Research article

Entrepreneurial failure influences the health of Chinese farmers: Evidence from the data of China labor-force dynamic survey

Guanghao Wu [a], Jiajia Li [a], Xiuyi Shi [b,*]

[a] Faculty of Applied Economics, University of Chinese Academy of Social Sciences, Beijing, 102488, China
[b] School of Economics and Management, Southeast University, Nanjing, 211189, China

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ABSTRACT

High failure rate is a primary characteristic of current farmer entrepreneurial activities in China. We examined the impact of entrepreneurial failure on the health of Chinese farmers based on the data from the China Labor-force Dynamics Survey (CLDS). We found that entrepreneurial failure significantly depresses the health of Chinese farmers. Specifically, the farmers with entrepreneurial failure experience are more likely to have low self-reported levels of psychological and physical health, and the probability of experiencing severe injury and illness is elevated by 4.6 %. Mechanism analysis shows that entrepreneurial failure depresses the health of Chinese farmers through weakening informal social support and increasing the probability of overwork. Furthermore, these effects are more significant in the older generation of farmers who were born before 1980 and the farmers striving to make a living.

1. Introduction

The common notion that equates entrepreneurship with income growth is an overly idealized and erroneous logic. In fact, due to the high risks and uncertainties associated with entrepreneurial activities, failure is a common phenomenon (Cacciotti et al. [1]; Poblete [2]; Nwachukwu et al. [3]). Entrepreneurship is merely one possible pathway for individual prosperity. Related studies have shown that the entrepreneurial failure rate is generally above 70 % in various countries around the world, and less than 10 % of start-ups survive more than three years (Boso et al. [4]). In addition, the entrepreneurial failure rate is difficult to be reduced in a short term by optimizing the entrepreneurial environment because of the high-risk attributes and individual differences of entrepreneurs. Less than 25 % can generate returns for investors among the high-quality start-ups that receive venture capital (Gage [5]). Data on entrepreneurial failure in China are notably scarce. Surveys conducted by organizations such as the China Youth Entrepreneurship International Program and IT "Juzi" reveal that the failure rate for first-time entrepreneurs in China reaches up to 90 %, with the failure rate for college student entrepreneurs as high as 95 %. The 2023 Global Entrepreneurship Monitor report indicates that the exit ratio of Chinese entrepreneurs within 12 months is close to one-third of new ventures.

The issue of entrepreneurial failure among Chinese farmers warrants attention. On the one hand, the entrepreneurial failure rate among Chinese farmers is quite high. After the founding of the People's Republic of China, the Chinese government established a separate urban-rural structure to serve the planned economy (Yang and Zhou [6]). In those days, the farmer was a social class identity formed based on a special social structure. It was difficult for farmers in China to have their rights and interests fully protected

compared with urban residents (Meng [7]). As a result, weak risk prevention ability and low levels of physical and social capital of farmer entrepreneurs are widely found. Coupled with the lack and allocation distortion of rural resources to some extent, the phenomenon of entrepreneurial failure is common among farmers in China (Kong et al. [8]; Qing et al. [9]). The "result view" regards entrepreneurial activities as complete processes, focusing on the ultimate outcomes of these activities and considering the cessation or exit from entrepreneurial activities as entrepreneurial failure. The "reason view", building on the result view, zeroes in on a specific cause that leads to the termination of entrepreneurial activities. According to the "result view", data from the China Family Panel Studies show that the failure rate of farmer entrepreneurs is 73.3 %, which is significantly higher than the 66.1 % entrepreneurship failure rate among urban residents. If according to the "reason view", data from the China Labor-force Dynamics Survey reveal that 72.15 % of farmer entrepreneurs terminate their entrepreneurial ventures within four years due to factors such as unprofitable businesses and the arduous nature of entrepreneurship.

On the other hand, the number of Chinese farmers is exceptionally large. As of now, the number of Chinese farmers holding agricultural household registration (hukou) remains at 491 million. Combining China's entrepreneurship rate, farmer entrepreneurship failure rate, and the number of farmers, it becomes evident that the scale of failed entrepreneurial attempts among farmers reaches millions. This also explains why entrepreneurial activities are exceptionally rare in rural areas of China.

The analysis naturally leads to the question: for Chinese farmer entrepreneurs, what kind of impact will the special event of entrepreneurial failure have on them? Regrettably, existing literature cannot provide a definitive answer. Existing research has mainly focused on the causal attribution, recovery, learning, and re-entrepreneurship after entrepreneurial failure (Vaillant and Lafuente [10]; Shepherd [11]; Costa et al. [12]). For example, as early as 20 years ago, Shepherd [13] employed psychological literature analysis to examine the negative emotions and recovery processes of entrepreneurial failure, incorporating organizational learning theory to analyze the learning effects of the recovery process. These studies have laid the foundation for us to analyze the theme of this paper deeply; however, existing research mostly stops at theoretical and case analyses, leaving empirical shortcomings. In fact, entrepreneurial failure may influence people in many ways. Entrepreneurial failure may create not only financial problems for the entrepreneur but also health problems and social problems. Some studies have shown that entrepreneurial failure not only influences the physical health of entrepreneurs but may also cause psychological problems, such as inhibiting self-confidence, causing negative emotions, and increasing mental stress (Lafuente et al. [14]; Lattacher and Wdowiak [15]). However, few literatures analyzed the impact of entrepreneurial failure on the health of Chinese farmers based on empirical methods, and there is also a lack of exploration of the corresponding impact mechanisms.

Therefore, we select Chinese farmers with high entrepreneurial failure rates and low-risk resilience as a representative sample, and attempt to explore the following questions based on the data in 2016 from the CLDS. First, does entrepreneurial failure impact the health of Chinese farmers? Second, if an impact exists, then the question arises: what are the specific impacts, and what are the mechanisms in it? Third, is there some aspect of heterogeneous impact? We believe the aforementioned studies aid in revealing the relationship between entrepreneurial failure and health, expanding the corresponding research dimensions, and offering empirical evidence for a more effective understanding and response to entrepreneurial failure.

The possible marginal contributions of this paper are as follows: First, this paper enriches the existing literature and offers substantial practical implications. While a plethora of studies have explored the effects of entrepreneurial behavior on well-being and health (Rietveld et al. [16]; Teixeira and Vasque [17]; Zhao et al. [18]), a notable gap persists regarding the frequently occurring phenomenon of entrepreneurial failure. Additionally, investigations into failure learning and subsequent entrepreneurial endeavors are scarce and often restricted to a minor segment of entrepreneurs who have experienced failure. Given the substantial costs and practical hurdles, fostering entrepreneurship post-failure poses significant challenges. This study delves into how entrepreneurial failure impacts farmers' health, thus furnishing more pertinent and advantageous insights for policymaking.

Second, this paper adopts a more precise methodology for measuring entrepreneurial failure. Typically, three perspectives are used to assess entrepreneurial failure: "outcome view", which emphasizes the survival status of the entrepreneurial venture; "reason view", which focuses on the main causes of entrepreneurial termination; and "expectation view", which highlights the failure to meet expected outcomes (Singh et al. [19]; Fuentelsaz et al. [20]). Challenges in tracking entrepreneurial samples, gathering longitudinal data, and eliciting recollections of adverse events from respondents have led to "empirical deficiencies" in the field. Most empirical studies prefer the "outcome view" due to these challenges. However, utilizing CLDS data, this paper employs the "reason view" for a more nuanced understanding of entrepreneurial failure, enhancing the accuracy of its measurement.

Third, the theoretical and empirical analysis presented is notably more thorough. Existing research seldom investigates the mechanisms through which entrepreneurial failure affects individual behavior. This paper explores the mechanisms by which entrepreneurial failure impacts the health of farmers, thereby making a valuable contribution to the existing literature. In addition, beyond merely examining the pathways through which entrepreneurial failure influences farmers' health, this paper undertakes a series of endogeneity, robustness, and heterogeneity tests, yielding more generalizable and persuasive findings.

The rest of the section is organized as follows. Section 2 shows the literature review and conceptual framework. Section 3 shows the design of empirical method with some corresponding formulas, variables, and data which are used in this paper. The empirical results and discussion are presented in Section 4. Based on the above analysis, the discussion and conclusions are given in Section 5, and some limitations and issues deserving further research are also shared.

2. Literature review and conceptual framework

2.1. Literature review

Since the 1960s, when Arrow [21] first introduced economic thoughts, concepts, and methods into health research, studies on health have rapidly emerged in the field of economics. Becker [22] first introduced the household production function by considering medical services as an input factor in the production of health. Grossman [23] constructed a health demand model based on the household production function by treating health as a capital stock that depreciates with age. Further, Whitehead [24], Folland [25], and others proposed models such as the rainbow model and the multi-factor model, which incorporate health care, income, education, and employment as factors that influence health. Based on these studies, the concept of Social Determinants of Health (SDOH) was finally formalized by Tarlov [26]. The SDOH is defined as the non-medical factors that influence health outcomes. In 2007, The World Health Organization (WHO) emphasized the theoretical and practical value of this concept and constructed a framework for analysis (Marmot [27]). Specifically, the framework consists of two parts: first, daily life factors including housing, transportation, education, food, environment; second, social structure factors, including social status, social-political, economic and cultural background. Based on this framework, some literature examined the possible factors influencing the health of Chinese farmers (Liang et al. [28]). These theories provide important support for the hypotheses and empirical design in this paper.

2.2. Conceptual framework

Entrepreneurial failure is a situation in which an entrepreneur fails to realize some expected value in the entrepreneurial activity and terminates it early (Jenkins and Mckelvie [29]). Numerous studies have shown that entrepreneurial failure has a long-term and multidimensional impact on farmers (Zunino et al. [30]). On the one hand, entrepreneurial failure can directly trigger negative emotions and mental burdens for farmers. For example, Shepherd [13] analyzed the reason of entrepreneurial failure causing grief from a psychological perspective and proposed "grief recovery" strategies; Ucbasaran et al. [31] found that entrepreneurs who had failed to start a business were less likely to show optimism in UK. The theory of failure recovery suggests that negative emotion recovery has gradually become an important issue in the field of entrepreneurial failure. On the other hand, entrepreneurial failure can directly harm the economic interests of farmers and change their employment status. Based on the theory of entrepreneurship, both the financial pressure and the cost of searching new opportunities due to entrepreneurial failure increase the difficulty to re-start a business in a short term (Cope [32]; Parker [33]). In addition, the specialization by social division leads to an increase in the cost of job switching, which reduces the remuneration of farmers (Borjas [34]; Klimas et al. [35]). As a result, the economic stress of those farmers may further increase, thus influencing their health level. In summary, Hypothesis 1 is formulated as follows.

Hypothesis 1. Entrepreneurial failure negatively impacts the health of Chinese farmers.

Informal social support is a kind of support given by private social relationships, including emotional care, material help, and information evaluation provided by family, friends, neighbors, etc (Tolsdorf [36]). Social support theory holds that informal social support is an important manifestation of the function of social relationships and can enhance the health of individuals (Cobb [37]). The dysfunctional formal social support system in Chinese rural society allows informal social support to play a more important role in the farmer community (Ruan et al. [38]). Entrepreneurial failure may impact the informal social support level of farmers. On the one hand, the typical social attributes of entrepreneurial activities suggest that entrepreneurial failure may make it more difficult for farmers to maintain their existing social relationships and may even destroy them, thereby reducing the informal social support level of farmers (Granovetter [39]). On the other hand, prospect theory suggests that individuals commonly have cognitive biases (Tversky and Kahneman [40]). Related studies show that the government's attention to entrepreneurial failure needs to be further strengthened (Uriarte et al. [41]). In Chinese rural society, there is generally a pronounced negative evaluation of farmers' entrepreneurial failures by others, and this bias causes the farmers to experience stigmatization in their work and lives (Simmons et al. [42]; Wyrwich et al. [43]). Psychological research has shown that stigmatization triggers social rejection and reduces the ability of individuals to self-regulate, thereby reducing the informal social support level of farmers (Sutton and Callahan [44]). Therefore, social bias against entrepreneurial failure is another constraint that exacerbates the decline of social support. Based on the above analysis, Hypothesis 2 is formulated as follows.

Hypothesis 2. Entrepreneurial failure negatively impacts the health of Chinese farmers through the path of weakening informal social support.

Overwork is a process of physical and psychological dysfunction caused by excessive working hours and intensity over a certain period of time (Jacobs and Gerson [45]). Chronic fatigue caused by overwork negatively impacts the physical and mental health of workers and increases the probability of work accidents and sickness (Golden [46]). For farmers having experienced entrepreneurial failure, entrepreneurial failure may result in serious financial losses, which aggravates the burden of maintaining a family (Hsu et al. [47]). Therefore, overwork is generally a passive behavior under the high cost of living (Kuroda and Yamamoto [48]). Experiential learning theory holds that experiences of entrepreneurial failure reflect the gap between personal pursuits and actual achievements for farmers, and this negative feedback helps farmers to sum up experiences and learn lessons from their failures as a way to motivate their re-entrepreneurial behavior (Yamakawa et al. [49]; Espinoza-Benavides and Diaz [50]). In China, farmer entrepreneurs tend to be sensitive about their reputations, which makes them more eager to achieve self-evidence in subsequent career development. As a result, overwork is inevitable for Chinese farmer entrepreneurs, whether they choose to seek employment or opt to continue with

entrepreneurship. Based on the above analysis, Hypothesis 3 is formulated as follows.

Hypothesis 3. Entrepreneurial failure negatively impacts the health of Chinese farmers through the path of increasing the probability of overwork.

In summary, entrepreneurial failure is highly likely to impact the health of Chinese farmers. Therefore, this paper intends to analyze the impact of entrepreneurial failure on the health of Chinese farmers based on data from the CLDS and attempts to examine the transmission mechanisms of informal social support and overwork in it. By studying the above issues, this paper aims to clarify the relationship between entrepreneurial failure and the health of Chinese farmers, enrich the research in the fields of entrepreneurial failure and farmer health, and provide empirical evidence for further improving the social security system for farmer entrepreneurship failure.

3. Empirical design

3.1. Probit model

The explained variables in this paper are binary dummy variables, thus a Probit model is constructed for empirical study. The specific model is as follows:

$$Health_{ij} = \alpha_0 + \alpha_1 EF_{ij} + \boldsymbol{\alpha_2}\mathbf{Control}_{ij} + \mu_i + \delta_j + \varepsilon_{ij} \tag{1}$$

where $Health_{ij}$ indicates the health level of farmer i in region j. EF_{ij} is the core explanatory variable indicating whether the farmer i in region j has entrepreneurial failure experiences. $\mathbf{Control}_{ij}$ is a vector of control variables including individual, household, and community characteristics. α_0, α_1, and $\boldsymbol{\alpha_2}$ are the parameters to be estimated; μ_i is the individual fixed effect, δ_j is the region fixed effect and ε_{ij} is the error term.

If the explained variable is an ordered dummy variable, an ordered Probit (Oprobit) model should be constructed. The specific model is shown in Equations (2) and (3):

$$Health_{ij}^* = \alpha_0 + \alpha_1 EF_{ij} + \boldsymbol{\alpha_2}\mathbf{Control}_{ij} + \mu_i + \delta_j + \varepsilon_{ij} \tag{2}$$

$$Health_{ij}^* = \begin{cases} 1, \text{if} & y_{ij} \leq c_1 \\ 2, \text{if} & c_1 < y_{ij} \leq c_2 \\ 3, \text{if} & c_2 < y_{ij} \leq c_3 \\ 4, \text{if} & c_3 < y_{ij} \leq c_4 \\ 5, \text{if} & c_4 < y_{ij} \end{cases} \tag{3}$$

where $Health_{ij}$* indicates the explained variable in the form of an ordered dummy variable. y_{ij} is the specific evaluation indicator of farmer i and region j. c_1, c_2, c_3, and c_4 are the discontinuity points. The meanings of other variables are the same as those in Equation (1).

In order to explore the impact mechanism of entrepreneurial failure on the health of farmers, we construct the following mediating effect models:

$$Overwork_{ij} = \alpha_0 + \alpha_1 EF_{ij} + \boldsymbol{\alpha_2}\mathbf{Control}_{ij} + \mu_i + \delta_j + \varepsilon_{ij} \tag{4}$$

$$Support_{ij} = \alpha_0 + \alpha_1 EF_{ij} + \boldsymbol{\alpha_2}\mathbf{Control}_{ij} + \mu_i + \delta_j + \varepsilon_{ij} \tag{5}$$

where $Overwork_{ij}$ and $Support_{ij}$ indicate the mediating variable of the overwork and informal social support level of farmer i in region j, respectively. The meanings of other variables are the same as those in Equation (1).

3.2. Variables

The explanatory variable in this paper is the health level of farmers (*Health*). This paper refers to the definition of health by the WHO, which states that "Health is not only the absence of disease or infirmity but also includes good physical and psychological state as well as social adaptation", as well as the classic studies by Clarke and Ryan [51] and Braveman and Gottlieb [52]. Specifically, the health level of farmers is characterized by three aspects: self-reported physical health (*Physical*), self-reported psychological health (*Psychol*), and severe injury and illness experiences (*SII*). For the variable *Physical*, the question in the Likert scale is "How do you think your physical health is this year?" and the options are "Very poor physical health, Poor physical health, Average physical health, Good physical health, Very good physical health." The variable *Physical* is assigned values 1 to 5 in order based on the answers. For the variable *Psychol*, the question in Likert scale is "Have you had any psychological problems this year that cannot be relieved for more than one month?", and the options are "Never, Rarely, Sometimes, Often, Always." The variable *Psychol* is assigned values 1 to 5 in order based on the answers. For the variable *SII*, the question in the Likert scale is "Have you had severe injuries and illnesses this year?", and the options are "Yes, No." The variable *SII* is assigned value 1 if an answer is "Yes", otherwise, it is 0.

The core explanatory variable in this paper is entrepreneurial failure (*EF*). As mentioned above, there are three main methods of measuring entrepreneurial failure, and this paper uses a more precise "reason view". Referring to the study of McGrath [53], Ucbasaran

et al. [54] and the questionnaire in the CLDS, we define the concept of entrepreneurial failure as the termination of a business within two years due to unprofitability, lack of capital, and mental exhaustion. The variable *EF* is assigned value 1 if a farmer has entrepreneurial failure, otherwise it is 0. There are differences in the measurement results of the "reason view" and the "result view", and the method of counting entrepreneurial failure at the macro level is mainly the "outcome view".

The mediating variables in this paper are overwork level (*Overwork*) and informal social support level (*Support*). Referring to the Chinese Labor Law on working hours and the study of Cohen and Wills [55], Zhan et al. [56], the variable *Overwork* includes moderate overwork (*Moverwork*) and severe overwork (*Soverwork*), and the variable Support includes instrumental support (*Instrumental*) and emotional support (*Emotional*). Specifically, the variable *Moverwork* (*Soverwork*) is assigned value 1 if a farmer has an experience of working more than 50 (60) hours within a certain week this year, otherwise it is 0. The variable *Instrumental* (*Emotional*) is measured by the number of persons who can give tangible help, such as information and capital (emotional help, such as emotional guidance and stress relief).

Referring to existing research (Palladan and Ahmad [57]; Wu et al. [58]), we select the control variables from three perspectives: individual, household, and community. Referring to the relevant studies, the variables in this paper include gender (*Gender*), age (*Age*), education (*Education*), marital status (*Marriage*), regular exercise (*Exercise*), medical insurance (*Insurance*), household size (*Size*), household debt (*Debt*), community pollution (*Pollution*), and community healthcare (*Healthcare*). Table 1 reports the specific definitions and descriptive statistics of the variables. Since the overall sample includes farmers of various occupations, the proportion of entrepreneurial failure is only 0.04.

3.3. Data

The data used in this study are all from the CLDS in 2016. The CLDS is a comprehensive database with a survey of the labor force population aged 15 to 64. The CLDS uses a multi-stage and multi-level sampling approach in data collection and takes into account the size proportion of the labor force distribution. The survey sample of 2016 data from the CLDS covers 14,226 households in 401 villages across 29 provinces in China. In this paper, the CLDS data are processed as follows: first, matching the data by the codes of householder and household; second, excluding urban resident samples and samples with missing or abnormal data; third, winsorizing the continuous variables at the 99 % and 1 %. The final dataset in this paper includes 7654 farmers from 29 provinces, 259 cities, and 391 villages in China.

4. Results and discussion

4.1. Baseline regression

Table 2 reports the results of baseline regression. Columns (1), (3), and (5) report the results controlling for individual characteristics only, and columns (2), (4), and (6) report the results controlling for all characteristics. As shown in columns (1) and (2), the coefficients of entrepreneurial failure are significantly negative at the 5 % and 1 % significant levels, respectively, indicating that entrepreneurial failure exerts a negative impact on the level of self-reported physical health among Chinese farmers. Columns (3) and (4) present that the coefficients of entrepreneurial failure are significantly positive at the 1 % significant levels, which implies that entrepreneurial failure produces positive impacts on the frequency of psychological problems among Chinese farmers. It can be seen from columns (5) and (6) that the coefficients of entrepreneurial failure are significantly positive at the 1 % and 5 % significant levels,

Table 1
Variable definitions and descriptive statistics.

Variable	Definition	Obs.	Mean	S. D.	Min.	Max.
Physical	Self-reported physical health (Very poor = 1, Poor = 2, Average = 3, Good = 4, Very good = 5)	7654	3.51	1.02	1.00	5.00
Psychol	Self-reported psychological health measured by the frequency of psychological problems (Never = 1, Rarely = 2, Sometimes = 3, Often = 4, Always = 5)	7654	1.80	0.98	1.00	5.00
SII	Severe injury and illness experiences (Have = 1, Not have = 0)	7654	0.10	0.30	0.00	1.00
EF	Entrepreneurial failure (Yes = 1, No = 0)	7654	0.04	0.16	0.00	1.00
Moverwork	Having an experience of working more than 50 h within a certain week this year (Yes = 1, No = 0)	7654	0.41	0.49	0.00	1.00
Soverwork	Having an experience of working more than 60 h within a certain week this year (Yes = 1, No = 0)	7654	0.22	0.41	0.00	1.00
ln*Instrumental*	Number of persons who can give tangible help (taking the natural logarithm)	7654	1.37	0.88	0.00	2.77
ln*Emotional*	Number of persons who can give emotional help (taking the natural logarithm)	7654	1.06	0.76	0.00	2.40
Age	Age in 2016	7654	46.93	9.91	18.00	65.00
Gender	Male = 1, Female = 0	7654	0.51	0.49	0.00	1.00
Marriage	Married = 1, Otherwise = 0	7654	0.87	0.33	0.00	1.00
Education	Years of education	7654	7.49	3.81	0.00	22.00
Exercise	Performing regular physical exercise for more than one year (Yes = 1, No = 0)	7654	0.24	0.43	0.00	1.00
Insurance	Purchased medical insurance (Yes = 1, No = 0)	7654	0.90	0.29	0.00	1.00
Size	Number of household members	7654	4.60	1.99	1.00	18.00
Debt	The household has outstanding debts (Yes = 1, No = 0)	7654	0.35	0.41	0.00	1.00
Pollution	The community has obvious environmental pollution (Yes = 1, No = 0)	7654	0.64	0.47	0.00	1.00
Healthcare	The community has primary care services (Yes = 1, No = 0)	7654	0.82	0.38	0.00	1.00

Notes: Obs. and S. D. stand for Observations and Standard Deviation.

Table 2
Results of baseline regression.

Variable	Physical		Psychol		SII	
	Oprobit	Oprobit	Oprobit	Oprobit	Probit	Probit
	(1)	(2)	(3)	(4)	(5)	(6)
EF	−0.183[b] (0.076)	−0.201[a] (0.077)	0.254[a] (0.079)	0.257[a] (0.079)	0.0472[a] (0.020)	0.046[b] (0.020)
Gender	0.124[a] (0.025)	0.147[a] (0.025)	−0.191[a] (0.027)	−0.205[a] (0.027)	−0.022[a] (0.007)	−0.023[a] (0.007)
Age	−0.028[a] (0.001)	−0.029[a] (0.001)	0.001 (0.001)	0.001 (0.001)	0.001[a] (0.000)	0.001[a] (0.000)
Gender	0.186*** (0.038)	0.205[a] (0.039)	−0.101[a] (0.040)	−0.117[a] (0.041)	−0.024[b] (0.010)	−0.028[a] (0.010)
Marriage	0.022[a] (0.003)	0.015[a] (0.003)	−0.009[b] (0.004)	−0.005 (0.004)	−0.003[a] (0.001)	−0.002[b] (0.001)
Education	0.104[a] (0.029)	0.065[b] (0.029)	−0.032 (0.031)	0.002 (0.031)	−0.013[c] (0.008)	−0.005[c] (0.008)
Exercise	−0.009 (0.042)	−0.027 (0.043)	−0.071 (0.045)	−0.055 (0.045)	0.014[c] (0.012)	0.020[c] (0.012)
Insurance		−0.010 (0.006)		0.011[c] (0.006)		0.004[a] (0.001)
Size		−0.293[a] (0.026)		0.211[a] (0.027)		0.047[a] (0.007)
Debt		−0.094[a] (0.026)		0.113[a] (0.028)		0.019[a] (0.007)
Pollution		0.009 (0.033)		0.038 (0.036)		0.009 (0.009)
Individual fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7654	7654	7654	7654	7500	7500

Notes: Robust standard errors are in parentheses. Significance levels are.
[a] p < 0.01.
[b] p < 0.05.
[c] p < 0.1. Columns (5) and (6) report the average marginal effects. Similarly hereinafter.

respectively, meaning that entrepreneurial failure increases the risk of severe injuries and illnesses among Chinese farmers. Hypothesis 1 is fully verified. In addition, some of the control variables also have significant effects on the health of Chinese farmers. Farmers who are male, of low age, married, highly educated, have regular exercise experiences, have no household debt, and live in a community free of pollution in China, have higher health levels. The results are in line with those in relevant studies. One result that requires special attention is that medical insurance significantly increases the probability of severe injuries and illnesses at the 10 % significant level among Chinese farmers. The possible reason is that farmers who have purchased medical insurance have a higher probability of detecting severe injuries and illnesses.

4.2. Endogeneity test

The first issue addresses the endogeneity problem arising from omitted variables and reverse causality. The variables *Physical* and *Psychol* are multi-valued dummy variables. Thus, the OProbit model is not applicable to testing the endogeneity directly by the instrumental variable (IV) method. According to this, we use the conditional mixed process (CMP) and linear two-stage least squares (2SLS) method for estimation, respectively. The variable *SII* is a binary dummy variable; the IV-Probit model is therefore employed for the endogeneity test.

We select the failure rate of entrepreneurship among other members of the same village with the same social status as an IV for entrepreneurial failure. The reasons are as follows. First, the selected proxy variable comprehensively reflects the entrepreneurial environment in which the rural entrepreneurs operate and the social resources they possess. It also reflects the likelihood of entrepreneurs ultimately facing failure, which is highly relevant to the core explanatory variable in this paper, namely, entrepreneurial failure. Second, this intermediate village-level indicator, derived through matching, organizing, and computation, does not directly influence the individual health status of rural farmers at the micro-level. This approach is commonly used in existing research and satisfies the exogeneity requirements of an effective instrumental variable.

Table 3
Results of conditional mixed process and instrumental variable approach (the second stage).

Variable	Physical	Psychol	Physical	Psychol	SII
	CMP	CMP	2SLS	2SLS	IV-Probit
	(1)	(2)	(3)	(4)	(5)
EF	−0.994[a] (0.214)	1.208[a] (0.201)	−2.578[a] (0.760)	1.248[a] (0.612)	2.136[b] (1.159)
Control variables	Yes	Yes	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes	Yes
Atanhrho_12	0.412[a] (0.118)	−0.509[a] (0.115)			
F-statistic			39.54	42.00	39.64
Constant	−1.789[a] (0.399)	−1.896[a] (0.398)	4.274[a] (0.224)	2.155[a] (0.202)	−1.533[a] (0.388)
Observations	6584	6584	6584	6584	6527

Notes: The first stage estimates of each endogeneity test model are all significant.

The estimates of the second stage of each model are reported in Table 3. Note that the results of the first stage are not reported due to space limitations. In the CMP model, the Atanhrho_12 parameter, which is the hyperbolic arctangent transformation of the rho parameter, is used to test for correlations between the error terms of the model, thereby revealing issues of endogeneity among the variables. In columns (1) and (2), The endogeneity test parameters Atanhrho_12 are all significant at the 1 % significant level, indicating that the baseline regression model has endogeneity problems and using the IV approach is acceptable. In columns (3) to (5), the F-statistics in the first stage are greater than 16.38 (it is the critical statistic value of the 10 % significant level), indicating that the hypothesis of weak instrumental variables in the models can be rejected. Based on the significance of the coefficients of the variable *EF*, it can be seen that the variable *EF* significantly negatively impacts the variable *Physical* at the 1 % significant level, significantly positively impacts the variable *Psychol* at the 1 % significant level, and significantly positively impacts the variable *SII* at the 5 % significant level. In summary, the conclusions drawn from the results of baseline regression remain valid after considering the potential omitted variables and reverse causality problems.

The second is the endogeneity problem caused by self-selection bias. A treatment effect model (TEM) is used in this paper to address the self-selection bias. Table 4 reports the results of TEM. It can be found that the inverse Mills ratios (λ) are all significant at least at the 10 % significant level, indicating the existence of self-selection bias. We further test the endogeneity problem by maximum likelihood estimation. In columns (1) to (3), the Wald test results are all significant at the 1 % significant level, indicating that the TEM regression should also use the IV approach. As shown in Table 4, the variable *EF* significantly negatively impacts the variable *Physical* at the 1 % significant level, and significantly positively impacts the variables *Psychol* and *SII* at the 1 % significant level. Therefore, the conclusions drawn from the results of baseline regression remain valid after considering the self-selection bias problems.

4.3. Robustness check

First, we perform robustness checks using sub-samples. In the original sample, the farmers having no entrepreneurial failure experiences include the farmers with and without entrepreneurial experiences. Since some differences may exist in health levels between the two types of farmers, we conduct a robustness check by excluding the farmers without entrepreneurial experiences in the sample. Columns (1) to (3) in Table 5 report the robust check results using sub-samples. The results show that the variable *EF* significantly negatively impacts the variable *Physical* at the 1 % significant level, and significantly positively impacts the variables *Psychol* and *SII* at the 1 % and 10 % significant levels, respectively. Therefore, the results of baseline regression are robust.

Second, we perform some other robustness checks by changing the core explanatory variable referring to the work of Shi et al. [59]. The continuity of entrepreneurial activity is an important precondition for its social value. Thus, some scholars focus more on the continuity of entrepreneurial activity and consider the termination of entrepreneurial activity within a short term as entrepreneurial failure (Ucbasaran et al. [54]). Therefore, we redefine the variable *EF* here and consider the termination of entrepreneurial activity within two years as entrepreneurial failure. Columns (4) to (6) in Table 5 report the robust check results by changing the core explanatory variable. The results show that the variable *EF* significantly negatively impacts the variable *Physical* at the 1 % significant level, and significantly positively impacts the variables *Psychol* and *SII* at the 1 % and 10 % significant levels, respectively. Therefore, the results of baseline regression are robust.

4.4. Mechanism analysis

A further mechanism analysis is conducted based on the mediating variables selected in the previous section. Referring to the study of Baig and Chang [60], we explore the transmission mechanism of informal social support from the perspectives of instrumental support (*Instrumental*) and emotional support (*Emotional*). To weaken the heteroskedasticity of the regression, we take the natural logarithm of variables *Instrumental* and *Emotional*. The mechanism regression results of informal social support are reported in Table 6. As shown in columns (1) and (3), the variable *EF* significantly negatively impacts the variables *Instrumental* and *Emotional* at the 1 % and 5 % significant levels, respectively. Furthermore, the regression results in columns (2) and (4) indicate that the conclusions are robust. Therefore, entrepreneurial failure depresses the health of farmers through weakening informal social support. The hypothesis 2 is fully tested.

Given that the work intensity and fatigue status of farmers are often difficult to quantify, we measure overwork in terms of the

Table 4
Results of treatment effect model (the second stage).

Variable	*Physical*	*Psychol*	*SII*
	(1)	(2)	(3)
EF	−0.622[a] (0.260)	0.887[a] (0.268)	0.248[a] (0.087)
λ	0.218[c] (0.125)	−0.333[a] (0.129)	−0.095[b] (0.042)
Control variables	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes
Wald test of exogeneity	114.55[a] (0.000)	319.51[a] (0.000)	774.38[a] (0.000)
Observations	6584	6584	6527

Notes: The first stage estimates of each endogeneity test model are all significant.

Table 5

Results of robustness check.

Variable	Using sub-samples			Changing the core explanatory variable		
	Physical	Psychol	SII	Physical	Psychol	SII
	Oprobit	Oprobit	Probit	Oprobit	Oprobit	Probit
	(1)	(2)	(3)	(4)	(5)	(6)
EF	−0.301[a] (0.092)	0.247[a] (0.095)	0.047[c] (0.026)	−0.159[a] (0.063)	0.199[a] (0.065)	0.033[c] (0.017)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1056	1056	994	7564	7564	7500

Table 6

Mechanism regression results of informal social support.

Variable	ln*Instrumental*		ln*Emotional*	
	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)
EF	−0.158[a] (0.068)	−1.099[b] (0.533)	−0.090[b] (0.051)	−0.729[a] (0.267)
Control variables	Yes	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes
F-statistic in the first stage		46.28		52.56
Observations	6171	5560	5972	5337

number of hours farmers' work. The mechanism regression results of overwork are reported in Table 7. Columns (1) and (3) show that the variable *EF* significantly positively impacts the variables *Moverwork* and *Soverwork* at the 1 % and 5 % significant levels, respectively. The average marginal effects are 0.1084 and 0.0658, respectively. The results of corresponding IV-Probit model regressions are reported in columns (2) and (4), further confirming that the former results are robust. Therefore, entrepreneurial failure depresses the health of farmers through increasing the probability of overwork. The hypothesis 3 is fully tested.

4.5. Heterogeneity analysis

The previous parts well confirm that entrepreneurial failure can negatively impact the health of Chinese farmers. Further, we provide a heterogeneous analysis of this impact from the perspective of inter-generational differences and entrepreneurial motivation. First, we group the sample farmers according to their ages, defining those born in 1980 and later as the younger generation group and those born before 1980 as the older generation group. Table 8 presents the results of the inter-generational heterogeneity analysis. The results show that the variable *EF* significantly impacts the variables *Physical*, *Psychol*, and *SII* whether in the younger or older generation group. Nevertheless, the significance levels (all at the 1 % levels) of these effects are higher in the older generation group. Possible reasons for this are that the older generation of farmers has a heavier financial burden, greater difficulty in employment, and a higher probability of suffering stigmatization than the younger generations.

Second, We define two new explanatory variables named *Living* and *Opportunity* according to entrepreneurial motivations. If a farmer decides to start a business due to striving to make a living, then we assign 1 to the variable *Living* and 0 to the variable *Opportunity*. If a farmer decides to start a business due to having discovered good entrepreneurial opportunities, then we assign 1 to the variable *Opportunity* and 0 to the variable *Living*. Based on this, we construct the following model to conduct an entrepreneurial motivation heterogeneity analysis:

Table 7

Mechanism regression results of overwork.

Variable	*Moverwork*		*Soverwork*	
	Probit	IV-Probit	Probit	IV-Probit
	(1)	(2)	(3)	(4)
EF	0.108[a] (0.039)	1.200[a] (0.390)	0.065[b] (0.032)	0.953[b] (0.447)
Control variables	Yes	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes
F-statistic in the first stage		79.48		83.32
Observations	4841	4653	4841	4615

Table 8
Results of inter-generational heterogeneity analysis.

Variable	Younger generation (born in 1980 or later)			Older generation (born before 1980)		
	Physical	Psychol	SII	Physical	Psychol	SII
	Oprobit	Oprobit	Probit	Oprobit	Oprobit	Probit
	(1)	(2)	(3)	(4)	(5)	(6)
EF	−0.159[c] (0.101)	0.240[b] (0.102)	0.040[c] (0.023)	−0.319[a] (0.121)	0.333[a] (0.127)	0.076[a] (0.031)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1663	1663	1600	5964	5964	5836

$$Health_{ij} = \alpha_0 + \alpha_1 Living_{ij} + \alpha_2 Opportunity_{ij} + \boldsymbol{\alpha_3} \textbf{Control}_{ij} + \mu_i + \delta_j + \varepsilon_{ij} \tag{6}$$

where the meaning of other variables can be referred to Equation (1). The regression results of Equation (6) are presented in Table 9. As shown in columns (1) and (2), compared with the farmers without entrepreneurial failure experiences, the farmers with entrepreneurial failure experiences significantly have worse self-reported levels of physical and psychological health, whether their entrepreneurial motivations are striving to make a living or having discovered good entrepreneurial opportunities. The result in column (3) indicates that the farmers with entrepreneurial failure experiences whose entrepreneurial motivation is striving to make a living are more likely to suffer from severe injuries and illnesses than the farmers without entrepreneurial failure experiences. A possible reason for this is that the farmers with entrepreneurial failure experiences who are pressured to make a living are more willing to engage in industries that are more prone to injury and illness.

5. Discussion and conclusions

In recent years, entrepreneurial failure and the health of farmers have continued to be important research topics in the process of economic and social development. Based on the data in 2016 from the CLDS, this paper thoroughly examines the impact of entrepreneurial failure on the health of farmers and its mechanisms. This not only fills the gap in empirical research on the negative impacts (financial, social, and psychological costs) of entrepreneurial failure as noted in the studies by Ucbasaran et al. [54] and Khelil [61], but also addresses the lack of attention to entrepreneurial failure events in the field of health economics (Hatak and Zhou [62]).

First, our findings unequivocally demonstrate that entrepreneurial failure has a significant detrimental impact on the health of farmers. This is manifested in lower self-reported levels of both psychological and physical health, alongside a 4.6 % increased likelihood of experiencing severe injuries and illnesses. This conclusion corroborates some subjective inferences regarding the negative emotional impact of entrepreneurial failure on individuals (Singh et al. [19]; Shepherd [11]). However, it suggests that this impact is not only confined to the mental health aspect, as Subramanian and Kumar [63] and Cubbon et al. [64] have focused on, but also extends to the physical health of entrepreneurial failure sufferers. These outcomes also underscore the profound personal costs associated with such failures, emphasizing the necessity for targeted support and interventions to alleviate these effects, providing corroborative evidence for the inference made by Adobor [65]. Second, we also found that entrepreneurial failure depresses the health of farmers through weakening informal social support and increasing the probability of overwork. This conclusion contributes to addressing the question of "how to effectively mitigate the negative impacts of entrepreneurial failure," providing a basis for us to propose policy recommendations. Third, heterogeneity exists in the effect of entrepreneurial failure on the health of farmers. Specifically, the effects of entrepreneurial failure are more significant for the older generations and the farmers striving to make a living. These results suggest that the vulnerabilities associated with entrepreneurial failure are not uniformly distributed, with certain groups bearing a heavier burden. The finding also calls for a more nuanced understanding of the socio-economic contexts in which farmer entrepreneurs operate and underscores the necessity for targeted policy interventions.

According to the findings, in order to effectively address entrepreneurial failure and mitigate its negative impact on health, it is necessary to propose some policy recommendations. First, the entrepreneurial failure protection mechanism should be improved. Currently, China lacks protective measures for farmers facing entrepreneurial failure. Only a handful of local governments have independently implemented policies aiming at addressing entrepreneurial failure among undergraduates. The coverage and support provided by these policies are limited. Therefore, our results have implications for policy-makers seeking to minimize the negative influences of entrepreneurial failure on farmers. Compensation for the farmers facing entrepreneurial failure is conducive to alleviating their financial losses and mental stress. Second, creating a social climate that is prone to accepting entrepreneurial failure. Social media plays an important role in guiding the thinking of the masses. Reducing social biases against farmers with entrepreneurial failure experiences and highlighting the social contributions of farmer entrepreneurs are helpful for improving the health of farmer entrepreneurs. Third, providing employment assistance for farmers who fail in entrepreneurship. Helping farmers facing entrepreneurial failure get jobs quickly is beneficial to reduce the probability of overwork among farmers. As such, employment guidance for farmers facing entrepreneurial failure is beneficial. Policy-makers should implement targeted vocational skills training to help them adapt to the job market. Fourth, providing psychological support to farmers facing entrepreneurial failure. Timely counseling can relieve the psychological stress of failed entrepreneurs and mitigate the damage caused by negative emotions. Finally, the policy should be

Table 9
Results of entrepreneurial motivation heterogeneity analysis.

Variable	The farmers without entrepreneurial failure experience as a control		
	Physical	Psychol	SII
	Oprobit	Oprobit	Probit
	(1)	(2)	(3)
Living	−0.214[b] (0.101)	0.294[a] (0.103)	0.071[b] (0.036)
Opportunity	−0.204[c] (0.115)	0.210[c] (0.119)	0.028 (0.038)
Control variables	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes
Observations	7564	7564	7500

proposed with a directed focus on the farmers in the older generations and the farmers striving to make a living. Policymakers should pay attention not only to their physical health but also to their psychological health. In summary, our study underscores the critical need to address the adverse health outcomes of entrepreneurial failure and to ensure the well-being of affected farmers.

This paper has several limitations that merit emphasis and suggest avenues for further research. We provide a brief estimation on the heterogeneity analysis of entrepreneurial motivation and entrepreneurs' age among other factors. Future research should delve deeper into more specific studies to reveal the influencing factors and the internal mechanisms. Additionally, the study is somewhat limited by the data available. For instance, this paper defines entrepreneurial failure from a "reason view", which is more accurate compared to the commonly used "result view" (Klimas et al. [35]). However, a more precise conclusion could be achieved by examining from an "expectation view". Furthermore, while the paper successfully measures the overall health of the farmer entrepreneur population from three dimensions, it lacks specific measurements in terms of hypertension, obesity, heart disease, etc. In summary, conducting more detailed longitudinal surveys targeting the farmer entrepreneur demographic is of great importance for advancing research on farmer entrepreneurship and the study of entrepreneurial failure.

Ethics statement

Not applicable.

Data availability statement

Data associated with the study has not been deposited into a publicly available repository.
Data will be made available on request.

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CRediT authorship contribution statement

Guanghao Wu: Writing – original draft, Methodology, Formal analysis, Data curation. **Jiajia Li:** Investigation, Conceptualization. **Xiuyi Shi:** Writing – review & editing, Methodology, Funding acquisition, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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