

Article

Has the Household Old-Age Burden Affected Farm Household Incomes? Evidence from a Survey of Chinese Farm Households

Hongwei Lu ^{1,†} , Mingjie Gao ^{1,†}, Guojing Li ¹, Tingting Li ^{2,*} and Qiyu Luo ^{1,*}

¹ State Key Laboratory of Efficient Utilization of Arid and Semi-Arid Arable Land in Northern China, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China; 82101221355@caas.cn (H.L.); gaomingjie@caas.cn (M.G.); liguojing@caas.cn (G.L.)

² Institute of Agricultural Economy and Development, Chinese Academy of Agricultural Sciences, Beijing 100081, China

* Correspondence: 82101221340@caas.cn (T.L.); luociyou@caas.cn (Q.L.)

† These authors contributed equally to this work.

Abstract: Income increase is an important way to achieve comprehensive human development and to escape from poverty, and the growing aging problem in rural China poses a challenge to farm household income increase. In order to gain a deeper understanding of the impact of China's rural old-age burden on farm household income, this paper empirically examines the impact and mechanism of household old-age burden on farm household income based on the data from the 2023 micro-farm field survey of China's Henan Province, utilizing linear regression modeling and mediation effect modeling, filling the research gaps in the related fields. The results of the study found that, firstly, family old-age burden has a significant impact on the income of farm households, and that the heavier the family old-age burden, the lower the total income of farm households. Secondly, from the results of the heterogeneity of the impact, the poorer the health condition, the greater the negative impact of family old-age burden on farm household income. Old-age burden has a greater impact on high-income farm households than on low-income farm households, and old-age burden has a significant impact on the income of part-time farm households, while the impact is not significant on purely farm and non-farm households. Thirdly, the heavier the household old-age burden, the more unfavorable it is to the non-farm employment of farm households, thus affecting the income capacity of farm households. Finally, corresponding countermeasures and recommendations are put forward in three areas, namely, the continuous improvement of the social old-age security system, the realization of the function of the social old-age mechanism as an old-age pocket for key special groups, and the improvement of the social flexible employment mechanism.

Keywords: aging; old-age burden; farm household income; non-farm employment; mediating effects



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1. Introduction

Raising the income level of the population has always been an important goal in China's endeavor to build a modern socialist State. The Chinese government pointed out in the Outline of the Fourteenth Five-Year Plan and Vision 2035 that it is necessary to achieve the basic synchronization between the growth of residents' disposable income and the growth of gross domestic product (GDP). Generally speaking, since the reform and opening up of the economy, China's residents' income has achieved a sustained and rapid growth, but there is still a big gap between residents' income from the perspective of urban and rural areas [1], rural residents' income grows slower, and the absolute gap between urban and rural incomes is always at a high level. According to the National Bureau of Statistics (NBS), the per capita disposable incomes of China's urban and rural residents in 2023 will be RMB 51,821 and RMB 21,691, respectively, with an income gap of 2.39 times, and there are still about 550 million people living in rural areas in China, making the realization of coordinated growth of urban and rural residents' incomes a major challenge for China's

economic development [2,3]. At the same time, along with the rapid growth of China's economy and the improvement of medical technology, the average life expectancy has been greatly extended, and due to the decreasing birth rate, China is now facing a serious problem of population aging [4,5]. According to the data of the seventh population census, the proportion of Chinese people aged 60 and above has reached 18.7%, an increase of 8.34% from 2000, and China has entered the stage of deep aging [6]. Moreover, with the development of urbanization and a large number of young and strong labor force moving to cities, China's rural areas are facing even more severe challenges of population ageing [7,8]. According to Figure 1, from 2000 to 2021, the proportion of the rural population in China's total population will continue to decline, from 63.8% in 2000 to 35.3% in 2021, with the proportion of the rural population in the total population nearly halved. At the same time, the aging rate of the rural population continues to rise, from 7.35% in 2000 to 18.59 in 2021, the aging rate of the rural population has nearly tripled, exceeding the aging level of the urban population by nearly 8 percentage points [9].

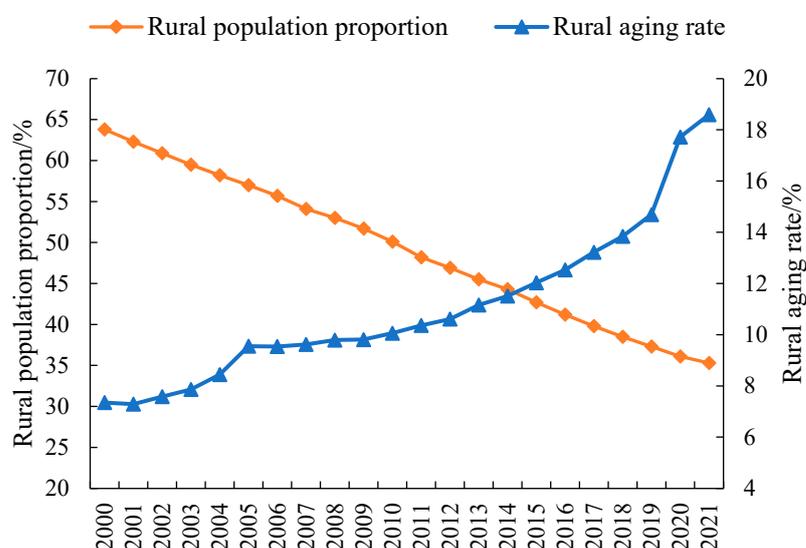


Figure 1. China's rural population as a proportion of total population and aging rate, 2000–2021.

Unlike foreign countries where social old-age care is the main mode of old-age care, China is deeply influenced by Confucianism. Family old-age care has always been a traditional function of the family, and it is the traditional obligation of children to support the elderly [10,11], and there are still a majority of families in China in which the elderly are completely dependent on the family old-age care model [12]. Under the traditional family model of old-age care, when children take on the obligation to support the elderly [13,14], they will reduce their personal work accordingly, and young people need to make a trade-off between the spiritual benefits of caring for the elderly and the reduced income due to the reduction of work [15]. The aging of the population also aggravates the burden of family old-age care, and family members will further increase precautionary savings as a result of reduced working hours, which weakens the ability of the younger generation to invest in human capital [16,17]. On the other hand, under the aging population and the relaxation of fertility policies, the main labor force of young and middle-aged families has to take care of their elderly parents on the one hand, and raise their minor children on the other [18]. The hidden opportunity cost of caring for the elderly and children is large, and as the number of elderly people in the family increases, the time spent by children in caring for the elderly increases, which reduces the working hours of the labor force, and thus affects their ability to increase their income [19].

Currently, there have been many studies on the constraints on the growth of farmers' income in academia [20–30]. Classification is mainly focused on the following aspects: first of all, non-farm employment, many scholars use empirical research methods to explore the

non-farm employment will have a significant impact on improving farmers' income [31]. Owing to the relatively limited resources of arable land, it is difficult for farmers to rely solely on agricultural production to realize sustained growth in income, and non-farm employment, as an important way of expanding the sources of income of farmers, has an important impact on the increase of farmers' income [32]. Secondly, human capital factors, the level of farmers' human capital significantly affects the nature of their work and their ability to generate income [33–35]. Compared with less-educated farmers, farmers with higher education tend to have certain advantages in the efficiency of agricultural production and operation and the nature of non-farm employment [36,37], and the level of human capital significantly affects their agricultural production decision-making behavior and non-farm employment behavior, which in turn significantly affects their income-generating capacity [38–40]. Other scholars have found that the factor of rural public investment is also an important factor influencing the increase in farmers' income [41]. Another study found that rural public investment factors are also important factors affecting farmers' income increase [41], and government investment in rural public investment will significantly affect agricultural production conditions and rural business conditions, reduce the transaction costs of farmers' agricultural production, and improve the efficiency of agricultural production and operation. The improvement of rural transport facilities has a direct and significant impact on farmers' ability to broaden their income channels and increase their sales channels [26,42,43]. Finally, the organizational factors: some scholars have found that joining co-operatives can improve the degree of organization of farmers [44,45], which has an important impact on farmers' ability to improve the negotiation position in the market for agricultural products, reduce the transaction cost of agricultural production, and improve the efficiency of agricultural production. important impact. In addition, some scholars have explored the impact of household registration system on the income of farm households [46].

The above studies have explored the influencing factors of farm household income growth from different perspectives, which is of some significance for understanding the constraints of farm household income growth. However, with the gradual deepening of population aging, economic development will be significantly affected [47–52], and the increase in the burden of old-age for farm households and the decrease in labor supply have seriously affected the improvement of farm household income [47]. From the perspective of agricultural production, with the deepening of population aging, the number of laborers engaged in agricultural production decreases, which in turn affects the income of farming households. At the same time, compared with the young labor force, the aging labor force has poorer physical condition, knowledge system, cognitive ability, and learning ability [53,54], which is not conducive to the progress of agricultural technology [55], and seriously affects labor productivity, and consequently, the efficiency of agricultural output [56], and significantly reduces the share of labor income [57]. In addition, China is in a very different situation from developed Western countries when facing the aging problem. Western developed countries have a better social security system [58,59], and there is no mechanism for the micro-impact of old-age burden on farmers' income. In general, the past literature has mainly focused on the impact of education, investment, and institutional factors on the growth of farmers' income [50], while paying less attention to the impact of the deepening burden of family old-age on their income, and there is a dearth of studies specifically on rural areas, and there is a lack of systematic theoretical analysis and empirical research on the impact of family old-age burden on the income of farm households from a micro perspective.

Based on the reality of the aging of China's rural population and the aggravation of the burden of family old-age care and the shortcomings of existing studies, the following questions are raised: Does the burden of family old-age care affect the income of farm households in the context of the aging of the population? Through which path does the burden of family old-age care affect income? And what are the heterogeneous effects on different groups? In the context of the deepening aging of China's rural population,

an empirical study of the mechanism and path of the impact of China's rural residents' burden on their incomes can provide an in-depth understanding of the impact of China's rural burden on the incomes of rural residents, and is of great significance for scientifically grasping the issue of increasing incomes of farm households in the context of aging.

The rest of this study is structured as follows: Section 2 carries out a theoretical analysis of the impact of family old-age burden on farm household income and puts forward a research hypothesis. Section 3 describes in detail the data sources, modelling methods, and variable indicator settings of the study. Section 4 presents the results related to the benchmark regression, robustness test, heterogeneity and mediation effect test of this study. Section 5 presents the discussion and conclusion of the paper and suggests relevant countermeasures.

2. Theoretical Analysis and Research Hypotheses

The income growth of farm households comes from the broadening of income channels and the improvement of work efficiency per unit of time. Most studies have concluded that non-farm employment is effective in raising total farm household income [60,61]. When the labor force participates more in the labor market, the labor force is faced with employment options outside of agriculture. Rational farm households will allocate labor resources to higher yielding sectors and regions, and when more laborers in farm households participate in non-farm employment, it will increase income to a certain extent [62]. And age is one of the most important factors affecting employment choices. With age, the accumulation of experience and knowledge of individuals will increase [63]. Some studies have shown a U-shaped relationship between risk aversion and age [64,65], while employment decisions are related to risk tolerance [66], and there may be an inverted "U"-shaped relationship between age and nonfarm employment. As risk aversion increases with age [67], an increase in the share of the elderly population can lead to households being less risk tolerant, more risk averse, and risk averse [65]. In addition, health status is also an important factor influencing household risk preferences, with households with more elderly people likely to have poorer health on average, leading to greater risk aversion [68]. Agricultural income is a part of farm household income, and age is directly related to farm productivity of farm households. However, currently, the main source of income for farm households is non-farm employment, and agriculture is becoming a smaller and smaller share of total farm household income; therefore, the focus should be on the impact of household old-age burden on non-farm employment. In addition, the aging labor force is in a disadvantaged position in terms of access to non-farm employment information and employment channels, knowledge and skills, and relationship networks, and it is difficult for them to make non-farm transfers on their own. Therefore, an increase in household old-age burden may change their risk preferences, thus affecting household non-farm employment decisions [69].

China has been deeply influenced by Confucian culture for thousands of years, and old age has been a traditional function of the family, and the intergenerational reciprocity mechanism within the family still plays a great role [70,71]. Moreover, due to the lack of infrastructure and social services related to elderly care in rural China, traditional family caregiving is still the main way of rural elderly care, and it is still very common for children to give time care and financial help to their elderly parents [72], and some studies have shown that more than ninety percent of elderly people need to be cared for by their children [73,74]. Firstly, caring for the elderly is a time-intensive activity with hidden opportunity costs; the more elderly there are in a family, the more time children usually need to spend caring for them, which may cause them to reduce their employment activities. In addition, in order to care for aging parents, children have a higher need for flexibility in time allocation, and agricultural employment can go some way to meeting this need of families [75,76]. Secondly, there are explicit economic costs of supporting the elderly. The more elderly there are in a household, the more its members may tend to choose to work nearby to reduce the cost of caring for their parents. The rural household

as a decision-making unit with adult family members in a net-paying position carries the dual pressure of caring for the elderly and raising children [77], and the employment decisions of its members are affected by the number of elderly in the household, requiring multiple trade-offs between family old-age care and employment. Children caring for the elderly prevents labor from being transferred to other sectors, discouraging children from participating in non-farm employment, which in turn affects the growth of farm household income. The burden of old-age care for the elderly in the household acts as a disincentive to labor mobility, i.e., the burden of old-age care for the family will inhibit the growth of household income by hindering labor mobility. Taken together, the old-age burden reduces total household income by affecting the non-farm employment of household members [78].

In summary, in conjunction with Figure 2 below, the following research hypotheses are proposed.

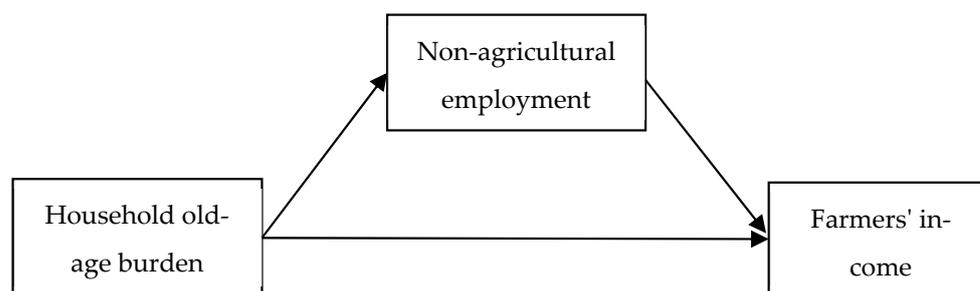


Figure 2. Mechanism of household old-age burden impact on farm household income.

- H1.** *Other things being equal, old-age burden has a negative effect on farm household income.*
- H2.** *All other things being equal, old-age burden has a negative effect on non-farm employment of farm households.*
- H3.** *Old-age burden affects the level of total income by affecting the non-farm employment of farm households.*

3. Data sources and Research Methodology

3.1. Data Source

The empirical data used in this study come from a household questionnaire survey conducted in July–August 2023 in Luoshan County, Xinyang, China. Henan Province is a typical populous province in China, with the third largest population in the country, and faces a serious problem of population aging, with the proportion of people aged 60 and above reaching 18.08%. The proportion of people aged 60 and above has reached 18.08%, and the income ratio between urban and rural residents in Henan Province has reached 2.26:1. Like many other provinces in China, the countryside of Henan Province is facing serious problems of aging and increasing the income of farm households. Luoshan County is located in the south of Henan Province, at the northern foot of Dabie Mountain and on the southern bank of Huai River, with diverse topography and geomorphology, and is a large agricultural county with a population of 780,000 people, which is highly typical in the country. This paper adopts a combination of stratified progressive sampling and random sampling to select farm households, and the specific sampling process is as follows: 2 to 3 townships are randomly selected, 1 to 3 villages are selected from each township, and 40 to 80 farm households are selected from each village. A total of 420 questionnaires were distributed, and after deleting the data of missing data, outliers, and other problematic data, the final sample size was 401, with an effective rate of 95.5%. The main method of the survey was face-to-face interviews, which include small farmers as well as large planting

households, and the content of the research mainly includes the basic situation of planting households' families, agricultural production, employment, and household consumption. The distribution of villages is shown in Table 1 below.

Table 1. Distribution of villages in the research sample.

Village Name	Number of Questionnaires	Terrain Characteristics
Wan He village	42	Hilly
Xiao Fan village	70	Mountainous
Tian Qiao village	52	Mountainous
Zhao Shan village	43	Plains
Tian Yan village	79	Plains
Tan Gang village	55	Hilly
Zhang Gang village	60	Hilly

3.2. Variable Selection and Data Description

1. **Explained variables:** The explained variable in this paper is the annual income of farm household. Considering the problem of excessive sample variance due to the wide income gap among farm households [79], the annual income of farm households is added by one and then logarithmized. In addition, considering that the composition of the annual income of agricultural households may be complex and therefore there may be bias in the measurement, and non-agricultural income is an important aspect of the measurement of household income, this paper also selected non-agricultural income as an explained variable in order to carry out the robustness test. The specific settings are shown in Table 2.
2. **Core explanatory variables:** The key to validating the role of old-age burden on farm household income is to analyze the differences in the impact of the number of elderly people in the household relative to the number of people in the labor force on household income. Therefore, in this paper, the ratio of the number of older people in the household aged 60 years or older to the number of people in the labor force between the ages of 18 and 60 years is selected to represent the core explanatory variable of old-age burden. In addition, for the consideration of the robustness of the estimation results, this paper narrows the sample to a sample of households with the head of the household aged 45–70 years old as a way to perform the robustness test. The specific settings and descriptive statistics of the core explanatory variables are shown in Table 2.
3. **Control variables:** Considering that the household income of farming households is affected by many factors, in order to ensure the scientific and rigorous research, combined with the relevant research results [80–82], the individual characteristics of farming households (age, education, occupation, marital status) and the characteristics of farming households (total household population, total household labor force, household acres of arable land, acres of arable land transfer), as well as the village economic situation (per capita income, higher than the county average is “high”, lower than the county average is “low”) and other relevant variables as control variables in the model. The specific meanings of the control variables and their descriptive statistics are shown in Table 2.

Table 2. Variable definitions and descriptive statistics.

Variables		Definition	Mean	SD
Explained variable	Household income level	Gross annual household income (10,000 yuan)	9.577	6.217
Explanatory variable	Old-age burden	Number of persons over 60 years of age in the household/number of persons between 18 and 60 years of age	1.016	0.684
	Sex	Sex of head of household (1 = male, 0 = female)	0.776	0.418
Control variables	Age	Age of head of household (years)	59.815	12.788
	Educational level	Educational attainment of head of household (illiterate = 1, primary school and below = 2, junior high school = 3, secondary school and high school = 4, college and above = 5)	2.611	0.845
	Occupation	Occupation of the head of household (enterprise worker = 1, farmer = 2, commercial service worker = 3, self-employed worker = 4, migrant worker = 5, school student = 6)	2.848	1.562
	Marital status	Marital status of head of household (unmarried = 1, married = 2, divorced = 3, widowed = 4)	2.092	0.514
	Family size	Total household size (persons)	4.910	1.882
	Labor force size	Total household labor force (persons)	2.566	1.215
	Land size	Cultivated land area of the family (acres)	5.979	15.492
	Land Transfer	Area of arable land transferred (acres)	3.789	17.300
	Village Economy	Level of village economic development (higher = 1, lower = 0)	0.509	0.501
	Mediator variable	Non-farm employment	Household head engaged in non-farm employment = 1, otherwise = 0	0.284

3.3. Modelling Approach

3.3.1. Ordinary Least Square Method

In order to verify the impact of old-age burden on farmers' household income and draw on relevant research results, this paper constructs a model of the impact of old-age burden on farmers' household income. Considering that the explained variable is annual household income, this paper mainly constructs a linear regression model and adopts OLS estimation method to analyze the influencing factors of agricultural household income, and its benchmark model can be set as follows:

$$Y = \beta_0 + \beta_1 FD + \beta_2 Control + \varepsilon \quad (1)$$

where Y denotes the annual income of farm household, FD is the core explanatory variable, which denotes the burden of family old-age burden; at the same time, combining with the existing studies and considering the availability of data, the control variable (including gender, age, education level, occupation, marital status, total household size, total household labor force, acres of household cultivated land, and acres of cultivated land transferred) is added to Equation (1), β_0 is the constant term, β_1 and β_2 are the coefficients of the explanatory variables, and ε is the random perturbation term.

Based on the previous analysis, this paper removes the negative samples and then takes the logarithm after adding 1 to the annual household income, so the model becomes:

$$\ln(Y + 1) = \beta_0 + \beta_1 FD + \beta_2 Control + \varepsilon \quad (2)$$

3.3.2. Mediating Effect Model

In order to test the mechanism of the old-age burden on the income of farm households, this paper draws on the steps of the mediation effect test proposed by Wen et al. (2014) [83] to verify the intermediate impact mechanism. The specific steps are as follows.

Firstly, test the total effect of the impact of the old-age burden on the income of farm households:

$$Y_{it} = \alpha_0 + \alpha_1 X_{it} + \sum \alpha_i X_i + u_i + \varepsilon_{it} \quad (3)$$

Secondly, the total effect of old-age burden on the impact of the mediating variables is tested:

$$Mid_{it} = \beta_0 + \beta_1 X_{it} + \sum \beta_i X_i + \gamma_i + \varepsilon_{it} \quad (4)$$

Thirdly, the mechanism of the mediating variables in the impact of old-age burden on farm household income is tested:

$$Y_{it} = \varphi_0 + \varphi_1 X_{it} + \varphi_2 Mid_{it} + \varphi_3 Control + \omega_i + \varepsilon_{it} \quad (5)$$

where Y_{it} is the farm household income, X_{it} is the old-age burden, X_i is the set of control variables (personal characteristics, family characteristics, etc.), Mid_{it} is the mediator variable, α , β , and φ are the coefficients to be estimated, u , γ , and ω are the unobservable individual heterogeneity, and ε_{it} is the random perturbation term.

4. Results and Analysis

4.1. Baseline Regression

In order to investigate the relationship between old-age burden and farm household income and its interaction mechanism, the article firstly constructs a linear regression model for preliminary research. In order to increase the validity of the model regression results, the model results need to be tested. The maximum value of VIF was found to be 4.41, and the minimum value was found to be 1.13, which indicates that there is no significant multicollinearity problem among the variables since the maximum value does not exceed 10. In addition, White's test was used to test the heteroskedasticity of the model results and it was found that the p -value was much greater than 0.05, indicating that there is no heteroskedasticity in the model variables. From the regression results, it is clear that (1) in Table 3 examines the direct impact of old-age burden and farm household income, and the results show that, without introducing a series of control variables, old-age burden has a significant negative impact on farm household income at the 1% significance level, which indicates that the higher the household old-age burden, the greater the negative impact on farm household income, i.e., the greater the proportion of elderly people in the household compared with the labor force the lower the total income of the farm household. (2) Examining the impact of the introduction of individual variables of the burden of old age on the income of agricultural households, the results also show that the burden of old age has a significant negative effect on the income of agricultural households at the 1% significance level, and that gender, age, and literacy also have a significant impact on the income of agricultural households, and the direction of the impact is positive. Occupation has the same significant effect on the income of farm households, indicating the significance of the effect of changes in different occupations on the ability of farm households to generate income. In model (3), family characteristics are further introduced as explanatory variables to explore the impact of old-age burden on farm household income, and the estimated coefficients are still negative, but the coefficient value and goodness-of-fit R^2 increase relative to model (1) and (2), and the total number of family laborers and the number of cultivated land transferring acres pass the significance test. This indicates that whether the impact of burden on farm household income is explored alone or individually when family characteristics variables are introduced, the negative impact of burden on farm household income is more significant, and the explanatory power of the model is enhanced by the addition of individual and family characteristics, and the research hypothesis H1 is verified. However, the gender, age, and occupation of individuals, as well as the total number of laborers in the household and the number of acres of cultivated land transferred, can mitigate the negative effect of old-age burden on farm household income. These variables reflect the work and income-generating capacity of individuals and households, and are significant in easing the old-age burden constraint for farm households.

In terms of individual characteristics, males have certain advantages over females in work, individual age reflects the accumulation of work experience and seniority, and the level of education has a significant effect on individual income-generating capacity. For the overall characteristics of the household, the number of household laborers can reflect the household income-generating capacity, and the number of arable land transfers reflects the degree of household's dependence on agriculture, which reflect the level of work or capacity of an individual or a household, and thus have a significant effect on the income of a household. Therefore, they all have a significant effect on the income of farming households.

Table 3. Baseline regression results.

Variables	(1)		(2)		(3)	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
Old-age burden	−2.266 ***	0.410	−2.187 ***	0.412	−0.261 **	0.454
Sex			1.391 **	0.711	1.635 **	0.648
Age			0.079 ***	0.028	0.069 ***	0.026
Educational level			0.816 **	0.410	0.458	0.375
Occupation			0.418 **	0.187	0.410 **	0.170
Marital status			−0.255	0.588	0.295	0.543
Family size					−0.004	0.169
Labor force size					2.056 ***	0.317
Land size					−0.011	0.034
Land Transfer					0.084 **	0.035
Area variables	Controlled		Controlled		Controlled	
Constant	10.445 ***	0.502	1.759	2.795	−5.502 **	2.667
Sample size	401		401		401	
F-statistic	30.58		8.13		15.03	
Adj R-squared	0.069		0.097		0.260	

*** $p < 0.01$, ** $p < 0.05$.

4.2. Robustness Check

In order to verify the robustness of the impact of old-age burden on the income of farm households, this paper will carry out the robustness test by replacing the dependent variable, replacing the model and reducing the sample size in three ways. Firstly, replace the dependent variable. This paper uses non-farm income to replace the total farm household income variable for re-estimation. The results in column (1) in Table 4 show that the old-age burden has a significant negative effect on non-farm income, indicating that the old-age burden significantly suppresses the non-farm income of farm households, confirming the robustness of the benchmark regression results. Secondly, replace the estimation model. The Ologit model is re-estimated, and farm households are categorized into “high-income”, “middle-income”, and “low-income” according to their income levels, and the results of Table 4 (2) show that the old-age burden significantly affects the non-farm income of farm households, also in a negative direction, which is basically consistent with the results of the benchmark regression. Thirdly, replace the sample set. The paper intercepts by age quartile, due to the fact that the middle and older age groups are more likely to face support burdens. Therefore, only the sample of farmers aged 45–70 is retained for robustness testing. The results in column (3) of Table 4 show that the old-age burden can also significantly and negatively affect the income of farm households, which further confirms the reliability of the regression results of this paper.

Table 4. Robustness test.

Variables	(1)		(2)		(3)	
	Alternate Dependent Variable Coef.	Std. Err	Replacement Model Coef.	Std. Err	Narrow Down THE Sample Coef.	Std. Err
Old-age burden	−0.643 ***	0.206	−2.055 ***	1.339	−2.168 ***	0.462
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Area variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Constant	1.922 ***	0.252	12.169 ***	0.724	10.463 ***	0.540
Sample size		401		401		401
F-statistic		9.78		36.22		21.99
Adj R-squared		0.022		0.081		0.070

*** $p < 0.01$

4.3. Heterogeneity Analysis

This paper analyzes the heterogeneity of the impact of old-age burden on farm household income based on the heterogeneity of individual health status, the heterogeneity of farm household income between high, middle and low levels, and the heterogeneity of farm household part-time employment status perspectives, respectively. As can be seen in Table 5, In terms of the heterogeneity of individual health status, the impact of old-age burden on farm household income passes the significance test for both healthy and less healthy individuals, but the negative effect of old-age burden on farm household income is greater for less-healthy individuals, suggesting that the old-age burden of a household has a greater negative impact on its income-generating capacity when its health status is in trouble. In terms of the heterogeneity of farm household income, farm households are categorized into “high-income”, “middle-income”, and “low-income” according to their income levels, and the impact of the old-age burden on farm household income is explored in the context of heterogeneity of income levels. The results show the old-age burden on the income of farm households in the cases of heterogenous income levels. The results show that the impact of old-age burden on the total income of farm households at different income levels is relatively significant.

Table 5. Heterogeneity regression result.

Variables	Individual Heterogeneity			Income Heterogeneity		Household Heterogeneity		
	(1) Health	(2) Less Healthy	(3) Low Income	(4) Middle Income	(5) High Income	(6) Pure Farmers	(7) Part-Time Farmers	(8) Non-Farmer Household
Old-age burden	−2.082 *** (0.433)	−3.045 ** (1.225)	−1.800 *** (0.272)	−2.151 *** (0.302)	−2.571 *** (0.0621)	−3.609 (0.0864)	−2.333 *** (0.401)	−1.061 (2.216)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Area variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Constant	10.263 *** (0.505)	11.581 *** (1.740)	6.599 *** (0.511)	9.453 *** (0.288)	12.856 *** (0.684)	9.745 *** (2.878)	10.628 *** (0.489)	8.844 *** (2.890)
Sample size	327	74	125	162	114	36	307	58
Adj R-squared	0.064	0.068	0.062	0.054	0.044	0.070	0.086	0.007

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$

As for the size of the impact of old-age burden on different income levels, it can be seen that the impact of old-age burden on high-income households is greater than that on low-income households, and the burden of old-age burden constrains the ability of high-income households to increase their incomes, which further confirms the robustness of the impact of the burden of old-age burden on the incomes of agricultural households. In terms of heterogeneity of part-time farming households, the impact of the old-age burden on the income of part-time farmers passes the significance test, while the impact on purely farming and non-farming households fails the significance test, suggesting that the impact of the old-age burden on the income of different types of farmers is also different. The

impact of old-age burden on total income is more pronounced for farmers who need to engage in both non-farm work and agricultural production. When the number of old people in their households is high relative to the number of laborers, the heavier old-age burden on laborers affects their ability to engage in non-farm employment, causing their incomes to fall further. For purely agricultural or non-agricultural households, on the other hand, they do not need to change their status between non-agricultural and agricultural labor, and it is easier for them to take care of the elderly in a more stable manner, so the impact of the old-age burden on them is not significant.

4.4. Mechanism Testin—Mediation Effects Test

In order to further analyze in depth how the old-age burden affects the income of farm households through mediating variables, the article empirically tests the mediating effect of the old-age burden on the total income of farm households through non-farm employment according to the mediating effect test method, and further verifies Hypothesis 3. As can be seen in Table 6, the estimated coefficient of the impact of old-age burden on the total income of farm households in column (1) is significantly negative, indicating that old-age burden has a more significant negative impact on the total income of farm households. The estimated coefficient of the impact of old-age burden on non-farm employment of farm households in column (2) is significantly negative, indicating that old-age burden has a more significant negative impact on non-farm employment of farm households, and the research hypothesis H2 is tested. The estimated coefficients of the old-age burden and the mediating variable nonfarm employment in column (3) pass the significance test, and the estimated coefficient of the negative old-age in (3) increases relative to model (1), indicating that nonfarm employment plays a mediating effect between old-age burden and farm income, and the research hypothesis H3 is tested. In addition, the article uses the Sobel test to verify the significance of this mediating effect. The test results show that the Z value of Sobel test is -4.242 , which passes the test of 5% significance level. This shows that the intermediary effect of non-farm employment is significant, in the process of the impact of the old-age burden on the income of farm households, non-farm employment plays an important intermediary role, which shows the transmission mechanism of “old-age burden \rightarrow non-farm employment \rightarrow farm household income”. That is, the old-age burden affects the total income of farm households by influencing the non-farm employment behavior of farm households, that is, the old-age burden affects the non-farm employment behavior of farm household labor, and the heavier the old-age burden, the more detrimental to the non-farm employment of labor, which affects the ability of farm households to earn income. The above mediation effect test results again prove that this article’s Hypothesis 3 is valid.

Table 6. Testing the intermediary effect of non-farm employment.

Variables	(1)		(2)		(3)	
	Household Income Coef.	Level Std. Err	Non-Farm Employment Coef.	Std. Err	Household Income Coef.	Level Std. Err
Old-age burden	-2.266^{***}	0.410	-1.623^{***}	0.382	-0.758^{***}	0.209
Non-farm employment					0.929^{***}	0.027
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Area variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Constant	10.445^{***}	0.502	8.524^{***}	0.468	2.525^{***}	0.338
Sample size		401		401		401
F-statistic		30.58		18.00		666.55
Adj R-squared		0.069		0.041		0.769
Sobel test			$Z = -4.242, p < 0.05$			

*** $p < 0.01$.

5. Discussion and Conclusions

5.1. Discussion

5.1.1. Similarities and Differences with Existing Studies

Population aging is one of the most important demographic phenomena of this century [84]. Against the background of deepening population aging in rural China, the age structure of the population in rural households is also undergoing profound changes. Restricted to the inadequacy of the social old-age security system and the family-oriented model of old-age [72], Chinese rural households are under tremendous pressure from the old-age burden, which will inevitably have an impact on their ability to generate income [76]. Based on the perspective of aging, this study investigates in depth the mechanism of the impact of family old-age burden on the income of rural households, and draws a number of conclusions of practical significance.

First of all, after controlling the variables, the family old-age burden still has a significant impact on the income of agricultural households, and it is also supported by the robustness test. It indicates that with the increase of family old-age burden, farm household income will decrease, and when the family old-age burden increases, supporting the elderly will further compress and occupy the labor force's employment time, which in turn affects the farm household's normal work income, which is also supported by relevant studies [25,32,39,42].

Secondly, according to the results of the heterogeneity analysis, it can be seen that health status, income level, and part-time employment status have significant heterogeneity in the impact of old-age burden on farm households. For poorer health farmers, the burden of old age further aggravates the reduction of their income, which further compresses the energy for work when they are in poorer health [5], and thus the impact of the burden of old age on the income of poorer health farmers is greater. For higher-income households, the time spent on supporting the elderly has a greater impact on their income when the burden of old age increases, which means that the opportunity cost of supporting the elderly is also higher for higher-income households. For part-time farmers, non-farm employment and agricultural production are often spatially divided, and an increase in the old-age burden further affects the duration of their non-farm employment, causing their farm income to be affected, which is somewhat similar to other scholars' studies [8,60,75].

Finally, the study concludes that household old-age burden has an impact on income by influencing the non-farm employment of farm households. In China, as a country with a small peasant economy where the economy of rural areas is still underdeveloped, the main way of income for most people in rural areas is non-farm employment [61]. And the increase of family old-age burden under the influence of Confucian filial piety culture has a profound impact on the non-farm employment of part-time farmers [85]. Henan Province, chosen for this study, is a highly representative province in terms of rural population aging and farm household income increase in China. In addition, as a traditional East Asian cultural circle, there are many countries such as Japan, South Korea, and other countries like China that are deeply influenced by the Confucian culture of small farmers, and which at the same time are facing the threat of population aging; the findings of the study on the impact of the burden of family old-age burden on the income of farm households in China are also of certain reference value to them.

Compared with existing studies, this paper may have the following four marginal contributions: (1) Based on China's family-based old-age model, we discuss the mechanism of the impact of old-age burden on farm household income from the perspective of family old-age burden, and clarify the impact of farm household old-age burden on the household income of different types of farm households. (2) From the perspective of non-farm employment, we discuss the mechanism by which the old-age burden affects the income level of farm households by influencing their non-farm employment. (3) From the perspectives of health, income, and part-time employment, this paper explores the heterogeneous effects of old-age burden on the income of farm households. (4) This paper also adopts the three ways of replacing the dependent variable, replacing the model and reducing the sample

size to carry out the robustness test, which greatly enhances the credibility of the research results. The above point provides new perspectives for possible future research related to the impact of household old-age burden on farm household income.

5.1.2. Limitations and Future Recommendations

Restricted by the availability of data on research indicators, there are still some areas for further expansion of research in this study. Firstly, because this study is based on the cross-sectional data obtained from the questionnaire survey of farmers, this study can only obtain the impact of the household old-age burden situation on the income of farmers in a certain year, but not the dynamic impact of the old-age burden on the income of farmers as it changes over time. Secondly, the old-age burden of households is not only related to the number of elderly people relative to the labor force. From the perspective of the average age and health status of the elderly, there is still a certain degree of variability in the old-age burden of different households, and this study focuses mainly on the overall old-age burden represented by the number of elderly people relative to the labor force. Based on this, we plan to continue to track farm households to obtain data on the dynamics of household old-age burdens and incomes and to analyze the variability of old-age burdens across households to draw more detailed conclusions in the future.

5.2. Conclusions and Policy Implications

5.2.1. Conclusions

Against the background of deepening rural aging and increasing household old-age burden in China, this paper applies a linear regression model to investigate the impact of household old-age burden on farm household income based on the household old-age burden and farm household income data obtained from the Farm Household Survey in Henan Province, China, and examines the mediating effect of non-farm employment on that impact.

Owing to the important role of the family in the old age security system, family old age support takes up most of the function of supporting the elderly. The larger the number of elderly people in the household compared to the labor force, the heavier the burden of supporting the elderly that the labor force has to face. Therefore, this study reveals, through modeling, that for a farm household that uses the family as a decision-making unit, it makes its overall income-generating capacity receive a great impact. From the perspective of farmers' health, the poorer the health status of farmers, the more limited the ability of their families to generate income, and the greater the negative impact of the burden of old age on the income of farmers. From the results of the study, it can be seen that the burden of old-age has a greater impact on high-income farmers than on low-income farmers, and the impact on the income of part-time farmers is more significant, and non-agricultural employment plays a certain mediating role in that impact. These findings reveal a real problem that deserves our attention. Against the backdrop of China's slowing economic growth, the increasing burden of old-age care on households has had a significant impact on the incomes of farm households, as the income gap between urban and rural areas remains wide and the rural population is aging. The impact is even more pronounced for those who are in poorer health and are engaged in both agricultural and non-agricultural employment. The key aspect of this problem is that the burden of old-age changes the non-farm employment behavior of farm households. The revelation of these patterns is not only valuable for the study of the aging problem in China, but also instructive for many countries in the world that are facing the aging problem.

5.2.2. Policy Recommendations

The following countermeasures are proposed in response to the above findings: Firstly, continuously improve the social old-age security system [86]. Through the establishment of a sound social security mechanism for old-age burden, the old-age burden on rural residents' families will be further reduced. Give full play to the role of social old-age as

a substitute for family old-age, and gradually form a new pattern of social old-age as the mainstay of rural old-age. Secondly, give full play to the function of the social old-age mechanism for the key special groups of the old-age [73]. While giving full play to the universal role of social old-age care, it should focus on strengthening the screening and support for the old-age burden of special groups. Focus on the changes in the old-age burden of poor health, part-time farmers, and high-income people in order to better play the buffer role of old-age mechanisms on the reduction of farmers' income. Thirdly, improve the mechanism for flexible social employment. Promote the flexible participation of the rural labor force in non-farm employment, establish multi-channel non-farm employment channels for the rural labor force, and continuously improve their income-generating capacity by promoting the transfer of the rural labor force to non-farm employment [27].

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