et al.*, 2022), early development (Li *et al.*, 2021), and mental health (Wu *et al.*, 2019). In contrast, some studies have found that increased income has a significant positive impact on children's development (Wu, 2020). Therefore, the evidence is mixed on whether maternal migration can reduce child poverty. More importantly, existing studies have ignored that mothers' PNFW can significantly improve their family status, thus empowering women, which probably has a positive impact on children.

2.2 Conceptual framework

2.2.1 Non-farm employment empowers women. Although women's empowerment is defined differently by different scholars, most of the definitions relate to the rights of women in certain areas, particularly controlling over their own lives, and having the freedom to make decisions (Sen, 1997; Kabeer, 1999; Duflo, 2012). United Nations Development Fund for Women (UNIFEM, 2019) incorporated family bargaining power and self-esteem into the concept of women's empowerment. Therefore, women's empowerment can be defined as a process in which women increase their self-reliance, control over available resources, and sense of self-esteem, and actively seek to improve their family status. Building on this definition, this study focuses on two main aspects of women's empowerment: intrahousehold bargaining power and self-esteem.

2.2.1.1 Enhancing women's intrahousehold bargaining power. Women's intrahousehold bargaining power is the power of women to negotiate and bargain over the allocation of intrahousehold resources (Doss, 2013). In many rural areas of developing countries, women were asked to engage in chores by the traditional social norms, such as "men go out to work while women take care of the family", which makes them lack power. In China, after non-farm employment became the main form of men's employment, women took on the majority of agricultural work for a long time. However, the economic benefits of the land are difficult to divide among family members (Wang, 2022), and it is difficult for women to obtain economic returns equal to their input. Therefore, women's economic autonomy is restricted to their husbands. PNFW is entirely dependent on women's human capital rather than on land resources held by men and is generally more stable than family farms. Therefore, PNFW can effectively improve their income and their voice, improving their intrahousehold bargaining power.

2.2.1.2 Improving women's self-esteem. Self-esteem is the evaluation of self-worth and the embodiment of women's empowerment at a psychological level and is usually measured with the Rosenberg Self-esteem Scale (Orth *et al.*, 2008). In some rural areas of developing countries, women's educational levels and social status are relatively low (Shen and Zhang, 2010). In addition to the influence of traditional social norms, women have automatically bound themselves to do household chores, subconsciously giving up some rights and interests. Mother's PNFW can provide more opportunities for contacting non-kinship social networks. Their vision will no longer be limited to traditional family affairs, improving women's self-confidence and self-strength, thus affecting women's self-esteem, and breaking away from the psychological subordination to men (Pangaribowo *et al.*, 2019).

2.2.2 Women's empowerment alleviates child poverty. The increased women's intrahousehold bargaining power will lead to a shift in intrahousehold resources in favor of children. Since women favor children more than men (Carlson *et al.*, 2015), the improvement in mothers' intrahousehold bargaining power can lead to more resources allocated to children. Mother's intrahousehold bargaining power improvement not only increases the money spent on children's nutrition, thus having a direct effect (Holland and Rammohan, 2019), but also indirectly affects children through the inter-generational transmission by improving mothers' nutritional status. In education, existing research shows that a mother's increased intrahousehold bargaining power increases children's years of schooling and school enrollment and reduces repetition rates (Hendrick and Marteleto, 2017; Afoakwah *et al.*, 2020).

Women with increased self-esteem can provide better parenting and a positive family atmosphere for children's growth. Firstly, increasing women's self-esteem can improve their communication skills and enable them to learn more scientific parenting knowledge in their interactions with others, especially urban residents, which is "social remittances", which makes parenting behavior more scientific and rational. Also, they will probably pay more attention to children's education (Fan *et al.*, 2020; Ge *et al.*, 2018). Secondly, women with higher self-esteem tend to create a harmonious family atmosphere and adopt positive parenting styles with high warmth, low rejection, and low psychological control, making their children have more positive self-perceptions, higher self-worth, and fewer emotional problems (Laursen and Collins, 2009).

The mechanism is illustrated in Figure 1.

3. Data, measurement and descriptive statistics
3.1 Data
The empirical analysis uses the rural sample of the *China Family Panel Studies* (CFPS) combined with the rainfall data. The latest available sample of CFPS, the rural sample of 2018
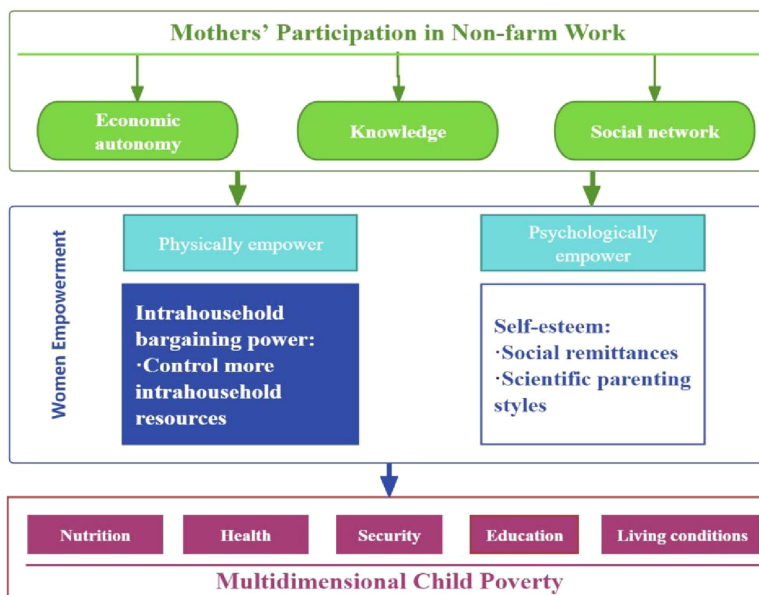

Figure 1. Conceptual framework

and 2020 is used. CFPS adopted a multi-stage probability sampling method, sampled about 20,000 households, 640 administrative communities or villages, and 25 provinces in China, and conducted the baseline survey in 2010 (Xie *et al.*, 2017). Since then, CFPS has conducted a full-sample follow-up survey every two years. CFPS is nationally representative data and one of China's most widely used data in research. We restrict the study samples to: (1) children aged 3–15 years, because multidimensional poverty among children aged 0–2 years is difficult to measure, and there were 3,826 children in 2018, and 2,978 children in 2020. (2) Mothers aged 20–60 years old with children aged 3–15 years old, and we got 2,242 observations in 2018 and 2,215 observations in 2020, respectively. The reason for the mother age range is that the minimum legal age of marriage for women in China is 20, and we assume the oldest age at which a woman can give birth is 45, with a maximum age of 60 if she has children between the ages of 3 and 15.

The rainfall data comes from the European Centre for Medium-Range Weather Forecasts Reanalysis v5-Land (ERA5-Land) [4]. Based on the administrative boundary data, the grid mean of precipitation within the boundary is calculated to obtain the annual average daily precipitation data. We chose county-level average daily precipitation data from 1989 to 2020 to construct rainfall shock variables.

We match the rainfall data with CFPS data at the county level. Finally, we obtained unbalanced panel data with 2,242 observations from 118 counties, 24 provinces in 2018, and 2,215 observations from 119 counties, 24 provinces in 2020. Given the sampling method of CFPS (Xie *et al.*, 2017), we weighted our study sample to make it nationally representative.

3.2 Measuring multidimensional child poverty

Based on Sen's capability poverty theory framework (Sen, 1993, 2001), we adopt the widely used Alkire-Foster (A-F) method to measure children's poverty (see Appendix for details). The three most recognized basic capabilities are health, education, and living conditions (OPHI and UNDP, 2023). Considering the "Outline for the Development of Chinese Children (2011–2020)" highlights the rights to education, health, security, welfare, family, environment, and legal protection of children, as well as the availability of data, this paper includes three basic dimensions, education, health, and living conditions and extends nutrition and security, for a total of five dimensions (see Table 1).

(1) Nutrition. Adequate nutrition is crucial to children's growth and development, and poverty most easily deprives children of nutrition. We use stunting and wasting as the indicators of nutrition, which are both prominent indicators of child malnutrition (WHO, 2023). Likewise, we use the Body Mass Index (BMI) and height for age (HAZ) to measure wasting and stunting, respectively, with the cutoff of the Chinese Center for Disease Control and Prevention (China's CDC).

(2) Health. Health is the most important basic capacity of humans, especially for children. Children's capacity for health includes physical health, medical services, and a healthy lifestyle. Referring to existing studies (Gao *et al.*, 2022) and the availability, we use the number and severity of illnesses to directly represent children's health. Insufficient sleep affects children's growth and development. We use the sleep deprivation indicator and set the cutoff according to the recommendation of American Academy of Sleep Medicine (AASM). The catastrophic health expenditure indicator shows the health status and medical burden of family members. According to the WHO standards, if the ratio of out-of-pocket medical expenditure to non-food expenditure exceeds 40% of the household, the household is considered to have catastrophic medical expenditure.

(3) Security. According to the asset-building theory, family assets have a significant impact on children's academic performance and mental health (Orr, 2003). Referring

Table 1. Multidimensional poverty index for children aged 3–15

Dimension	Indicator	Deprivation cutoff	Weight
Nutrition	Wasting	The child with a BMI lower than the 2SD standard set by the CDC of China	1/10
	Stunting	The height for age (HAZ) of the child is shorter than the 2SD standard set by the CDC of China	1/10
Health	Frequent illness	The child has seen the doctor more than 5 times in the past 12 months	1/20
	Hospitalization	The child has been hospitalized at least once in the past 12 months	1/20
	Sleep deprivation	3–5 year-old: sleep less than 10 h per day 6–12 year-old: sleep less than 9 h per day 13–15 year-old: sleep less than 8 h per day	1/20
	Catastrophic health expenditure	Per capita household expenditure on health care is 40% higher than per capita net income	1/20
Security	No access to insurance	The child has no access to any insurance	1/10
	Household savings	The household savings per capita are 40% lower than the sample mean	1/10
Education	Education expenditure	Per capita household expenditure on education is 40% lower than the sample mean	1/15
	School attendance	3–6 year-old: not enrolled in preschool 7–15 year-old: not enrolled in school (any level)	1/15
	Long school commutes	3–12 year-old: takes more than15 min on the way to school per day 13–15 year-old: takes more than 30 min on the way to school per day	1/15
Living conditions	Drinking water	Unclean drinking water comes from ponds, springs, rivers, lakes, cellars, wells, or rainwater	1/20
	Cooking fuel	Cooking fuel is firewood, coal, or other non-clean fuel	1/20
	Assets	The value of household assets per capita is 40% lower than the sample mean	1/20
	Housing	The living area per capita in the household is less than 15 m^2	1/20

Note(s): BMI is Body Mass Index. China's CDC is Chinese Center for Disease Control and Prevention
Source(s): Authors' own work

to Qi and Wu (2019), we select insurance and household savings to measure children's medical and economic security, respectively.

(4) Education. Children's capacity for education includes attending preschool or kindergarten in the early childhood of 3–5 years old and receiving formal compulsory education at the age of 6–15 years old. We select three indicators: education expenditure, school attendance, and long school commutes. Following the catastrophic medical expenditure, we set the cutoff of education expenditure. Spending too much time on the journey to school not only makes it more difficult for children to be educated, but the longer the journey, the greater the safety risks children face. The setting of long school commutes considering that most primary schools in China are in administrative villages or township-level centers, and most secondary schools are located in township-level centers, we set the cutoff based on the time usually required for children aged in primary school (aged 3–12) and in secondary school (13–15).

(5) Living conditions. Referring to global MPI (OPHI and UNDP, 2023) and data availability, we choose drinking water, cooking fuel, assets, and housing. The cutoff of drinking water and cooking fuel refers to global MPI (OPHI and UNDP, 2023). Since CFPS has no available information on the number of durables, we use the value of

household assets per capita to show the durables owned by the household, and the threshold was set with reference to catastrophic medical expenses. Overcrowded housing can have negative impacts on children's development. Referring to existing studies (Ge *et al*., 2018; Gao and Wang, 2022), we set that if the per capita living area in a family is less than 15 square meters, children are deprived of housing.

Referring to most studies (Alkire *et al*., 2019; Gao and Wang, 2022), this study uses the dimensional equal weight method (see Table 1). The multidimensional deprivation threshold k gives the child is deprived in at least k dimensions among all dimensions. Without losing generality, we adopt $k = 1/3$ as the multidimensional deprivation threshold as many studies (Alkire and Santos, 2010; OPHI and UNDP, 2023). The results of multidimensional child poverty are shown in Table 2, and the results under different thresholds (k value) are also presented in Table A2 and Table A3 of the Appendix.

3.3 Multidimensional child poverty in rural China

Panel A of Table 2 shows the Multidimensional Poverty Index (MPI), the headcount ratio (H), the deprivation intensity (A), and the deprivation score among all 3–15 years old children in rural China. The deprivation score is the weighted number of deprived dimensions of all children. Like deprivation intensity, the higher the deprivation score, the more dimensions among which the child is deprived.

Firstly, child poverty in China's rural areas has improved, with the MPI, headcount ratio, deprivation score, and deprivation intensity falling from 0.116, 27.0%, 0.273, 0.429 in 2018 to 0.087, 21.3%, 0.247, 0.410 in 2020. Although the overall situation of children has improved, more than one-fifth of rural children still live in multidimensional poverty. Using 2013–2018 China Household Income Project data, Gao and Wang (2022) have found that the headcount ratio of multidimensional child poverty in rural China in 2018 is 37.67%, which is higher than our results. Even though the results vary in studies with different data, overall, there are still many children living in multidimensional poverty in rural China. Secondly, there is almost no gender difference in multidimensional child poverty. For example, the headcount ratio of girls and boys in 2020 is 20.5% and 21.9%, respectively, which is consistent with the results of Shen and Alkire (2022), Gao and Wang (2021). The results indicate that there is no obvious gender difference in child poverty in rural China. Thirdly, the younger a child is, the worse of poverty status is. For example, the MPI is 0.168, 0.080, and 0.038 for children aged 3–5, aged 6–12, and aged 13–15, respectively. This finding means that young children are more vulnerable, which is consistent with Wang and Guo (2022).

Panel B of Table 2 reports the contribution of each dimension to the MPI index. Firstly, education contributed to the highest MPI, meaning there are still some children who are deprived of education. The contribution rate shows a downward trend, from 28.3% in 2018 to 25.2% in 2020. With the development of education poverty alleviation, children being deprived of education are gradually improving. Secondly, health and nutrition contributed less to MPI. The contribution of health dropped from 9.9% in 2018 to 7.7% in 2020, indicating that with the continuous medical security improvement in rural China, children's health is well-guaranteed.

3.4 Descriptive analysis

Table 3 shows the distribution of characteristics between mothers' PNFW and mothers' PFW. We calculated the mean of variables between different groups and tested the significance of conditional differences. The dependent variable is whether the child lives in multidimensional poverty, as mentioned above. The explanatory variable of interest is whether the mother participated in non-farm work. The control variables include household economic characteristics, household head characteristics, and child characteristics. The definitions and descriptive statistics of all variables are shown in Table A4 of the Appendix.

Table 2. Multidimensional child poverty in rural China (2018 and 2020)

Panel A. Multidimensional child poverty

	Observations	Multidimensional poverty index (MPI)		Headcount ratio (H), %		Deprivation score		Deprivation intensity (A)	
		2018	2020	2018	2020	2018	2020	2018	2020
Rural children	6,804	0.116	0.087	27.0	21.3	0.273	0.247	0.429	0.410
Girls	3,205	0.120	0.084	27.8	20.5	0.278	0.246	0.432	0.410
Boys	3,599	0.112	0.090	26.4	21.9	0.269	0.248	0.426	0.410
Aged 3–5	1,571	0.240	0.168	51.2	39.6	0.355	0.302	0.469	0.424
Aged 6–12	3,826	0.090	0.080	22.5	19.9	0.255	0.239	0.400	0.403
Aged 13–15	1,407	0.060	0.038	14.9	9.60	0.227	0.207	0.400	0.395

Panel B. Contribution of each dimension to MPI (Deprivation rate, %)

	Observations	Nutrition	Health	Security	Education	Living conditions
2018	3,826	11.9	9.9	26.9	28.3	23.0
2020	2,978	11.8	7.7	32.0	25.2	23.3

Note(s): The table gives the multidimensional child poverty status in rural China with all children aged 3–15. Observations of Panel A are the sum of 2018 and 2020
Source(s): Authors' own work

Table 3. The characteristics of mothers who participated in non-farm work (PNFW) and mothers who participated in farm work (PFW)

	(1) Full sample (N = 4,457)		(2) Mothers PNFW (N = 1,541)		(3) Mothers PFW (N = 2,916)		(4) Difference
	Mean	SD	Mean	SD	Mean	SD	(3)–(2)
Dependent variable							
Child poverty	0.245	0.430	0.228	0.376	0.322	0.452	0.094***
Household economic characteristics							
House area	31.187	23.257	29.960	24.507	29.400	22.504	−0.567
Land assets	0.694	1.643	0.415	0.867	0.883	1.927	0.468***
Income	9.277	0.925	9.476	0.905	9.114	0.902	−0.362***
Public transfers	0.544	0.498	0.482	0.500	0.631	0.492	0.150***
Household debt	0.037	0.190	0.037	0.183	0.044	0.193	0.007
Raise ratio	0.393	0.149	0.398	0.144	0.394	0.152	−0.003
Chronic patients	0.309	0.560	0.376	0.563	0.361	0.559	−0.014
Male spouse's job	0.320	0.467	0.539	0.494	0.190	0.380	−0.348***
Household head characteristics							
Age	44.797	11.609	44.880	12.894	45.450	10.824	0.565
Education	6.821	4.312	7.686	4.272	6.363	4.264	−1.323***
Health level	0.871	0.336	0.873	0.316	0.839	0.346	−0.034***
Marital status	0.861	0.346	0.841	0.367	0.892	0.333	0.051***
Child characteristics							
Age	8.947	3.738	8.309	3.665	8.685	3.775	0.376***
Gender	0.565	0.496	0.554	0.493	0.543	0.497	−0.011
IV							
Rainfall shock	−0.960	1.557	−0.924	1.826	−0.628	1.363	0.296***

Note(s): We perform the Wilcoxon-Mann-Whitney test on dummy variables and perform *t*-test on continuous variables. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

The results show that there are significant differences in many characteristics between mothers' PFW and mothers' PNFW, indicating that mothers' employment choice is associated with family characteristics. Meanwhile, we find that children are significantly poorer when their mothers PFW than mothers PNFW. The incidence of child poverty is 32.2% if mothers PFW while only 22.8% when mothers PNFW. Consequently, there is an endogeneity of the mothers' PNFW and children's poverty.

4. Empirical analysis

4.1 Empirical strategy: Rainfall shock as IV

We are aware that there could be concerns about the endogeneity of the mothers' PNFW and children's poverty. Firstly, there is a classic selection bias. Mothers' PNFW ability tends to be higher than that of mothers engaged in farm work. Secondly, mothers are more likely to PNFW to lower their families' economic pressure when their children are in poverty (Das gupta, 2003), leading to a possible reverse causality problem in the estimation. Thirdly, there are some unobservable variables, such as the mother's preferences, which also lead to biased estimation results.

To address these concerns of endogeneity, we take rainfall shock as the IV. Rainfall shock, especially drought, is one of the most widespread natural disasters in rural China. There are two reasons that we choose rainfall shock as IV: (1) Rainfall shock increases the likelihood of women's PNFW, which meets the correlation requirement of IV. Drought usually reduces crop

yields, thus reducing demand for female agricultural labor and prompting women to PNFW (Mahajan, 2017). Meanwhile, drought reduces farm incomes, making women must PNFW to smooth household income (Pangaribowo *et al.*, 2019). Figure 2 shows the correlation of the rural female PNFW ratio with rainfall shock in a county in 2018, and the result shows a strong negative correlation. When a county suffers a negative rainfall shock (decreased rainfall in a certain year), the proportion of rural female PNFW will increase. (2) As a natural phenomenon, rainfall shock has nothing to do with the behavior and characteristics of a family, meeting the exogenous requirements of IV. Therefore, rainfall shock is a good IV for women's PNFW.

We conduct IV estimation in the following steps. First, rainfall shock may have a lagging impact on women's employment behavior (Amare *et al.*, 2018). We thus define rainfall shock (RS_{tc}) as the difference between the average daily rainfall of the county in $t-1$ year and that of in recent 30 years. That is,

$$RS_{tc} = R_{(t-1)c} - \overline{R_c} \tag{1}$$

where $R_{(t-1)c}$ is daily rainfall of county c in year $t-1$, $\overline{R_c}$ is the average daily rainfall in the recent 30 years of county c.

Second, rainfall shocks may affect both men's and women's PNFW. To identify the effect on rural female employment choice, we use the Bartik IV approach (Borusyak *et al.*, 2022). Specifically, we use the ratio of the county's cultivated land area to the national cultivated land area in the year as the share of the rainfall shock ("the shift"). Since measured at the county level, this ratio satisfies the exogeneity requirement of share (Goldsmith-Pinkham *et al.*, 2020). Although the proportion of women's PNFW has increased in recent years, men still occupy the majority of PNFW. According to the Migrant Workers Monitoring Survey Report 2018, 65.2% are male and 34.8% are female among all migrant workers in 2018. This means that there are still many women who stay in rural areas to undertake agricultural work. As the main force of agricultural production, women will be more vulnerable to rainfall shocks in counties with more cultivated land. That is,
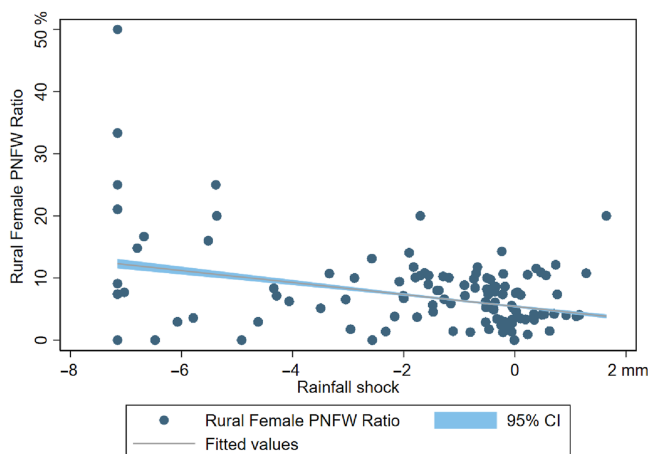
$$IV_{tc} = Land_{tc}/{Land_t} * RS_{tc} \tag{2}$$

Figure 2. Correlation of rural female PNFW rate with rainfall shock in 2018. Notes: (1) Each dot indicates the rural female PNFW ratio of the county, which is the total number of female PNFW in the county divided by the total population of the county and is shown on the vertical axis. (2) The horizontal axis gives the rainfall shock (mm) of the same county, which is the difference between the daily average rainfall of a particular year and that of the last 30 years in the county

where $Land_t$ denotes the total areas of cultivated land in year t, $Land_{tc}$ denotes the total areas of cultivated land of county c in year t.

Third, we use the following two-stage least squares method (2SLS) to perform the shift-share IV estimation:

$$Job_{itc} = \beta_0 + \beta_1 IV_{tc} + \beta_2 X_{itc} + \mu_i + \sigma_{tc} + e_{itc} \tag{3}$$

$$ChildPoor_{itc} = \alpha_0 + \alpha_1 \widehat{Job}_{itc} + \alpha_2 X_{itc} + \mu_i + \sigma_{tc} + \partial_{itc} \tag{4}$$

where Job_{itc} is a dummy variable, which equals one if the mother of the child i participated in non-farm work (PNFW) of county c in year t and zero otherwise. IV_{tc} is the share-shift instrument as we defined above, that is, *Rainfall shock×Land ratio*. $ChildPoor_{itc}$ is the multidimensional poverty status of child i in year t, which equals one if the child i living in multidimensional poverty and equals zero otherwise. X_{itc} are control variables vector. μ_i are individual fixed effects, that control for individual time-invariant unobservable characteristics, σ_{tc} are year and provincial fixed effects. e_{itc} and ∂_{itc} are the error terms. $ChildMPI_{it}$ Eq. (3) gives the first stage of 2SLS and estimated results the $\widehat{Job}_{it}$. Eq. (4) gives the second stage of estimation, and α_1 is the coefficient of interest [5].

4.2 Estimation results

4.2.1 Effects on multidimensional child poverty. Table 4 reports the estimated results. Columns (1) and (2) report the estimated results of the fixed effects model with the year and the province fixed effects added or not. As expected, the coefficients of Job in both columns are significantly negative. The marginal effect of Job is -0.051 and statistically significant at a 1% significance level (Column (2)), meaning that compared to mothers who stay in farm work, children with mothers who participated in non-farm work are 5.1% less likely to be deprived of multidimensional poverty. Columns (3) and (4) report the estimated results of 2SLS. Column

Table 4. Effects of mother's PNFW on multidimensional child poverty

| Variables | FE | | 2SLS | |
	(1) Child poverty	(2) Child poverty	First stage (3) Job	Second stage (4) Child poverty
Job	−0.053*** (0.016)	−0.051*** (0.016)	–	−0.045** (0.015)
Rainfall shock×Land ratio	–	–	−0.018*** (0.006)	–
Control Variables	YES	YES	YES	YES
Year FE	NO	YES	YES	YES
Province FE	NO	YES	YES	YES
IV test				
F-statistic	–	–	10.420***	–
Cragg-Donald Wald F statistic	–	–	18.840	–
Stock-Yogo weak ID test critical values	–	–	16.380	–
D-W-H statistic	–	–	6.386***	–
Observations	4,457	4,457	4,457	4,457

Note(s): The table presents the marginal effects with robust standard errors in parentheses. Control variables from Table 3 are included in all regressions and their estimates are omitted for space considerations and are available upon request. All results are weighted estimates. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

(3) gives the results of the first stage; the coefficient of rainfall shock is −0.018, statistically significant at a 1% significance level, suggesting that a drop in local rainfall increases the likelihood of a mother's PNFW. Column (4) shows the results of the second stage, the marginal effect of rainfall shock is −0.045, statistically significant at a 1% significance level, meaning that compared to mothers who stayed at home, exposure to rainfall shock that prompted maternal PNFW lowered the probability of children experiencing multidimensional poverty to 4.5%. This result empirically verifies that the mother's PNFW can significantly reduce their children's multidimensional poverty.

IV test of Table 4 gives the test results of IV. The F statistic value of the weak IV test is significantly higher than the critical value of 10, and the Cragg-Donald Wald F statistic is higher than the 10% of the Stock-Yogo weak IV test critical value, both indicating that the shift-share instrument, rainfall shock (the decrease of rainfall) multiply the land ratio is highly correlated with mother's PNFW and is not a weak instrument variable.

4.2.2 Effects on the deprived dimension of child poverty. Furthermore, we perform 2SLS to examine the effect of mothers' PNFW on the dimensions of multidimensional child poverty. Table 5 presents the second-stage results.

The marginal effects of Job are negative in all columns, indicating that the mother's PNFW alleviates all dimensions of deprivation. First, the mother's PNFW at the 10% significance level reduced the educational deprivation. Mothers PNFW can be exposed to more urban forms of education, that is, "social remittances", and they will probably pay more attention to children's education (Ge *et al.*, 2018; Fan *et al.*, 2020). The increase in household income and savings from working mothers can also increase investment in children's educational resources (Ge *et al.*, 2018). Second, the mother's PNFW also significantly reduced the deprivation of living conditions. As mothers assume greater responsibility for their families and children's daily lives, mothers' PNFW increases their economic autonomy, improving the living conditions of families and children.

4.3 Heterogeneity analysis

4.3.1 Heterogeneity across children's ages. Children have different needs for their mothers at different ages (Luo and Miao, 2018). When children are young, they generally need their mother's intensive care. As children grow up, the need for maternal care decreases. We categorize children into three age groups: 3–5, 6–12, and 13–15 years old. Table 6 Panel A shows that mother's PNFW significantly improves poverty among children aged 6–12 and 13–15 at a level of 1%, indicating that mothers' PNFW has a more positive effect on older children's poverty. However, it has no significant effect on children aged 3–5. This may be because children in early childhood need more maternal accompaniment and care (Wang,

Table 5. Effects of mothers' PNFW on dimensions of multidimensional child poverty (Second Stage of 2SLS)

Variables	(1) Nutrition	(2) Health	(3) Security	(4) Education	(5) Living conditions
Job	−0.006	−0.015	−0.028	−0.001*	−0.039**
	(0.019)	(0.022)	(0.018)	(0.020)	(0.014)
Control Variables	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Province FE	YES	YES	YES	YES	YES
Observations	4,457	4,457	4,457	4,457	4,457

Note(s): The table presents the marginal effects with robust standard errors in parentheses. The results of the first stage and control variables are omitted due to space limitations. Control variables from Table 3 are included in all regressions. All results are weighted estimates. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

Table 6. Heterogeneous effects on multidimensional child poverty(Second Stage of 2SLS)

Panel A: Effects on children of different ages

	(1) Aged 3–5	(2) Aged 6–12	(3) Aged 13–15
Job	0.507 (2.360)	−1.959*** (0.802)	−2.446*** (0.316)
Control Variables	YES	YES	YES
Year FE	YES	YES	YES
Province FE	YES	YES	YES
Observations	1,103	2,505	849

Panel B: Effects on children of different genders

	Girls	Boys
Job	−1.903** (0.746)	−1.444** (0.796)
Control Variables	YES	YES
Year FE	YES	YES
Province FE	YES	YES
Observations	2020	2,437

Panel C: Effects on children of different education levels of mothers

	Primary school or less	Junior high school or above
Job	−1.786** (0.913)	1.351 (2.089)
Control Variables	YES	YES
Year FE	YES	YES
Province FE	YES	YES
Observations	2,241	2,216

Note(s): The results of the first stage and control variables are omitted due to space limitations. Control variables from Table 3 are included in all regressions. Robust standard errors are in parentheses. All results are weighted estimates. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

2013). As children grow older, they become less dependent on their mothers (Luo and Miao, 2018), highlighting the positive effects of the empowerment of mothers.

4.3.2 Heterogeneity across children's gender. Due to the "Son Preference" cultures (Das gupta *et al.*, 2003), the positive effects of mothers' PNFW on multidimensional child poverty may vary in different genders of children. Table 6 Panel B shows that mothers' PNFW significantly reduces the multidimensional poverty rate of girls and boys at the level of 1%, and 5% respectively, indicating there is no obvious "son preference" in mothers' non-farm employment on child poverty. Considering that the incidence of multidimensional poverty among boys and girls is close (as Table 2 shows), we believe that the "son preference" is gradually waning in rural China. This may be because, in the post-industrial service economy era, women have more job opportunities and are able to assume more responsibilities for elderly care.

4.3.3 Heterogeneity across mothers' education level. The effect of a mother's PNFW on their children's multidimensional poverty may vary when mothers with different educational levels. On the one hand, mothers with low educational levels may have lower family status and weaker control over family resources, and engaging in non-farm jobs can significantly improve their family status (Xi *et al.*, 2023). On the other hand, mothers with low educational levels may engage in low-skilled jobs and hard to earn more, resulting in the alleviating effect of child poverty being limited. Table 6 Panel C gives the estimated results. The results indicate that mothers with a primary school education or less who participated in non-farm work significantly

reduced their children's multidimensional poverty, while no such significant effect was observed among mothers with a junior high school education or above. This result, obtained after controlling for household economic characteristics, lends stronger support to the hypothesis that mothers who participated in non-farm work with lower educational levels reduce their children's multidimensional poverty through increased control over household resources.

4.4 Robustness checks

We used several methods to check the robustness of our main findings, and the results are shown in Table A5 of the Appendix.

First, the replacement of the dependent variable. (1) We use the continuous variable of children's deprivation score to replace the dummy dependent variable (poor or not). The deprivation score does not depend on the k value and the result is shown in Column (1). Similar to the main results, mothers' PNFW was significantly negatively associated with their children's deprivation score, indicating that mothers' PNFW could significantly reduce the level of child deprivation. (2) We recalculate multidimensional child poverty incidence by changing the threshold to $k = 0.4$. The result is shown in Column (2). Again, mothers' PNFW still significantly alleviates multidimensional child poverty.

Second, we perform PSM estimation to address the potential self-selection bias instead of IV estimation. We use the kernel matching method and show the result in Column (3). After addressing the self-selection bias of mothers' employment choice, mothers' PNFW is still significantly negatively associated with children's multidimensional poverty.

Third, a potential concern is the outbreak of the COVID-19 pandemic that occurred in 2019–2022, which could reduce the probability of mother's PNFW and aggravate multidimensional child poverty. To exclude this concern, we use CFPS 2016–2018 data to test the robustness of our main findings. The result is shown in Column (4) and indicates that before the COVID-19 pandemic, mothers' PNFW significantly reduced multidimensional child poverty. Therefore, our main finding is robust.

5. Mechanisms: Women's empowerment

5.1 Empirical model

As discussed in section 2 of the paper, mothers' PNFW can lift their children out of poverty by empowering women. To empirically examine this mechanism, the following model is constructed:

$$Job_{itc} \times Empower_{itc} = C_1 IV_{tc} + C_2 X_{itc} + \mu_i + \sigma_t + \epsilon_{itc} \tag{5}$$

$$ChildMPI_{itc} = \delta_1 Job_{itc} \times \widehat{Empower}_{itc} + \delta_2 X_{itc} + \mu_i + \sigma_t + \varphi_{itc} \tag{6}$$

where $Empower_{itc}$ refers to women's empowerment, ϵ_{itc}, φ_{itc} are the error terms. The other variables are the same as Eq. (3).

How to measure women's empowerment is one of the biggest challenges in the literature (Duflo, 2012). One of the most widely used measurements of women's empowerment is the Women's Empowerment in Agriculture Index (WEAI) proposed by Alkire *et al*. (2013). WEAI measures women's rights in agriculture, which can well reflect women's empowerment in agriculture-based countries (Holland and Rammohan, 2019; Quisumbing *et al*., 2022). However, WEAI is not suitable for measuring empowerment in industrialized countries such as China, where agriculture provides few job opportunities or relatively lower wage rates, thereby women are more likely to seek non-agricultural employment.

Building on the definition of UNIFEM (UNIFEM, 2019), we define women's empowerment as the process of women increasing their dominance of available resources and improving their self-esteem. Based on the definition and considering the availability of data, we use the commonly used indicator of intrahousehold bargaining power and self-esteem as the proxy

measurement for women's empowerment. Intrahousehold bargaining power measures the decision-making power of women within the family (Doss, 2013), which is measured with women's relative income in the paper. We use an index to measure women's self-esteem, which includes five questions referred to in the simplified version of the Rosenberg Self-esteem Scale (Orth *et al.*, 2008). We sum up the scores for the five questions, and the full score is 20, with higher scores indicating greater self-esteem. Detailed criteria and descriptive statistics are shown in Table 7. It is noted that constrained by data, although we select a comprehensive measurement as possible, the measurement of women's empowerment is not perfect. This requires further research to collect more detailed data about women's empowerment when made available.

5.2 Estimation results

5.2.1 Effects of mothers' PNFW on women's empowerment. We first explore the effects of women's PNFW on their empowerment. Firstly, the coefficients of Job are positive and significant at the level of 1% (Column (1)(2) of Table 8), which indicates that PNFW significantly improves women's intrahousehold bargaining power and self-esteem. The findings prove that economic development empowers women by providing better-paying non-farm jobs, improving their voice in the family, and boosting their confidence, which confirms the findings of existing research (Duflo, 2012) by providing supportive evidence from China. This suggests that obtaining discretionary income through employment is key to improving women's bargaining power and self-confidence within the household.

Secondly, since women's empowerment increases with their educational level (Doss, 2013), we explore the heterogeneous effect across different education levels of women, and the results are shown in Columns (3)–(6) of Table 8. The results show that engaging in non-farm work significantly enhances rural mothers' self-esteem at all levels of education. Mother's PNFW significantly enhances the intrahousehold bargaining power of women with higher education levels, which may be because lower-educated women tend to have low-skilled jobs. This result may suggest that low-educated women are still unable to obtain an equal wage income like their husbands, which results in their lack of control over family resources. Therefore, the improvements in macro-systems such as gender equality (Duflo, 2012) and legal security will also help empower women within the family.

5.2.2 Estimation results of mechanism. Table 9 gives the results of Eq. (6). The results show that the coefficients of interaction terms are negative and statistically significant at the level of 1% respectively, indicating that the effects of mothers' PNFW on multidimensional child poverty mainly exist in families where mothers have higher bargaining power and self-esteem.

Table 7. Description of women's empowerment proxy variables

Proxy variables	Indicators	Description	Mean	SD
Intrahousehold bargaining power	Relative income	Female earnings divided by family total net income	0.394	0.221
Self-esteem	Life satisfaction	1 = very dissatisfied, ~ 5 = very satisfied	4.006	0.941
	Future confidence	1 = no confidence, ~ 5 = very confident, ~	4.200	0.888
	Sense of accomplishment	1 = not important, ~ 5 = important	3.111	1.377
	Having child	1 = very important, ~ 5 = not important	1.904	1.129
	Work hard	1 = strongly disagree, ~ 5 = strongly agree	3.982	0.714

Note(s): Self-esteem is measured with the simplified version of the Rosenberg Self-esteem Scale, which includes 5 questions
Source(s): Authors' own work

Table 8. Effects of mothers' PNFW on women's empowerment and heterogeneity of mother's different education levels

| | All samples | | Primary school and below | | Junior high school and above | |
	(1) Intrahousehold bargaining power	(2) Self-esteem	(3) Intrahousehold bargaining power	(4) Self-esteem	(5) Intrahousehold bargaining power	(6) Self-esteem
Job	0.058*** (0.009)	1.025*** (0.172)	0.023 (0.014)	1.244*** (0.249)	0.062*** (0.012)	0.408** (0.197)
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Province FE	YES	YES	YES	YES	YES	YES
R^2	0.126	0.209	0.092	0.358	0.202	0.143
Observations	4,457	4,457	2,241	2,241	2,216	2,216

Note(s): Control variables from Table 3 are included in all regressions. Their estimates are omitted for space considerations and are available upon request. Robust standard errors are in parentheses. All results are weighted estimates. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

Table 9. Effects of mothers' PNFW on multidimensional child poverty through women's empowerment

Variables	(1) Child poverty	(2) Child poverty
Job $\times$ Intrahousehold bargaining power	−4.259*** (0.557)	
Job $\times$ Self-esteem		−0.117*** (0.035)
Intrahousehold bargaining power	0.106 (0.130)	
Self-esteem		0.003 (0.008)
Job	−0.201*** (0.066)	−0.198*** (0.065)
Control Variables	YES	YES
Year FE	YES	YES
Province FE	YES	YES
Observations	4,457	4,457

Note(s): Control variables from Table 3 are included in all regressions. Their estimates are omitted for space considerations and are available upon request. Robust standard errors are in parentheses. All results are weighted estimates. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

Therefore, the results verify women's empowerment is the mechanism by which mothers' PNFW can lift children out of poverty.

6. Conclusions and policy implications

With the CFPS 2018–2020 rural data, this study empirically investigates the effect of mothers' PNFW on multidimensional child poverty. The multidimensional child poverty measurement includes nutrition, security, health, education, and living conditions dimensions, and the AF method is used. Rainfall shock as IV of the mother's PNFW is used for IV estimation.

We find that: (1) child poverty in China's rural areas has improved, with the poverty incidence falling from 27.0% in 2018 to 21.3% in 2020. Although the overall situation of children has improved, more than one-fifth of rural children still live in multidimensional poverty. (2) IV estimation results show that rural mothers' PNFW can significantly reduce the probability of their children's deprived of poverty. Mothers' PNFW reduces deprivation for all

dimensions of children, especially in education and living conditions. These findings are still valid after robustness checks. (3) Improved women's empowerment from mothers' PNFW is an important mechanism that mothers' PNFW can reduce multidimensional child poverty. Rural mothers who have a non-farm job are more likely to have higher intra-household bargaining power and self-esteem, favoring children in resource allocation and providing better parenting and family atmosphere, reducing the likelihood of their children living in multidimensional poverty. These findings not only prove the importance of women's ability to negotiate and bargain for family resources for children's development (Doss, 2013) but also support that economic development empowers women (Duflo, 2012), improving their voice in the family and boosting their confidence, especially in developing countries.

The above findings have three policy implications. Firstly, given the multifaceted nature of child poverty, which extends beyond mere economic insecurity to encompass deprivations in nutrition, healthcare, and educational opportunities, policies aimed at enhancing the comprehensive well-being of rural children should be prioritized on the policy agenda. Secondly, a family-oriented child social welfare policy should notice the inequitable distribution of resources within the family. The specific way includes giving priority to mothers or other female guardians when providing child cash transfers or allowances. Thirdly, empowering women can promote the development of both women and children, helping rural families invest more in children. Public policies that encourage rural women to participate in the labor market, including providing skill training for women and reducing the gender wage gap, will effectively empower women.

Appendix

1. Alkire-Foster (A–F) method

The A–F method identifies the poor population by setting a double threshold: the threshold of the dimensional indicators (z), below which the sample is considered poor on this indicator; and the threshold of the number of dimensions (k), above which the sample is considered poor. Using the A–F method a Multidimensional Poverty Index (MPI) can be obtained. The index consists of the multidimensional incidence of poverty (H) and the degree of poverty deprivation (A), calculated as follows:

First, we define the deprivation matrix $g_{ji} = \begin{cases} 1, y_{ij} \leq z_j \\ 0, y_{ij} > z_j \end{cases}$, where y_{ij} denotes the value of child i on the indicator j, z_j denotes the threshold for the indicator z. d denotes the dimension, indicator j's relative importance is denoted by w_j, which usually take equal weights. Then the deprivation score of child i, c_i can be denoted by $\sum_{j=1}^{d} w_j g_{ij}$. Second, we use the schematic function $I_i(k)$ to denote the poverty status of child i. When $c_i \geq k$, $I_i(k) = 1$, otherwise $= 0$, where k is the cutoff of dimensions. As there is no standard value of k, referred to Alkire and Santos (2010), we set $k = 0.33$, which means a child is considered to be in multidimensional poverty if he or she is deprived of more than one third of the dimensions. Child's k-dimensional poverty incidence H_k, and the degree of poverty deprivation A_k can be denoted as:

$$H_k = \frac{1}{n} \sum_{i=1}^{n} I_i(k); \; A_k = \frac{\sum_{i=1}^{n} c_i I_i(k)}{\sum_{i=1}^{n} I_i(k)} \tag{A.1}$$

n is the whole sample. H_k reflects the breadth of the incidence of child poverty, while A_k reflects the depth. The Multidimensional Poverty Index M_k can be denoted as:

$$M_k = H_k \times A_k = \frac{1}{n} \sum_{i=1}^{n} I_i(k) \times \frac{\sum_{i=1}^{n} c_i I_i(k)}{\sum_{i=1}^{n} I_i(k)} = \frac{\sum_{i=1}^{n} c_i I_i(k)}{n} \tag{A.2}$$

By introducing A_k, we can adjust H_k to M_k, solving the problem that H_k is not sensitive to the increase or decrease of the deprivation dimension of child i.

Table A1. Threshold of wasting by age and gender

Age	Boys Wasting	Stunting	Girls Wasting	Stunting
3	13.48	90.5	13.20	89.3
4	13.33	97.2	12.95	96
5	13.13	103.6	12.83	102.5
6	13.03	109.7	12.70	108.5
7	13.60	113.51	13.20	112.29
8	13.80	118.35	13.40	116.83
9	14.00	122.74	13.70	121.31
10	14.30	126.79	14.10	126.38
11	14.70	130.39	14.60	132.09
12	15.10	134.48	15.20	138.11
13	15.70	143.01	15.80	143.75
14	16.30	150.22	16.30	146.18
15	16.80	155.25	16.70	147.02

Source(s): Chinese Center for Disease Control and Prevention (China's CDC) (WS/T 423—2022; WS/T 612—2018; GB/T 31178-2014)

2. Sensitive analysis of multidimensional child poverty

First, to test the sensitivity of the cutoff of multidimensional child poverty, we recalculate the headcount ratio and multidimensional poverty index at different k values. As expected, as the k value increases (from 0.2 to 0.5), the headcount ratio and multidimensional poverty index decrease, which means the number of children trapped in multidimensional poverty decreases. Regardless of the threshold selected, the headcount ratio and the multidimensional poverty index show a downward trend. For example, when $k = 0.4$, the headcount ratio drops from 15.9% in 2018 to 10.6% in 2020. These results mean that the ranking of the deprived status of households is unrelated to the weights of MPI.

Table A2. Multidimensional child poverty with different poverty cutoff

Thresholds	Headcount ratio, %		Multidimensional poverty Index(MPI)	
	2018	2020	2018	2020
$k = 0.2$	70.3	62.7	0.225	0.190
$k = 0.3$	37.0	29.9	0.147	0.114
$k = 0.4$	15.9	10.6	0.076	0.049
$k = 0.5$	5.70	2.60	0.032	0.014

Note(s): Sample size is the same as Table 2 in the main text
Source(s): Authors' own work

Second, we selected the cutoff of $k = 0.4$ to check the robustness of the main estimated results. The multidimensional child poverty status under $k = 0.4$ are shown in Panel A and Panel B of Table B2. The results show that an improved trend from 2018 and 2020. Therefore, the results indicate that the main findings of the paper are robust.

Table A3. Multidimensional child poverty in rural China (2018 and 2020), $k = 0.4$

Panel A. Multidimensional child poverty

Indicator	Observations	Multidimensional poverty index (MPI)		Headcount ratio, %		Deprivation score		Deprivation intensity	
		2018	2020	2018	2020	2018	2020	2018	2020
Rural children	6,804	0.076	0.049	15.9	10.6	0.273	0.247	0.478	0.464
Girls	3,205	0.084	0.049	17.7	10.5	0.278	0.246	0.475	0.463
Boys	3,599	0.069	0.050	14.4	10.7	0.269	0.248	0.482	0.465
Aged 3–5	1,571	0.200	0.109	40.0	22.9	0.355	0.302	0.501	0.474
Aged 6–12	3,826	0.046	0.040	10.1	8.70	0.255	0.239	0.452	0.462
Aged 13–15	1,407	0.032	0.021	7.10	4.80	0.227	0.207	0.446	0.438

Panel B. Contribution of each dimension to MPI (deprivation rate, %)

	Nutrition	Health	Security	Education	Living conditions
2018($N = 3,826$)	13.2	9.8	25.4	29.4	22.2
2020($N = 2,978$)	13.9	7.7	31.0	24.3	23.2

Note(s): The table gives the multidimensional child poverty status in rural China with all CFPS data. Observations of Panel A are the sum of 2018 and 2020
Source(s): Authors' own work

3. Descriptive statistics
Table A4 shows the definitions and descriptive statistics of variables with the study sample of the study. The dependent variable is whether the child lives in multidimensional poverty as mentioned above. The explanatory variable of interest is whether the mother participated in non-farm work. In 2020, 37.8% of mothers engaged in non-farm work, 62.2% engaged in farm work in rural China. The control variables include household economic characteristics, household head characteristics, and child characteristics. The average age of children is 9.327 in 2020. The proportion of boys is about 49.8% in 2020, indicating that the gender ratio of children in the sample is relatively balanced.

Table A4. The descriptive statistics of variables

Variables	Description	2018 (N = 2,242) Mean	SD	2020 (N = 2,215) Mean	SD
Dependent variable					
Child poverty	1 = Multidimensional Poor, 0 = Non-poor	0.264	0.441	0.226	0.418
Independent variable					
Job	1 = Mothers participated in non-farm work (PNFW), 0 = Mothers participated in farm work (PFW)	0.340	0.474	0.378	0.485
Household economic characteristic					
House area	House owned area square divided by the number of family members	32.170	24.470	30.230	21.970
Land assets	Land owned assets divided by the number of family members	0.659	1.419	0.729	1.835
Income	Logarithm of family income divided by the number of family members	9.222	0.967	9.330	0.880
Public transfers	1 = Received public transfers, 0 = Not	0.559	0.497	0.530	0.499
Household debt	1 = The household has debts, 0 = No debt	0.046	0.210	0.029	0.167
Raise ratio	The ratio of the number of family members aged over 65 and younger than 15 to total numbers	0.383	0.149	0.403	0.148
Chronic patients	The number of family members with chronic diseases	0.353	0.599	0.267	0.516
Male spouse's job	1 = Fathers participated in non-farm work, 0 = Otherwise	0.311	0.463	0.310	0.463
Household head characteristics					
Age	Age, year	44.610	11.680	44.980	11.540
Education	Years of education	6.445	4.155	7.392	4.153
Health	1 = Healthy, 0 = Unhealthy	0.859	0.348	0.882	0.322
Marital status	1 = Married, 0 = Otherwise	0.866	0.341	0.863	0.344
Child characteristics					
Age	Age, year	8.555	3.691	9.327	3.744
Gender	1 = Male, 0 = Female	0.581	0.494	0.549	0.498
IV					
Rainfall shock	The difference between the daily average rainfall of that year and that of the last 30 years	−0.714	1.399	−0.746	1.374

Note(s): CFPS only counted the change of house square in the post-survey, the house square per capita is calculated according to the 2012–2020 annual family economic database. Health of the household head is selected from the self-rated health level of the adult questionnaire, and the choices are "unhealthy", "average", "healthy", "very healthy" and "quite healthy", the last four items are re-coded as "healthy". We converted the education variable from categorical to continuous by assigning numerical values: 0 (illiterate/semi-illiterate), 6 (primary school), 9 (junior high school), 12 (high school or equivalent), and 15 (associate degree and above)
Source(s): Authors' own work

4. Results of robustness checks

Table A5. Results of robustness checks

Variables	Replace dependent variable (1) Deprivation score	Adjust threshold (k = 0.4) (2) Child poverty	PSM (3) Child poverty	CFPS 2016–2018 data (4) Child poverty
Job	−0.254** (0.0106)	−2.073** (0.499)	−0.056** (0.022)	−2.392*** (0.244)
Control Variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Province FE	NO	YES	NO	YES
Observations	4,457	4,457	4,429	4,959

Note(s): Control variables from Table 3 are included in all regressions. Their estimates are omitted for space considerations and are available upon request. Robust standard errors are in parentheses. All results are weighted estimates. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$
Source(s): Authors' own work

Notes

1. Data source: World Bank Data. https://data.worldbank.org/indicator/SL.TLF.ACTI.FE.ZS?locations=CN

2. Data source: 2023 Migrant Workers Monitoring Survey Report of China.

3. Data source: 2023 Migrant Workers Monitoring Survey Report of China.

4. Data source: ECWMF.https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land-monthly-means?tab=overview

5. The analysis of county-level restricted data from CFPS presented in this paper was performed at the Secure Data Facility of the Institute of Social Science Survey, Peking University.

References

Afoakwah, C., Deng, X. and Onur, I. (2020), "Women's bargaining power and children's schooling outcomes: evidence from Ghana", *Feminist Economics*, Vol. 26 No. 3, pp. 1-29, doi: 10.1080/13545701.2019.1707847.

Alkire, S. and Foster, J. (2011), "Counting and multidimensional poverty measurement", *Journal of Public Economics*, Vol. 95 Nos 7-8, pp. 476-487, doi: 10.1016/j.jpubeco.2010.11.006.

Alkire, S. and Santos, M. (2010), "Measuring acute poverty in the developing World: robustness and scope of the multidimensional poverty index", *World Development*, Vol. 59, pp. 251-274, doi: 10.1016/j.worlddev.2014.01.026.

Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G. and Vaz, A. (2013), "The women's empowerment in agriculture index", *World Development*, Vol. 52, pp. 71-91, doi: 10.1016/j.worlddev.2013.06.007.

Alkire, S., Haq, R. and Alim, A. (2019), "The state of multidimensional child poverty in South Asia: a contextual and gendered view". OPHI Working Papers. pp. 1-26.

Amare, M., Jensen, N.D., Shiferaw, B. and Cissé, J.D. (2018), "Rainfall shocks and agricultural productivity: implication for rural household consumption", *Agricultural Systems*, Vol. 166, pp. 79-89, doi: 10.1016/j.agsy.2018.07.014.

Azevedo, V. and Robles, M. (2013), "Multidimensional targeting: identifying beneficiaries of conditional cash transfer programs", *Social Indicators Research*, Vol. 112 No. 2, pp. 447-475, doi: 10.1007/s11205-013-0255-5.

Bai, Y., Yang, N., Wang, L. and Zhang, S. (2022), "The impacts of maternal migration on the cognitive development of preschool-aged children left behind in rural China", *World Development*, Vol. 158, 106007, doi: 10.1016/j.worlddev.2022.106007.

Baranov, V., Bhalotra, S., Biroli, P. and Maselko, J. (2020), "Maternal depression, women's empowerment, and parental investment: evidence from a randomized controlled trial", *The American Economic Review*, Vol. 110 No. 3, pp. 824-859, doi: 10.1257/aer.20180511.

Borusyak, K., Hull, P. and Jaravel, X. (2022), "Quasi-experimental shift-share research designs", *The Review of Economic Studies*, Vol. 89 No. 1, pp. 181-213, doi: 10.1093/restud/rdab030.

Carlson, G.J., Kordas, K. and Murray-Kolb, L.E. (2015), "Associations between women's autonomy and child nutritional status: a review of the literature", *Maternal and Child Nutrition*, Vol. 11 No. 4, pp. 452-482, doi: 10.1111/mcn.12113.

Das Gupta, M., Zhenghua, J., Bohua, L.Z.M., Chung, W. and Hwa-Ok, B. (2003), "Why is Son preference so persistent in East and South Asia? A cross-country study of China, India and the Republic of Korea", *Journal of Development Studies*, Vol. 40 No. 2, pp. 153-187, doi: 10.1080/00220380412331293807.

Doss, C. (2013), "Intrahousehold bargaining and resource allocation in developing countries", *The World Bank Research Observer*, Vol. 28 No. 1, pp. 52-78, doi: 10.1093/wbro/lkt001.

Duflo, E. (2012), "Women empowerment and economic development", *Journal of Economic Literature*, Vol. 50 No. 4, pp. 1051-1079, doi: 10.1257/jel.50.4.1051.

Fan, D., Wei, D. and Zheng, L. (2020), "The multi-dimensional poverty measurement and poverty factor analysis of children in disadvantaged families", *Social Policy Research*, No. 4, pp. 60-71, doi: 10.19506/j.cnki.cn10-1428/d.2020.04.007.

Fonta, C.L., Yameogo, T.B., Tinto, H., Huysen, T., Natama, H.M., Compaore, A. and Fonta, W.M. (2020), "Decomposing multidimensional child poverty and its drivers in the Mouhoun region of Burkina Faso", *BMC Public Health*, Vol. 20 No. 149, pp. 1-17, doi: 10.1186/s12889-020-8254-3.

Gao, Q. and Wang, Y. (2022), "Levels, trends, and patterns of multidimensional child poverty in China: evidence from CHIP 2013 and 2018 data", *Chinese Social Security Review*, Vol. 6, pp. 98-123, doi:CNKI:SUN:SBPL.0.2022-03-008.

Gao, Q., Zhai, F. and Wang, Y. (2022), "Welfare participation reduced severe multidimensional child poverty in rural China: better targeting can lead to greater poverty reduction", *Child Indicators Research*, Vol. 15 No. 3, pp. 913-932, doi: 10.1007/s12187-021-09885-2.

Ge, Y., Wu, H. and Chen, L. (2018), "Children's long-term multidimensional poverty dynamics and causal factors", *Finance and Trade Economics*, Vol. 39, pp. 18-33, doi: 10.19795/j.cnki.cn11-1166/f.2018.07.00.

Goldsmith-Pinkham, P., Sorkin, I. and Swift, H. (2020), "Bartik instruments: what, when, why, and how", *The American Economic Review*, Vol. 110 No. 8 , pp. 2586-2624, doi: doi:10.1257/aer.20181047.

Hendrick, C.E. and Marteleto, L. (2017), "Maternal household decision-making autonomy and adolescent education in Honduras", *Population Research and Policy Review*, Vol. 36 No. 3, pp. 415-439, doi: 10.1007/s11113-017-9432-6.

Holland, C. and Rammohan, A. (2019), "Rural women's empowerment and children's food and nutrition security in Bangladesh", *World Development*, Vol. 124, 104648, doi: 10.1016/j.worlddev.2019.104648.

Imai, K.S., Annim, S.K., Kulkarni, V.S. and Gaiha, R. (2014), "Women's empowerment and prevalence of stunted and underweight children in rural India", *World Development*, Vol. 62, pp. 88-105, doi: 10.1016/j.worlddev.2014.05.001.

Kabeer, N. (1999), "Resources, agency, achievements: reflections on the measurement of women's empowerment", *Development and Change*, Vol. 30 No. 3, pp. 435-464, doi: 10.1111/1467-7660.00125.

Kim, E. and Nandy, S. (2018), "Multidimensional child poverty in Korea: developing child-specific indicators for the sustainable development goals", *Child Indicators Research*, Vol. 11 No. 3, pp. 1029-1050, doi: 10.1007/s12187-017-9517-0.

Laursen, B. and Collins, W.A. (2009), "Parent-child relationships during adolescence", in *Handbook of Adolescent Psychology: Contextual Influences on Adolescent Development*, John Wiley & Sons, pp. 3-42, doi: 10.1002/9780470479193.adlpsy002002.

Leu, C., Chen, K. and Chen, H. (2016), "A multidimensional approach to child poverty in Taiwan", *Children and Youth Services Review*, Vol. 66, pp. 35-44, doi: 10.1016/j.childyouth.2016.04.018.

Lewit, E.M., Terman, D.L. and Behrman, R.E. (1997), "Children and poverty: analysis and recommendations", *The Future of Children*, Vol. 7 No. 2, pp. 4-24, doi: 10.2307/1602384.

Li, S., Yue, A. and Liu, G. (2021), "Maternal absence on early childhood development: evidence from a randomized control trial of parenting the future Program", *Studies in Labor Economics*, Vol. 9 No. 2, pp. 3-25, doi: CNKI:SUN:LDJJ.0.2021-02-001.

Luo, J. and Miao, Y. (2018), "Impact of the number of children on the female labor force participation rate", *The World of Survey and Research*, Vol. 12, pp. 36-43, doi: 10.13778/j.cnki.11-3705/c.2018.12.007.

Mahajan, K. (2017), "Rainfall shocks and the gender wage gap: evidence from Indian agriculture", *World Development*, Vol. 91, pp. 156-172, doi: 10.1016/j.worlddev.2016.11.004.

Minujin, A., Delamonica, E., Davidziuk, A. and Gonzalez, E.D. (2006), "The definition of child poverty: a discussion of concepts and measurements", *Environment and Urbanization*, Vol. 18 No. 2, pp. 481-500, doi: 10.1177/0956247806069627.

OPHI and UNDP (2023), "Unstacking global poverty: data for high-impact action", United Nations Development Programme and Oxford Poverty and Human Development Initiative, doi: 10.18356/9789210028325.

Orr, A. (2003), "Black-white differences in achievement: the importance of wealth", *Sociology of Education*, Vol. 76 No. 4, pp. 281-304, doi: 10.2307/1519867.

Orth, U., Robins, R.W. and Roberts, B.W. (2008), "Low self-esteem prospectively predicts depression in adolescence and young adulthood", *Journal of Personality and Social Psychology*, Vol. 95 No. 3, pp. 695-708, doi: 10.1037/0022-3514.95.3.695.

Pangaribowo, E.H., Tsegai, D. and Sukamdi (2019), "Women's bargaining power and household expenditure in Indonesia: the role of gender-differentiated assets and social capital", *Geojournal*, Vol. 84 No. 4, pp. 939-960, doi: 10.1007/s10708-018-9901-4.

Qi, D. and Wu, Y. (2019), "Comparing the extent and levels of child poverty by the income and multidimensional deprivation approach in China", *Child Indicators Research*, Vol. 12 No. 2, pp. 627-645, doi: 10.1007/s12187-018-9544-5.

Quisumbing, A., Meinzen-Dick, R. and Malapit, H. (2022), "Women's empowerment and gender equality in South Asian agriculture: measuring progress using the project-level Women's Empowerment in Agriculture Index (pro-WEAI) in Bangladesh and India", *World Development*, Vol. 151, 105396, doi: 10.1016/j.worlddev.2021.105396.

Roelen, K. (2017), "Monetary and multidimensional child poverty: a contradiction in terms?", *Development and Change*, Vol. 48 No. 3, pp. 502-533, doi: 10.1111/dech.12306.

Salmeron-Gomez, D., Engilbertsdottir, S., Leiva, J.A.C., Newhouse, D. and Stewart, D. (2023), "Global trends in child monetary poverty according to international poverty lines", Policy Research Working Paper 10525.

Sen, A. (1993), "Capability and well-being", in Nussbaum, M. and Sen, A. (Eds), *The Quality of Life*, Online ed., Oxford Academic, Oxford, doi: 10.1093/0198287976.003.0003.

Sen, G. (1997), "Empowerment as an approach to poverty", Human Development Report.

Sen, A. (2001), *Development as Freedom*, Anchor Books, New York.

Shen, Y. and Alkire, S. (2022), "Exploring China's potential child poverty", *China and World Economy*, Vol. 30 No. 1, pp. 82-105, doi: 10.1111/cwe.12406.

Shen, C. and Zhang, D. (2010), "The impact of 'staying behind' on the social gender values of rural women in China's Western Regions", *Northwest Population Journal*, Vol. 31 No. 5, pp. 97-102, doi: 10.15884/j.cnki.issn.1007-0672.2010.05.008.

UNICEF (2005), "The state of the world's children".

UNIFEM (2019), *Progress of the World's Women 2019-2020*, United Nations Development Fund for Women, New York.

Wang, Z. (2013), "Mother's employment and children's nutrition in rural areas", *Chinese Journal of Population Science*, Vol. 1, pp. 118-125+128, doi: CNKI:SUN:ZKRK.0.2013-01-013.

Wang, J. (2022), "Tradition, rule of law and identity: on the infringement of rural women's land rights and interests in China", *China Rural Survey*, Vol. 6, pp. 56-67, doi: CNKI:SUN:ZNCG.0.2022-06-004.

Wang, Z. and Guo, Z. (2022), "To build the standard for children's relative poverty and its multidimensional measurement", *Rural Economy*, Vol. 8, pp. 1-11, doi: CNKI:SUN: NCJJ.0.2022-08-001.

WHO (2023), *Levels and Trends in Child Malnutrition Child Malnutrition: UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates: Key Findings of the 2023 Edition*, World Health Organization, ISBN 978-92-4-007379-1.

Wu, P. (2020), "Study on the effect of rural labor migration on left-behind children's physical and mental health", *South China Journal of Economics*, Vol. 1, pp. 95-111, doi: 10.19592/j.cnki.scje.370194.

Wu, W., Qu, G., Wang, L., Tang, X. and Sun, Y.H. (2019), "Meta-analysis of the mental health status of left-behind children in China", *Journal of Paediatrics and Child Health*, Vol. 55 No. 3, pp. 260-270, doi: 10.1111/jpc.14349.

Xi, Y., Liu, Y. and Yin, Y. (2023), "Research progress on intra-household bargaining power", *Economic Perspectives*, Vol. 1, pp. 144-160, doi: CNKI:SUN:JJXD.0.2023-01-010.

Xie, Y., Zhang, X., Tu, P., Ren, Q., Sun, Y., Lv, P., Ding, H., Hu, J. and Wu, Q. (2017), *China Family Panel Studies User's Manual*, Peking University, Beijing, China.

Corresponding author
Xinxin Wang can be contacted at: xxwang@zufe.edu.cn