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The Impact of Rural Women's Education on Household Income in China: Empirical Study Based on CFPS

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ABSTRACT

This study examines the impact of rural women's educational attainment on household income in China using data from the 2018 China Family Panel Studies (CFPS). Drawing on human capital, market efficiency, and social capital theories, we test four hypotheses to evaluate the direct effects of education and mediating pathways through off-farm employment, entrepreneurial capability, and social capital. Employing multiple regression, instrumental variable (IV), and propensity score matching (PSM) methods to address endogeneity and selection bias, we find that rural women's education significantly increases household income, with a 1-year increase in education associated with a 3.0% rise in per capita income. Mechanism analyses reveal that entrepreneurial capability (H3) and social capital (H4) serve as critical mediators, explaining 29.1% and 4.6% of the total effect, respectively, while off-farm employment (H2) shows no significant mediating role. Heterogeneity analyses highlight regional and income-based disparities: the effect is strongest in China's eastern regions (coefficient = 0.036 vs. 0.020 in central and 0.032 in western areas) and among high-income households, where education contributes 1.2% to income growth, compared to negligible effects in low- and middle-income families. Robustness checks, including alternative datasets (CHFS 2019) and PSM models, confirm the results' consistency. The findings underscore the dual role of education in enhancing human capital and fostering social networks, which collectively empower rural women to access economic opportunities. However, structural barriers—such as limited resources in low-income households and regional economic imbalances—constrain these benefits in central/western regions. Policy implications emphasize targeted educational subsidies, skill-building programs, and social capital initiatives for disadvantaged households, particularly in under-developed areas, to amplify the income-enhancing potential of women's education and reduce rural inequality. This study contributes empirical evidence to the discourse on gender, education, and rural development, advocating for context-specific interventions to maximize educational returns.

INTRODUCTION

Income inequality, particularly the persistent urban-rural divide, remains a critical challenge for China's continued economic development. While rapid economic growth has lifted millions out of poverty, rural incomes continue to lag behind urban counterparts, posing a significant obstacle to achieving equitable prosperity. Understanding the factors that contribute to this disparity is crucial for designing effective policies aimed at promoting rural development and reducing income inequality.

Existing research has explored various determinants of rural household income, including household characteristics (Kim, 2019; Wei, 2004; Huo and Chen, 2023; Chen et al., 2024), social and environmental factors (Chang et al., 2012; Yang and Liu, 2012; Biagini et al., 2020; Zhou and Yu, 2011; Liu J. and Liu H., 2004; Wan and Zhou, 2005; Ren et al. 2019; Chen et al., 2023; Chi and Oksana, 2023; Zhao et al., 2024), and employment diversification (Cui and Chen, 2000). However, the specific role of rural women's education in influencing household income has received relatively limited attention. This is a significant oversight given the increasing recognition of women's empowerment as a key driver of economic development and poverty reduction.

This study addresses this gap by examining the impact of rural women's educational attainment on household income in China using data from the 2018 China Family Panel Studies (CFPS). We investigate the causal relationship between rural women's education and household income, employing both propensity score matching (PSM) and an instrumental variable (IV) approach to address potential endogeneity concerns. Furthermore, we explore the underlying mechanisms through which education affects income, focusing on the mediating roles of entrepreneurial activities and social capital. Finally, we examine the heterogeneity of this effect across different regions and income levels to provide a more nuanced understanding of the relationship.

This research contributes to the literature in several key ways. First, we provide robust causal evidence on the impact of women's education on rural household income using a large, nationally representative dataset. Second, our analysis of mediating factors sheds light on how education translates into higher incomes for rural families. Third, the use of an IV approach strengthens the causal identification of the education effect. Fourth, our heterogeneity analysis reveals important regional and income-based variations in the impact of women's education on household income, offering valuable insights for targeted policy interventions.

The structure of the paper is as follows: Section 1 covers the theoretical framework and research hypotheses. Section 2 provides an overview of the data, sources, and descriptive statistics. Section 3 presents the econometric models and key empirical results. The final section concludes with a discussion of the policy implications.

1. THEORETICAL FRAMEWORK AND HYPOTHESES

1.1 Primary Effect: The Impact of Education for Rural Women on Family Income

Despite recent advancements in the economy and culture that have narrowed the educational gap between men and women, significant disparities still exist. Women in rural households continue to experience higher levels of poverty, lower educational attainment, and reduced consumption compared to their male counterparts (Wu et al., 2013). Access to education remains a challenge for many women in rural areas, making state and community support essential. Enhancing women's education is crucial for reducing gender discrimination. Supportive policies aimed at women, particularly those in rural regions, can facilitate their pursuit of higher education, yielding substantial gender dividends that contribute to increased household income (Xiao and Wang, 2021). According to Saeed et al. (2018), gender inequality in education exacerbates local household poverty rates. By improving their educational qualifications, women acquire advanced farming techniques and agricultural knowledge, enabling them to diversify

crop production and engage in value-added industries such as farming and food processing. Consequently, increased productivity in agribusiness can significantly enhance household income. Based on this analysis, we propose the following hypothesis for testing:

H1: Higher education levels among rural women contribute to an increase in household income.

1.2 Mediating Mechanisms

1.2.1 Off-farm Labor Participation

Firstly, increasing women's educational attainment contributes to boosting household income by encouraging participation in off-farm employment. According to human capital theory, education is viewed as a strategic investment that enhances an individual's knowledge, skills, and capabilities, thereby improving their competitiveness and productivity in the labor market. This not only strengthens women's ability to manage complex tasks but also equips them with essential skills to enter technologically advanced or knowledge-intensive non-agricultural sectors. These sectors typically offer higher wages and more stable employment opportunities, significantly improving the economic conditions of families. Therefore, we propose the following hypothesis:

H2: The impact of rural women's education on household income is mediated by their participation in off-farm employment.

1.2.2 Entrepreneurial Capability

Secondly, enhancing the educational levels of rural women significantly improves their entrepreneurial capabilities, which in turn leads to an increase in family income. Market efficiency theory posits that information asymmetry and restrictions can impede the effective functioning of markets. Education can mitigate information asymmetry, enabling rural women to better understand market demands and price fluctuations, thus facilitating more informed business decisions. Furthermore, education helps them build broader social networks, which can provide crucial business information and assist in accessing necessary resources and support, such as loans and technical assistance, thereby enhancing their entrepreneurial capabilities. Based on this analysis, we propose the following hypothesis:

H3: Rural women's education positively affects household income by enhancing their entrepreneurial capabilities.

1.2.3 Social Capital

Moreover, improving the educational levels of rural women can enhance family income by influencing their social capital. Social capital theory emphasizes that an individual's networks, social relationships, and level of social participation can significantly impact economic performance. In rural areas, enhancing women's education can strengthen their social capital on multiple levels, thereby affecting household income. Education improves rural women's social skills and communication abilities, which are fundamental for establishing and maintaining social networks. Through education, they can interact and collaborate more effectively with others, gaining access to more information and resources while enhancing their influence and status within the community. Such strengthened social networks can provide greater economic opportunities, such as participation in larger economic activities through cooperatives or community groups. Based on the above discussion, we propose the following hypothesis:

H4: Rural women's education influences household income by enhancing their social capital.

2. DATA COLLECTION AND VARIABLE DESCRIPTION

2.1 Data collection

The data utilized in this paper originate from the 2018 China Family Panel Studies (CFPS). CFPS1 is a large-scale national survey project organized and conducted by the China Social Science Survey Center at Peking University, encompassing the eastern, central, and western regions of China. There are four categories in the database: community, family, adult, and children. In this work, adult and family data are used. This research uses only samples with rural household registration since it examines the educational attainment of married women in rural areas. After excluding individuals with missing values, duplicate entries, and outliers, we ultimately obtained 2,383 valid observations, spanning 25 provinces and 206 counties. The details are displayed in the second column of Table 2.

2.2 Variable description

To effectively address the research questions, we will specifically present the research variables using operational indicators to measure them.

2.2.1 Dependent variable: Household Income(income).

The dependent variable in this study is household income per capita. Specifically, the annual per capita net income of rural households is selected as the measure of household income, following the approach of Yang and Zeng (2021). To address potential heteroscedasticity and reduce data skewness, the income variable is transformed logarithmically.

2.2.2 Independent variables: Education(edu).

The independent variable, “edu,” represents the educational attainment of rural women. Based on survey data, the education levels are categorized into seven types:

- Never attended school (0 years).
- Primary school (6 years).
- Junior high school (9 years).
- Senior high school (12 years).
- Junior college (15 years).
- Undergraduate degree (16 years).
- Postgraduate degree (19 years).

2.2.3 Control variables.

Based on prior research and data availability, the study incorporates the following control variables:

2.2.3.1 Individual-Level Factors

Health: A binary variable where 1 represents good, excellent, or very good health, and 0 represents poor health.

Political Status (Party): A binary variable where 1 indicates the individual is a member of the Communist Party, and 0 otherwise.

2.2.3.2 Household-Level Factors

- Size: The total number of family members.
- Finance: The total financial assets of the household.
- Fix: The value of household fixed assets.
- Fhouse: The total property value of the household.

¹ Please check the following website for additional details regarding the CFPS data:
<http://www.isss.pku.edu.cn/cfps/>

2.2.4. Mediator variables

This study examines three mediating variables related to the effect of rural women’s education on household income:

Non-agricultural Employment (nr): This variable is derived from responses to the CFPS survey question: “Is this job agricultural or non-agricultural?” A value of 1 represents non-agricultural work, while 0 represents agricultural work.

Entrepreneurial Capability (Ability): This variable is based on responses to the CFPS survey question: “In the past 12 months, did any family member engage in self-employed business (individually operated businesses or private enterprises)?” A value of 1 indicates engaging in entrepreneurial activities, while 0 indicates otherwise.

Social Capital: Social capital is measured by expenditures on gifts for social relationships, as referenced by Xue et al. (2022). The spending on gifts is used as a proxy for the development and maintenance of social relationships.

2.2.5. Instrumental variable: iv-edu.

To address potential endogeneity issues, this study employs the instrumental variable method. The instrumental variable (iv-edu) is defined as the average educational attainment of rural women in the same county, excluding the women in the sample.

This approach is grounded in two key assumptions:

Correlation: The education levels of rural women within the same county are strongly associated due to shared cultural and economic contexts.

Exogeneity: The household income of the sampled individuals is not directly affected by the average education level of other women outside the sample.

Therefore, the instrumental variable (IV-Edu) satisfies the conditions of both relevance and exogeneity.

The detailed valuables as shown in Table 1 and Table 2.

Table 1. Explanation of the variables utilized in the study

Variables	Label	Description of variables
Dependent variable:		
Famer’s income(log)	income	Average disposable income in the household
Independent variable:		
Level of the women's education in rural areas	edu	Education years Never been to school (0) Primary school (6) Junior high school (9) Senior high school/secondary school/technical school/vocational senior school (12) 3-year college (15) 4-year college (16) Master’s program (19)
Control variables:		
Status of health	health	Excellent/very good/good=1 poor=0
Member of the Communist Party	party	Whether be a party member (yes=1 no=0)
Family members	size	Number of family members
Finance assets(log)	finance	Total household financial assets
Fixed assets(log)	fix	Household fixed assets

House assets(log)	fhouse	Total household property value
Mediator:		
Job category	nr	Off-farm job =1 agricultural job=0
entrepreneurial capability	ability	Whether engaged in self-employed business (yes=1 no=0)
Social capital(log)	social capital	Expenditure on gifts for social relations
Instrumental variable:	iv-edu	the average education level of rural women in the county except for the sample.

Source: own

Table 2. Descriptive statistics employed in this article

variable	obs	mean	sd	min	max
income	2382	9.401	0.923	0	12.638
edu	2382	6.963	4.502	0	19
health	2382	0.735	0.442	0	1
pty	2382	0.010	0.102	0	1
size	2382	5.002	2.052	1	15
finance	2382	7.667	4.364	0	15.009
fix	2382	4.101	4.595	0	17.728
fhouse	2382	11.897	1.546	0	16.524
nr	1989	0.488	0.500	0	1
ability	2383	0.107	0.309	0	1
social capital	2366	7.508	2.089	0	11.290
iv-edu	2310	6.990	1.727	0	16

Source: own

3. EMPIRICAL ANALYSIS

3.1 Model

In this study, multiple regression analysis has been used to examine the relationship between rural women's education and household income. The following is the econometric model:

$$\text{Income}_i = \alpha + \beta \text{edu}_i + \gamma \text{CV}_i + \varepsilon_i \quad (1)$$

In model 1, Income_i represents each capita income of the i farmer household. The term edu_i describes the rural women's educational attainment in the i family. If β is notably positive, it suggests a strong positive relationship between rural women's education and household income—the higher the education level of rural women, the greater the income of farmers. Conversely, the household's income level decreases as the education level of rural women decreases. CV_i represent the control variables that affect household income. ε_i is random error term.

Furthermore, this study adopts the intermediary effect model (Wen and Ye, 2014) and employs the stepwise regression method to explore the influence of rural women's educational attainment on the income of Chinese farmers. The regression model developed for this analysis is detailed below:

$$\text{MD}_i = \chi_0 + \chi_1 \text{edu}_i + \chi_2 \text{CV}_i + \varepsilon_i \quad (2)$$

$$\text{Income}_i = \delta_0 + \delta_1 \text{edu}_i + \delta_2 \text{MD}_i + \delta_3 \text{CV}_i + \varepsilon_i \quad (3)$$

Where, MD is the intermediary variable in the model (2), including mediator nr (non-agricultural employment), ability (entrepreneurial capability), and social capital.

The coefficient χ_1 represents the effect of the independent variable (edu) on the intermediary variable (MD). The coefficient δ_2 of the model (3) represents the effect of the intermediary variable (MD) on farmers' income (Income) while accounting for the impact of the independent variable (edu). The coefficient δ_1 measures the direct effect of the independent variable (edu) on the dependent variable (Income), controlling for the effects of the intermediary variable (MD). Definitions for other variables remain consistent with those given in eq. (1). The mediation effect is deemed significant if χ_1 , δ_1 , and δ_2 each demonstrate statistical significance.

3.2 Baseline regression

In this study, the issue of multicollinearity among variables was assessed using Stata 14.0 software. The variance inflation factor (VIF) for all independent variables was found to be less than 2, indicating no significant multicollinearity concerns. Subsequently, multiple linear regression analyses were conducted based on econometric model specifications.

The analysis uses household income as the dependent variable, with rural women's educational attainment serving as the primary independent variable. Additional variables, including individual and household characteristics, are incorporated as control variables. The detailed regression outcomes are presented in Table 3. Specifically, Column (1) reports the baseline model, which examines the impact of rural women's educational attainment on household income without additional controls. Columns (2) and (3) progressively incorporate individual and household control variables to verify the robustness of the results.

The empirical findings consistently demonstrate that rural women's educational attainment exerts a statistically significant and positive influence on household income at the 1% level in all models. This result aligns with Hypothesis 1, suggesting that improving women's education levels can lead to substantial increases in household income. A plausible explanation is that higher educational attainment enhances women's cognitive abilities, providing them with better access to resources, social capital, and non-agricultural employment opportunities, thereby boosting household income.

In addition to the primary independent variable, several control variables exhibit significant effects. First, the health status of rural women positively influences household income at the 1% significance level. Women in rural areas often engage in physically demanding work, and better health enhances productivity and earning potential. Conversely, poor health adversely affects productivity and increases the likelihood of household poverty.

Second, household size negatively correlates with household income at the 1% significance level, indicating that a larger family size reduces per capita resources and income. This finding highlights the economic burden associated with larger households in rural areas.

Lastly, financial assets, fixed assets, and housing assets all exhibit positive and statistically significant coefficients at the 1% level. These results indicate that asset accumulation plays a critical role in improving household income. Assets not only provide economic security but also serve as a source of capital for investment and income generation.

Table 3. Regression results for the impact of rural women's education level on household income (OLS)

	(1)	(2)	(3)
edu	0.042*** (0.004)	0.039*** (0.004)	0.030*** (0.004)
health		0.142*** (0.045)	0.139*** (0.043)
pty		0.034 (0.168)	0.178 (0.156)
size			-0.075***

			(0.009)
finance			0.045***
			(0.004)
fix			0.012***
			(0.004)
fhouse			0.133***
			(0.025)
Constant	9.117***	9.035***	7.481***
	(0.033)	(0.046)	(0.295)
Province Fixed Effects	Yes	Yes	Yes
Observation	2522	2433	2382
R-squared	0.141	0.142	0.264

Notes: Significance levels for P-values are denoted as follows: *** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10 . Standard errors in parentheses.

Source: The authors' detailed analysis of China CFPS data. The following tables are the same.

3.3 Mechanism investigation

Based on intermediary effect models 2 and 3, we have formulated the following empirical study.

3.3.1 Mediator: Non-agricultural employment (nr)

The enhancement of rural women's educational attainment is posited to positively influence family income by facilitating their engagement in off-farm employment. To investigate this hypothesis, this study identifies individuals participating in off-farm work as a mediating proxy variable. The results of this analysis are presented in Table 4.

Table 4. Testing of the Mediating Effect

Variables	(1) nr	(2) Income
edu	0.046*** (0.002)	0.020*** (0.005)
nr		0.273*** (0.042)
Sobel		0.013 (0.002)

Notes: Significance levels for P-values are denoted as follows: *** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10 . Standard errors in parentheses.

Source: own

The results in Table 4 indicate that the coefficient for educational attainment (edu) on non-agricultural employment (nr) is significantly positive, suggesting that an increase in women's education levels enhances their participation in off-farm employment. Furthermore, the coefficient for nr on household income is also significantly positive, indicating that engagement in off-farm employment contributes to increased household income.

However, the Sobel test results do not demonstrate statistical significance, implying that non-agricultural employment does not serve as a mediating factor in the relationship between women's education levels and rural household income. This finding suggests that the influence of women's educational attainment on family income is not mediated by their participation in non-agricultural employment. This outcome contradicts Hypothesis H2.

One potential explanation for this result is that off-farm employment may directly affect income growth for farmers, rather than functioning as an intermediary variable that influences the relationship between women's education and household income. This indicates that while education may enhance women's opportunities for off-farm work, the direct impact of education on income may operate through other channels.

3.3.2 Mediator: Entrepreneurial capability (Ability).

To evaluate Hypothesis H3, which posits that the impact of rural women's educational level on household income is mediated through the enhancement of their business capabilities, we conducted empirical analyses using Models 2 and 3. Following the research methodology outlined by Wen et al. (2004), we employed the Sobel test to assess the validity of the mediation effect. The findings are presented in Table 5.

Table 5. Testing of the Mediating Effect

Variables	(1) Ability	(2) Income
edu	0.004*** (0.001)	0.031*** (0.004)
Ability		0.291*** (0.064)
Sobel		0.001*** (0.001)

Notes: Significance levels for P-values are denoted as follows: *** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10 . Standard errors in parentheses.

Source: own

The results indicate that the Sobel statistic's P-value is less than 0.01, signifying a significant mediating effect. This finding suggests that the influence of rural women's educational attainment on household income is, to a certain extent, realized through the enhancement of their management and investment capabilities. Women with higher education levels may possess greater skills in resource management and allocation within their households. Consequently, as their asset management skills improve, household income is likely to increase. This outcome supports Hypothesis H3.

3.3.2 Mediator: Social capital.

The concept of social capital, first introduced by French scholar Pierre Bourdieu in the 1970s, refers to the resource individuals can access through their social networks. These connections can enhance cultural capital and provide various advantages. To analyze whether improvements in women's educational attainment can influence household income through social capital, "Expenditure on gifts for social relations" was selected as the proxy variable for social capital. To address heteroscedasticity and reduce data skewness, this variable was processed logarithmically. The mediation effect was assessed using the Sobel test, and the results are presented in Table 6.

Table 6. Testing of the Mediating Effect

Variables	(1) Social-capital	(2) Income
edu	0.023** (0.009)	0.033*** (0.004)
Social_capital		0.046***

	(0.008)
Sobel	0.001**
	(0.001)

Notes: Significance levels for P-values are denoted as follows: *** $\leq$ 0.01; ** $\leq$ 0.05; * $\leq$ 0.10. Standard errors in parentheses.

Source:own

The results indicate that the P-value of the Sobel statistic is less than 0.05, signifying a significant mediating effect. This finding demonstrates that increasing women's educational attainment can enhance family income by improving social capital. As women's education levels rise, rural households gain better access to external resources, which subsequently contributes to increased household income. In other words, one pathway through which women's educational attainment affects farmers' income is by enhancing the family's social capital. Therefore, Hypothesis H4 is confirmed.

3.4 Robustness analysis

The following robustness tests are carried out to confirm the reliability and consistency of the findings in this work.

3.4.1 Alternative the dependent variable

The dependent variable per capita household income is replaced with total household income. The results of the regression analysis are displayed in column (1) of Table 7.

3.4.2 Substitute the database

The database CFPS2018 is replaced with the China Household Financial Survey Project (CHFS)2019 which is organized and managed by the China Household Financial Survey and Research Center, South-western University of Finance and Economics. Column (2) of Table 7 presents the outcomes of the regression analysis.

Table 7. Robustness analysis

	(1) Income	(2) Income	(3) Income
edu	0.035*** (0.004)	0.126*** (0.026)	
edu1			0.295*** (0.054)
CV	Yes	Yes	Yes
Observation	2379	3071	927
R-squared	0.298	0.219	0.197

Notes: Significance levels for P-values are denoted as follows: *** $\leq$ 0.01; ** $\leq$ 0.05; * $\leq$ 0.10. Standard errors in parentheses.

Source: Own

3.4.3 Sample matching

To avoid endogeneity issues caused by sample selection bias, we use propensity score matching (PSM) to test robustness. Firstly, we define the independent variable, edu1. This variable is assigned a value of 1 if the years of women's education in rural areas exceed 0, and a value of 0 otherwise. Subsequently, this study employs the widely used nearest-neighbor matching method, utilizing a caliper of 0.02 and setting k=1. The results presented in Table 8 indicate substantial decreases in Pseudo-R2, Mean

Bias, and LR chi2 following matching. The Average Treatment Effect on the Treated (ATT) is significantly positive at the 1% level. Figure 1 illustrates a notable reduction in standardized bias across covariates after nearest-neighbor matching.

Furthermore, Fig. 2, which shows the results of the common support hypothesis test, indicates that the propensity scores of the treatment and control groups exhibit a wide overlap, suggesting high-quality sample matching with low loss of samples. All these results indicate that the PSM analysis is valid.

Column 3 in Table 7 presents the regression results after PSM, revealing a statistically significant positive coefficient for edu1 at the 1% level. This suggests that rural women's education contributes to the enhancement of farmers' income. The alignment of these results with the benchmark regression underscores their robustness after mitigating sample selection bias. The above results suggest that the study's result is robust and reliable.

Table 8. Balance diagnostics of explanatory variables and average treatment effect of PSM.

Sample	Pseudo-R ²	LR chi ² (p-value)	Mean Bias	ATT (s.e.)
Unmatched	0.058	149.00(0.000)	22.9	
Matched	0.004	21.64(0.001)	4.8	0.226*** (0.622)

Notes: Standard errors in parentheses; ***p < 0.01.
Source:own

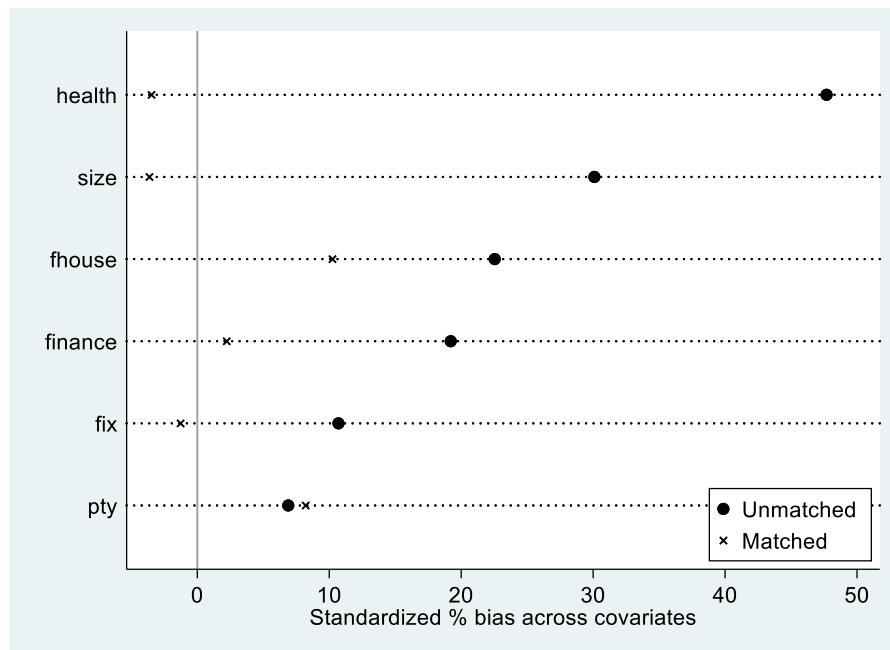


Figure 1. Standardized bias across covariates after nearest-neighbor matching

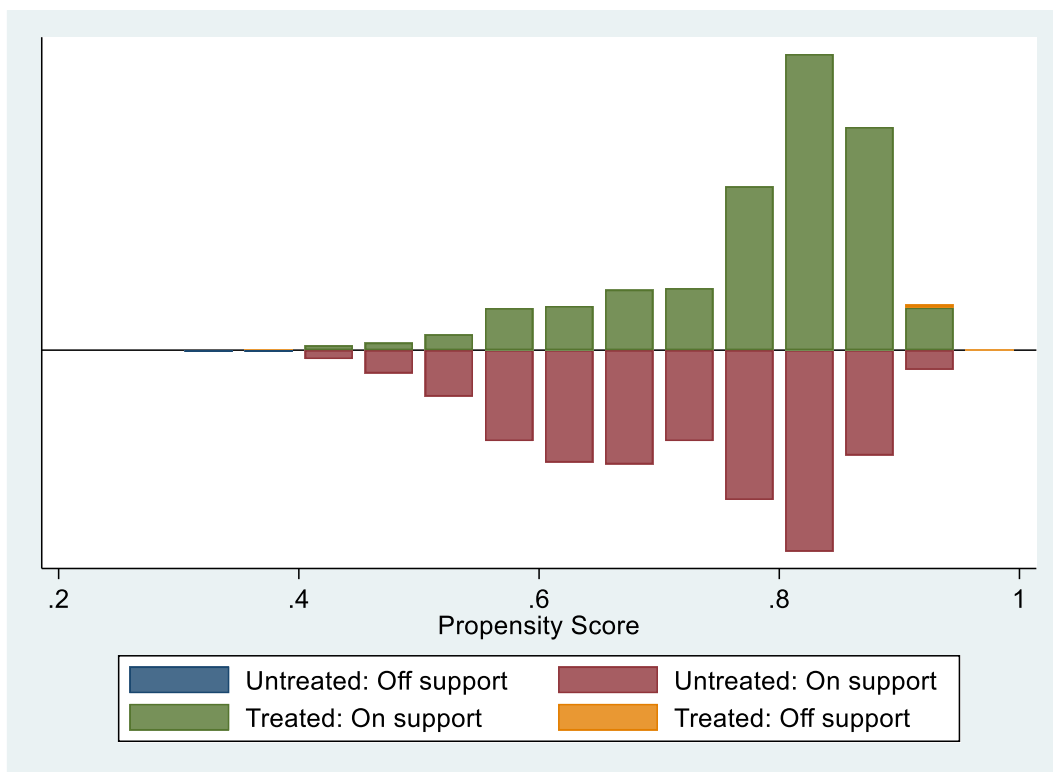


Figure 2. Common support of the propensity score.

3.5 Endogeneity analysis

The regression model may suffer from omitted variable bias due to the difficulty in collecting all relevant factors influencing farmers' income. Additionally, there exists the possibility that farmers' income could also affect the level of female education; for instance, wealthier farmers may be more likely to marry women with higher educational attainment. This potential mutual causality raises concerns about the endogeneity of female education level (*edu*) in relation to household income. To assess whether *edu* is an endogenous variable, we conducted the Durbin-Wu-Hausman test. The results, presented in Table 9, show a chi-square value of 10.727 with a probability of accepting the null hypothesis at 0.001. This indicates that the null hypothesis of exogeneity is rejected at the 1% significance level, thereby supporting the alternative hypothesis that *edu* is indeed an endogenous variable.

To address the endogeneity issue stemming from potentially omitted variables, this study incorporates as many control variables as possible to mitigate the impact of missing data on the model. Furthermore, to resolve the endogeneity problem arising from mutual causation, it is essential to identify instrumental variables that are correlated with the independent variable but not with the dependent variable. Following the approach of Xue (2022), we selected the average education level of rural women in the county, excluding the sample (*iv-edu*), as the instrumental variable. This variable is correlated with the family's female education level (the independent variable) but not with household income (the dependent variable), thus satisfying the criteria for a valid instrumental variable.

To confirm that the instrumental variable is not weak, we conducted additional tests. The findings in Table 9 indicate no issues with weak instruments, as Shea's partial R-squared is 0.0230 and the minimum eigenvalue statistic is 55.8903.

Table 9 compares the Ordinary Least Squares (OLS) and Instrumental Variable (IV) estimates of *edu* and household income. Column (1) presents the OLS regression results, while Column (2) displays the Two-Stage Least Squares (2SLS) regression results incorporating the instrumental variable (*iv-edu*).

Table 9. Comparison of the OLS and IV estimates

	(1) OLS	(2) 2SLS
edu	0.032*** (0.004)	
iv-edu		0.118*** (0.024)
health	0.130*** (0.042)	-0.074 (0.072)
pty	0.232 (0.153)	-0.055 (0.167)
size	-0.086*** (0.008)	-0.099*** (0.010)
finance	0.049*** (0.004)	0.044*** (0.005)
fix	0.009** (0.004)	0.008** (0.004)
fhouse	0.154*** (0.024)	0.117*** (0.029)
Constant	7.260*** (0.286)	7.377*** (0.311)
Observation	2383	2310
R-squared	0.222	0.079
Chi-square		10.727(p=0.001)
Shea's partial R-squared		0.0230
Minimum eigenvalue statistic		55.890

Notes: Significance levels for P-values are denoted as follows: *** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10 . Standard errors in parentheses.

Source: Own

3.6 Heterogeneity analysis

3.6.1 Heterogeneity analysis based on East, Central, and Western grouping

Table 10 presents the results of the regional regression analysis, which considers locational variables from the eastern, central, and western districts. The findings indicate that rural women's educational attainment significantly affects rural household income across all three regions. The details are as follows: In the eastern region, the edu coefficient is 0.036 (significant at the 1% level), in the central region it is 0.020 (significant at the 5% level), and in the western region it is 0.032 (significant at the 1% level).

Notably, the coefficient for edu in the eastern region is larger than those in the central and western regions, suggesting that the eastern region has a higher marginal contribution rate of female education to household income. One possible explanation for this disparity is that the eastern region has a more developed economy compared to the central and western regions, along with superior resources and environmental conditions. In this context, highly educated women are better positioned to leverage these advantages and fully utilize their capabilities. Conversely, the lower contribution of female education in the central region may be attributed to economic constraints, cultural barriers, which limit job opportunities for educated women. Meanwhile, the western region, while showing a significant positive effect, reflects emerging opportunities that are beginning to recognize the value of women's education, albeit at a slower pace than in the eastern region.

Table 10. Estimation outcomes for the subsample models: East, Central, West

	(1) East	(2) Central	(3) West
edu	0.036*** (0.007)	0.020** (0.008)	0.032*** (0.008)
health	0.122* (0.070)	0.119 (0.094)	0.138** (0.060)
pty	0.176 (0.218)	0.629 (0.425)	-0.002 (0.156)
size	-0.107*** (0.012)	-0.053*** (0.015)	-0.081*** (0.016)
finance	0.062*** (0.008)	0.036*** (0.007)	0.044*** (0.006)
fix	0.005 (0.006)	0.014* (0.007)	0.013** (0.006)
fhouse	0.129*** (0.026)	0.107*** (0.032)	0.228*** (0.060)
Constant	7.592*** (0.297)	7.841*** (0.393)	6.332*** (0.718)
Observation	875	698	799
R-squared	0.264	0.106	0.295

Notes: Significance levels for P-values are denoted as follows: *** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10 .
Standard errors in parentheses.

Source: Own

3.6.2 Heterogeneity analysis based on household income classification (Low, Mid, and High)

To investigate the consistency of the relationship between women's education and household income across various family income situations, the samples are categorized into three groups: low-income families, middle-income families, and high-income families, based on per capita income. The results of the regression analysis for these three subsamples are displayed in Table 11.

Table 11. Estimation results of the subsample models: Low, Mid, High

	(1) Low	(2) Mid	(3) High
edu	-0.003 (0.009)	0.002 (0.002)	0.012*** (0.004)
health	0.126** (0.064)	0.018 (0.016)	-0.036 (0.038)
pty	-0.097 (0.101)	0.176*** (0.055)	0.055 (0.109)
size	0.014 (0.015)	-0.004 (0.004)	-0.048*** (0.007)
finance	0.020*** (0.007)	0.001 (0.002)	0.018*** (0.003)
fix	0.015** (0.006)	0.001 (0.002)	0.003 (0.003)
fhouse	0.117** (0.053)	0.007 (0.004)	0.042*** (0.014)
Constant	6.839*** (0.622)	9.339*** (0.055)	9.734*** (0.170)
Observation	808	791	784
R-squared	0.073	0.014	0.108

Notes: Significance levels for P-values are denoted as follows: *** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10 . Standard errors in parentheses.

Source: Own

Table 11 shows the estimated outcomes for low-, middle-, and high-income households in columns (1), (2), and (3), respectively. The regression analysis reveals that while the effect of female education on household income is highly significant in high-income households (edu coefficient = 0.012, significant at the 1% level), it is not significant in low-income (edu coefficient = -0.003) and middle-income families (edu coefficient = 0.002). The disparity in the impact of women's education on household income across different income levels may be attributed to several interrelated factors. In low-income households, limited productive capital, social resources, and a supportive environment restrict the effective utilization of women's education, making it difficult for them to leverage their qualifications for economic gain. Additionally, the immediate need for income often forces women to prioritize short-term labor over opportunities that align with their education, leading to underemployment. Cultural norms and societal expectations further limit women's workforce participation in both low- and middle-income families, reducing the economic benefits of their education. In contrast, high-income households provide a more conducive environment where women's education can significantly contribute to household income, thanks to greater access to resources, networks, and opportunities that enable educated women to fully utilize their skills.

CONCLUSION

This study employs an econometric model to conduct an empirical analysis using the CFPS2018 data, demonstrating that rural women's educational attainment significantly influences household income. Notably, this effect varies across different geographical locations and income brackets. The Sobel test was utilized to investigate three mechanisms that may mediate the relationship between women's education and rural household income: off-farm employment, entrepreneurial capability, and business social capital. Additionally, robustness and endogeneity analyses were performed to ensure the validity of the empirical findings. The key findings of this research are as follows:

1. After controlling for individual and family characteristics, the results indicate a significantly positive relationship between the education level of rural women and household income. This suggests that higher educational attainment among women is associated with increased household income levels.

2. The impact of rural women's education on household income exhibits heterogeneity based on geographical and economic contexts. Specifically:

1) The influence is more pronounced in the eastern region compared to the central and western areas.

2) High-income families experience a greater positive effect from women's education than low-income families.

3. The relationship between rural women's education and household income is significantly mediated by factors such as entrepreneurial capability and social capital, while off-farm employment was found to be insignificant. This indicates that enhancing family management skills and fostering social support networks may be effective strategies for maximizing the economic benefits of women's education.

Based on the theoretical analysis and empirical findings, this paper offers several policy implications:

First, it is essential to encourage rural women to pursue higher education, as this can lead to increased family income and contribute to reducing income inequality.

Second, targeted interventions should be developed for low- and middle-income households, particularly in the western and central regions. Implementing supportive policies, such as educational subsidies and skill development programs, can enhance the effectiveness of leveraging women's education to improve family income.

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