Effects of air pollution on poverty vulnerability

Yinuo Liang¹, Jialing Li²,*, Dingping Chai³, and Chen Zhuang⁴

¹School of Economics, Ocean University of China, Qingdao, Shandong Province, 266100, China
²School of Economics, Shandong University of Finance and Economics, Jinan, Shandong Province, 250014, China
³School of Public Finance and Taxation, Shandong University of Finance and Economics, Jinan, Shandong Province, 250014, China
⁴School of public administration, Shandong University of Finance and Economics, Jinan, Shandong Province, 250014, China

Abstract. In order to study the extent of the impact of air pollution on poverty vulnerability and provide a reference for governments to formulate and adjust policy approaches, in this paper, CNRDS and CHIPS micro-survey data were used to test the effects of air pollution on poverty vulnerability by using the Probit model, and the tendency value matching (PSM) method was adopted to correct the selective bias. The basic results show that air pollution is significantly negatively correlated with farmers' vulnerability to poverty, that is, the higher the proportion of air pollution, the lower the economic vulnerability of farmers. And the effect of air pollution on farmers' economic vulnerability is U-shaped. The main contribution of this paper refers to its assessment of the poverty reduction effect of air pollution from a forward-looking perspective, which can effectively maintain the results of poverty relief, improve the effectiveness of poverty-relief inputs and the continuity of poverty-relief effects, and achieve a stable poverty relief of the poor.

1 Introduction

Since the reform and opening up, the country, under the leadership of the government of the authorities, has created a characteristic "Chinese-style poverty alleviation" route through the large-scale implementation of a nationwide development-oriented poverty alleviation strategy. From 1978 to 2018, the total number of rural poor in China decreased by about 800 million, and the incidence of poverty decreased by about 96%, which achieved remarkable results, making remarkable contributions to the promotion of poverty reduction in the world and the implementation of the United Nations Millennium Development Goals.

However, there are still a large number of families living in poverty in the country. The task of reducing poverty remains daunting, and the situation remains daunting. At the same time, with the arrival of a well-off society planning node in 2020, China is striving to promote a new round of rural poverty alleviation. Among them, the issue of air pollution is the focus of building a well-off society in an all-round way.

The effect of reducing the poverty of air is still in the stage of continuous research and exploration. Most of the literature focuses on the impact of air pollution on current poverty and does not address the persistence of poverty reduction effects. Focusing only on the current impact on the expected reduction of the effects of air pollution is one-sided and, in turn, misleads the formulation and implementation of relevant policies.

Therefore, it is important to further examine the impact of air pollution on future poverty. Poverty vulnerability can help us achieve this work. In the 2002 World Development Report, the World Bank proposed the concept of "vulnerability to poverty" to describe the likelihood of individual or family future poverty. Therefore, with the help of CNRDS, CHIPS micro-survey data, this paper demonstrates the impact of air pollution on the vulnerability of household poverty. The tendency value matching (PSM) method is adopted to eliminate sample selection bias as much as possible.

2 Basic analysis framework and model settings

2.1 Basic analytical framework

On the basis of perfecting the previous research, this paper constructs the mechanism of air pollution, vulnerability and rural poverty, so as to be able to analyze the air pollution and farmers' poverty vulnerability in a comprehensive way. In the framework of the analysis of this paper, air pollution has an impact on the vulnerability of farmers' poverty. Specifically, this effect, under the influence of air pollution, ultimately affects farmers' income, consumption and poverty through agricultural or non-agricultural activities. By combining the vulnerability of farmers' poverty with government policies, it is beneficial to further analyze the government's policy for vulnerability and guide farmers to enhance their ability to resist risks.
2.2 Specification of model

Based on the research purposes of this paper, the empirical model is designed as follows:
\[ \ln Y_i = \beta_0 + \beta_1 \ln x_i + \beta_2 X_i + e_i, \]

Among them, \( \ln Y_i \) are poverty vulnerability measured under the poverty standard of $2/person/day, \( \ln x_i \) indicates the logarithm of air pollution, and \( \beta_i \) is the parameter situating for the effect of air pollution on poverty vulnerability to be found in this paper; \( X_i \) represents a series of control variables. With the literature on the choice of control variables, reference Zhou Junxuan and Shi Guoqing (2017), Yang Wen (2012) research, the control variables of this paper mainly include two aspects: one is the material capital characteristics of the family, including household gross income, household net income, etc.; another is the individual characteristics of the family, including the medical insurance, age, gender and education level of the head of the household.

3 Data source and variable definition

3.1 Data source

In this paper, the data on air pollution and poverty vulnerability were selected for CNRDS, CHIPS microsurvey data.

3.2 Variable definition

In this paper, the level of poverty vulnerability is explained as an explained variable, and poverty vulnerability refers to the possibility of a family falling into poverty in the future. Air pollution is used as a key explanatory variable. The size of the family, the number of people involved in agriculture, forestry, animal husbandry and fisheries production in the family, the number of people involved in local wage work in the family, the number of people working outside the home, age, level of education, family net income, income, health insurance, old-age insurance and the welfare status of the labor insurance are used as control variables. It should be noted that the paper identifies farmers below the national poverty line as poor households.

4 Empirical study

Table 1 is the basic result of model regression: model 1-9 reports the effect of air pollution on poverty vulnerability, of which model 1 is air pollution indicator \( \ln \text{PM2.5} \) to poverty vulnerability indicator \( \ln \text{poor_china} \) regression, model 2-9 add family size respectively. The number of people in the family involved in agriculture, forestry, animal husbandry and fisheries production, the number of people in the family involved in local wage work, the number of people involved in local non-farm production and operation, the number of people working out of the family, the age, the number of children in the family (less than sixteen years old), the level of education, marital status, family net income, income, medical insurance, the old-age insurance situation and the welfare of labor insurance are returned after the situation. Effects of air pollution on farmers' vulnerability to poverty are a return based on a full sample.

Table 2 model 10 is the \( \text{PM25_square} \) of explanatory variables and the regression results of the \( \ln \text{poor_china} \) of the interpreted variables by the control variables mentioned above.

First, the effect of air pollution on farmers' vulnerability to poverty is analyzed. The impact of air pollution on farmers' vulnerability to poverty is significant at 1 per cent. That is, the higher the proportion of air pollution, the lower the vulnerability of farmers to poverty. According to Table 2, it can be seen that the regression coefficient of air pollution to farmers' poverty vulnerability is significantly negative and presents the U-shape, which shows that with industrial development, the impact of economic poverty vulnerability is gradually reduced.

Secondly, the effect of control variables on the vulnerability of farmers' poverty is analyzed. From the characteristic analysis of the family level, the regression coefficient of family size, family net income, income to farmers' poverty vulnerability are significantly negative at the level of 1%, indicating that the vulnerability of poverty increases significantly with the accumulation of income and family size. Family size, number of people involved in agriculture, forestry, animal husbandry and fisheries production in the family, number of people involved in local wage work, number of people involved in local non-farm production and operation, number of people working outside the family, age, number of children in the family (less than sixteen years old), level of education, marital status, net income of the family, income, and the control variables such as medical insurance, old-age insurance and labor insurance benefits are related to the poverty vulnerability of farmers.

| Variable          | Obs  | Mean   | Std.Dev | Min     | Max    |
|-------------------|------|--------|---------|---------|--------|
| \( \ln \text{poor_china} \) | 31,585 | .0475824 | .0583642 | 0       | .5151276 |
| \( \ln \text{PM25} \)       | 32,892 | 3.723812 | .4524749 | 2.000128 | 4.448633 |
| family_size       | 32,892 | 4.374833 | 1.496072 | 1       | 15     |
| num_work          | 32,892 | .8045725 | 1.005016 | 0       | 6      |
health insurance, old age, level of education, husbandry and fisheries production in the family, the explanatory variable into poverty in the future. Air pollution is used as a key microsurvey data. Gross characteristics include two aspects: research, the control variables of this paper mainly literature on the choice of control variables, reference represent the parameter situating for the effect of air pollution on microsome families. The size of the family, including household income, household net income, etc.; a series of control variables. With the control variables, model 2 presents the U-shaped relationship between air pollution and poverty vulnerability. The regression coefficient of air pollution to farmers' poverty is analyzed. According to Table 2, it can be seen that the higher the proportion of air pollution, the lower the vulnerability of farmers to poverty. According to Table 2, it can be seen that the higher the proportion of air pollution, the lower the vulnerability of farmers' poverty. According to Table 2, it can be seen that the higher the proportion of air pollution, the lower the vulnerability of farmers' poverty. According to Table 2, it can be seen that the higher the proportion of air pollution, the lower the vulnerability of farmers' poverty. According to Table 2, it can be seen that the higher the proportion of air pollution, the lower the vulnerability of farmers' poverty. According to Table 2, it can be seen that the higher the proportion of air pollution, the lower the vulnerability of farmers' poverty.

|                  | (1)      | (2)      | (3)      | (4)      | (5)      | (6)      | (7)      | (8)      | (9)      |
|------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| ln_PM25          | -0.027***| -0.024***| -0.025***| -0.024***| -0.024***| -0.024***| -0.025***| -0.024***| -0.023***|
| (-36.74)         | (-34.94) | (-39.56) | (-38.77) | (-38.54) | (-39.87) | (-40.50) | (-39.99) | (-39.15) |
| Control Variable | No       | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      |
| Time Effect      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      |
| Variable Control | _cons    | 0.145*** | 0.097*** | 0.082*** | 0.082*** | 0.081*** | 0.059*** | 0.061*** | 0.082*** |
|                  | (54.35)  | (34.71)  | (32.55)  | (32.57)  | (32.25)  | (22.81)  | (23.88)  | (31.73)  | (29.97)  |
| N                | 31585    | 31585    | 31585    | 31585    | 31585    | 31585    | 31585    | 31585    | 31585    |
| adj.R2           | 0.041    | 0.097    | 0.269    | 0.281    | 0.282    | 0.303    | 0.309    | 0.333    | 0.351    |

Table 2. Effects of industrial agglomeration on the emission intensity of three pollutants

Note: The regression uses robust standard error. The t statistic in parentheses. *, **, and *** represent significance levels of 10%, 5%, and 1% respectively.

References

1. Cole, M., R., Elliott and Shanshan Wu, Industrial Activity and the Environment in China: An Industry-level Analysis, China Economic Review 19, 393-408 (2008)
2. Min Yang, Empirical Research on the Influence of Industrial Agglomeration on Industrial Pollution Emission: Based on the Comparison of Manufacturing Agglomeration and Service Industry Agglomeration, Truth Seeking 02, 59-74+111 (2018)
3. Xin Zhang, Industrial Emission Reduction Effect of Logistics Industry Agglomeration: Based on the Yangtze River Delta Space Panel Model, Value Engineering 19, 92-95 (2019)
4. Fan Yang, Yi Zhou, Canfei He, Industrial Organization, Industrial Agglomeration and Chinese Manufacturing Pollution, Acta Scientiarum Naturalium Universitatis Pekinensis 03, 563-573(2016)
5. Zhiqiang Hu, Jianming Miao, Changhong Miao, Spatial Characteristics and Econometric Test of Industrial Agglomeration and Pollutant Emissions in China, Scientia Geographica Sinica 2, 168-176(2018)
6. Zhiqiang Hu, Changhong Miao, Feng Yuan, Impact of industrial spatial and organizational agglomeration patterns on industrial SO2 emissions of prefecture-level cities in China, Acta Geographica Sinica 10, 2045-2061(2019)