Research on the Efficiency of Beijing's Policy-oriented Agricultural Insurance

En Chen[a], Yifei Ma*

BEIJIGN INTERNATIONAL STUDIES UNIVERSITY, No. 1, Dingfuzhuang Nanli, Chaoyang District, Beijing, China
*[a]tw_chenen@126.com, *mayifei@bisu.edu.cn*

Abstract

Agricultural insurance, an important tool to reduce the risk of agricultural production, cannot function well without government subsidies due to its quasi-public nature. In 2007, China's fiscal subsidies for agricultural insurance premiums officially began. Beijing is one of the first cities to implement policy-oriented agricultural insurance and the study of its agricultural insurance operational efficiency has implications for other cities. This paper uses the insurance operation in Beijing for each year from 2007 to 2018 as the decision unit, government subsidies as the input and agricultural output value as the output to study the operational efficiency of agricultural insurance based on the DEA-BCC model. The study finds that the implementation efficiency of agricultural policy insurance in Beijing is higher than the national average. It is of replication significance to strengthen regulation, enrich the types of insurance, improve the electronic level of insuring and claims, and raise farmers' insurance awareness.

***Keywords**: Agricultural insurance, Operational efficiency, DEA.*

1.INTRODUCTION

Agricultural production is closely related to national stability, national security, and people's lives. However, China's agricultural production cannot be fully self-sufficient, and part of it needs to rely on imports from the international market. In 2020, China's imports of agricultural products such as grain and meat increased by 28% and 60.4% respectively. Among them, China imported 162.74 billion yuan of agricultural products from the United States, an increase of 66.9%. However, affected by the severe international situation and changes in international relations, the import of agricultural products is facing more uncertainty. Also, agriculture is vulnerable to natural and man-made disasters, including climate change, frequent extreme weather, animal and plant diseases, reduction of arable land, market price fluctuations and international trade frictions, making agricultural production risky. In 2020, various natural disasters directly damaged China's crop area of 19.9577 million hectares, with direct economic losses of 370.15 billion yuan. Even with a bumper harvest, the paradox of "Cheap grain harms the peasants" has exacerbated the vulnerability of agriculture. Therefore, it is important and urgent to reduce agricultural production risks and improve domestic agricultural production capacity.

The fragility and importance of agriculture make agricultural insurance especially important. Agricultural insurance is an important means to reduce agricultural production risks, which is conducive to stabilizing the income of farmers, expanding the scale of agricultural production, and maintaining the red line of agricultural production. However, agricultural insurance has not been implemented in China for a long time. Farmers' awareness of insurance is not strong and farmers are not willing to apply for insurance on their own initiative. Therefore, the government needs to provide subsidies and strengthen publicity to encourage farmers to participate in insurance. At the same time, agricultural insurance, as a quasi-public product with positive externalities, can easily lead to insufficient effective demand and limited effective supply. Therefore, appropriate government subsidies are also indispensable. In 2007, the Ministry of Finance launched a pilot project to subsidize agricultural insurance premiums. But scholars generally believe that the implementation of policy-oriented agricultural insurance in China has not been very efficient in these years [15]. Farmers' awareness of agricultural insurance is inadequate.

Previous studies mainly use national-level data, and there are few studies on specific regions. As the capital, the economic center of China and one of the first cities to implement policy-oriented agricultural insurance,

G. Vilas Bhau et al. (Eds.): MSEA 2022, ACSR 101, pp. 618–624, 2023.
https://doi.org/10.2991/978-94-6463-042-8_89

Beijing is an important reference for the formulation and implementation of agricultural insurance policies in other provinces in China. Beijing is located in a continental temperate monsoon climate zone with an unstable climate, which has a greater negative impact on agricultural production. According to statistics, during the ten years from 1995 to 2004, natural disasters, plant and animal diseases caused an average annual agricultural economic loss of 650 million yuan in the suburbs of Beijing. Beijing agriculture mainly serves the city. The main agricultural products are fruits, vegetables, grains, poultry, eggs and milk. The stability of agricultural production directly affects the people's lives in Beijing. Providing subsidies to Beijing's agriculture insurance is not only a guarantee for the income of farmers in Beijing, but also has significance for stabilizing the people's livelihood in the city. We study the operational efficiency of policy agricultural insurance in Beijing and analyze its strengths and weaknesses in the implementation process in order to make full use of its advantages and make up for its shortcomings. At the same time, it can provide experience for other provinces.

2.LITERATURE REVIEW AND THEORETICAL BASIS

2.1. Research on the Impact of the Implementation of Policy-oriented Agricultural Insurance on Farmers' Income

When agricultural production is damaged, agricultural insurance can make up for the loss of farmers. Also, agricultural insurance disperses the risk of agricultural production, making farmers bolder to expand production. Therefore, the implementation of policy-oriented agricultural insurance can effectively increase agricultural productivity and increase farmers' income. Wang, Fang and Xie (2020) demonstrate that agricultural insurance subsidy policy has a significant effect on increasing farmers' per capita net income and farmers' household operating income through multi-period DID model and continuous DID model [11]; Zhang, Yi, Xu and Huang (2019) propose that agricultural insurance subsidies encourage farmers to increase production input and influence their choice of crop type [13]; Liu (2010) propose that Beijing's policy-oriented agricultural insurance has achieved good results by virtue of its multiple forms of fiscal expenditure and guarantee, as well as its market-oriented management mode [5].

2.2. Research on the Problems Existing in Agricultural Insurance Subsidies

Scholars mainly demonstrate the possible problems of agricultural insurance subsidies from two dimensions. On the one hand, poor design of subsidies, failure to adapt to time and local conditions, poor implementation and poor supervision may all lead to poor implementation effects. Tuo and Zhu (2016) review the practice of policy-oriented agricultural insurance in China, and put forward two problems [18]. First, the strong promotion of government causes illegal operation. Second, scattered agricultural distribution makes agricultural insurance premiums and claims more costly. On the other hand, from the perspective of economic theory, government subsidies for agricultural insurance destroy the competitiveness of the market and reduce the overall social utility. Lusk and Jayson (2017) propose that the implementation of agricultural insurance subsidies in the United States reduces producer surplus and consumer surplus [8]. Capitanio and Fabian (2011) propose that in the case of competitive supply, subsidies for agricultural insurance will benefit farmers, while monopolistic supplier will receive most of the subsidies, thus dampening farmers' enthusiasm for wider participation [2].

2.3. Research on the Overall Implementation Efficiency of Policy-oriented Agricultural Insurance in China

China has not implemented policy-oriented agricultural insurance for a long time and the overall implementation efficiency is not high. In addition, affected by the differences in economic development and agricultural production methods, the implementation efficiency of policy-oriented agricultural insurance in China has large regional differences. Zhang (2020) defines the efficiency of premium subsidies as the ratio of the amount of premium subsidy funds converted into farmers' actual income and premium subsidies, and empirically calculated that the average efficiency of China's agricultural policy insurance subsidies is only about 70% [15]; Zhu and Jiang (2019) use the panel threshold model to calculate the FGT poverty index and agricultural insurance subsidies in various provinces across the country from 2010 to 2016. They propose that the poverty alleviation effect of China's policy-oriented agricultural insurance is subject to the level of economic development, and localities should consider the actual local economy to formulate appropriate subsidy policies [19]; He, Tuo and Li (2014) take Huai'an, Jiangsu Province as an example to illustrate that government intervention in agricultural insurance may damage the efficiency of agricultural insurance [4]. Zhang (2018) calculates the ratio of the total amount of China's agricultural insurance indemnities to the total premiums from 2003 to 2017 and the average indemnity of households receiving indemnities and finds that China's agricultural insurance does not play a role in risk-sharing [14]. Wang, Fang and Xie (2020) use multi-period DID model, continuous DID model to show that the implementation efficiency of China's agricultural insurance subsidy policies have large regional differences, and the implementation efficiency in the central and western regions is better than that in the eastern regions [11].

2.4. Literature Review

At present, domestic research on the efficiency of policy-oriented agricultural insurance mostly focus on national or regional differences, while research on Beijing's policy-oriented agricultural insurance is rare. Due to the different selected indicators and analysis methods, the results obtained are also different. The use of linear regression model or difference model is mainly for detailed and in-depth analysis of specific factors, while DEA model is more inclined to analysis comprehensive efficiency.

2.5. Theoretical Basis

Insurance has the function of financing and compensating for losses. On the one hand, insurance companies collect capital from individuals by charging premiums and transfer it to other investments. On the other hand, individuals who suffer losses can receive partial compensation so that risks can be compensated. It encourages people to expenditure more goods and services, thereby encouraging production and employment, and ultimately achieving economic growth. Insurance is generally paid by the policyholder, and insurance companies provide corresponding protection. Policy-oriented agricultural insurance is a special type of insurance, and the government provides subsidies for most of the premiums. There are two main reasons behind government subsidies for agricultural insurance. One is the market failure that restricts the development of the private insurance market, and the other is for national security and social stability. Although in many cases, subsidized agricultural insurance has many benefits, experience has shown that poorly designed or poorly implemented agricultural insurance subsidy programs can lead to disappointing results. For example, high government subsidies urge farmers to adopt riskier production mixes, which in turn increases the subsidy budget needed by the government, leading to major economic costs and inefficiencies, which may be more detrimental to economic and social development. In order to avoid these problems, any insurance subsidy policy needs to be carefully designed. To measure whether the insurance subsidy policy is "smart", it is necessary to analyze the relationship between government's subsidy for agricultural insurance and the effects of agricultural insurance such as the amount of compensation and the impact of agricultural insurance on increasing agricultural products.

3.EMPIRICAL STRATEGY

3.1.DEA Model

Data Envelopment Analysis (DEA) is a new method for the intersection of operations research, management science and mathematical economics. The DEA method and its model have been proposed by famous American operations researchers A. Charnes and W.W. Cooper since 1978. The DEA model uses a mathematical programming model to evaluate the relative effectiveness of objects (decision-making units) with multiple input and output indicators, and to judge whether the decision-making unit is on the frontier of the possible production set. The model results have three indicators: pure technical efficiency, scale efficiency, and comprehensive technical efficiency. According to the assumption of variable returns to scale, the DEA model can be divided into a CCR model based on constant returns to scale and a BCC model based on variable returns to scale.

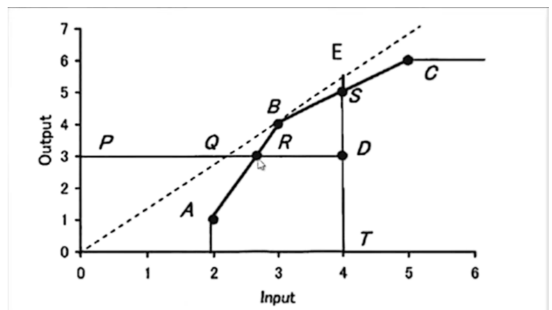

Figure 1: DEA model geometric illustration.

In Figure 1, the horizontal axis represents the amount of input in a certain economic process, and the vertical axis represents the output. The dashed ray represents the production frontier assuming constant returns to scale, the solid broken line ARBSC represents the production frontier assuming variable returns to scale, and point D represents any possible input-output production point. CCR_TE stands for comprehensive technical efficiency, BCC_TE stands for pure technical efficiency, and SE stands for scale efficiency.

CCR_TED = PQ/PD, which means that when the corresponding point of production input and output is point D, assuming constant returns to scale and constant output, the ratio of the amount of input under the optimal configuration to the actual amount of input. BCC_TED = PR/PD, which represents the ratio of the amount of input under the optimal configuration to the actual amount of input, assuming a variable return to scale and a certain output. SED=PQ/PR=CCR_TED/BCC_TED, which means the difference in efficiency because of the different return to scale assumptions. From SED=PQ/PR=CCR_TED/BCC_TED, it can be calculated that CCR_TED=BCC_TED×SED, that is, comprehensive technical efficiency equals pure technical efficiency multiply scale efficiency.

Generally speaking, the efficiency rate is between 0 and 1. When the efficiency rate is equal to 1, the resource allocation achieves optimal results; when the efficiency value is equal to 0, the resource allocation is completely invalid; the greater the efficiency rate, the more effective the resource allocation. For the BCC model, the assumption of variable returns to scale has two situations: increasing returns to scale and diminishing returns to scale. Increasing returns to scale means that with the expansion of scale, the increase in output brought about by each additional unit of input is increasing; diminishing returns to scale means that with the expansion of scale, the increase in output brought about by each additional unit of input is diminishing. It can be seen from the figure 1 that the return to scale at point B remains constant, the return to scale above point B decreases, and the return to scale below point B increases.

According to the different focus on the analysis results, the DEA model can be divided into output-oriented and input-output types. The output-oriented type is to study whether the output is maximized when the input is certain; the input-oriented type is to study whether the input is minimized when the output is certain.

To study the efficiency of output under certain government subsidies for agricultural insurance and assuming variable returns to scale, the output-oriented DEA-BCC model is chosen.

3.2. Variable Selection and Data Sources

We use 2007-2018 Beijing agricultural insurance premium income, agricultural insurance density, and insured amount as input variables, and the average output value of agriculture, forestry, animal husbandry, and fishery created by each producer, agricultural insurance depth, and agricultural insurance indemnities as output variables. The data comes from the 2008-2019 "Insurance Statistical Yearbook" and "Beijing Statistical Yearbook", as well as the official website of the government.

3.2.1. Input Variables

(1) Agricultural insurance premium income refers to the actual income of insurance companies selling agricultural insurance, which can indirectly reflect the government's subsidies for agricultural insurance. (2) Agricultural insurance density is equal to the premium income of agricultural insurance divided by the number of people engaged in agricultural production, reflecting the importance that agricultural producers attached to agricultural insurance. The higher the insurance density, the more importance the producer pays to insurance, and the higher the degree of insurance. (3) Insured amount is equal to the effective insured amount minus the end-of-term liability reserve, where the effective insured amount refers to the maximum amount that the insurance companies need to pay if the insurance incidents with the maximum payment amount in the insurance contract occur; the end-of-term liability reserve is the statutory minimum liability reserve that China Banking and Insurance Regulatory Commission required. The insured amount reflects the scope of insurance coverage and the degree of protection for the overall agricultural production.

Table 1: Summary Statistics

	Mean	Median	Max	Min	SD	Skew.	Kurt.	N
(I)insurance income	464.45	482.11	777.20	75.35	189.23	-0.44	2.82	12
(I)insurance density	52.80	57.82	76.94	11.53	16.87	-1.14	4.14	12
(I)risk coverage	16183.75	13750.00	26267.00	2240.00	8843.26	-0.04	1.50	12
(O)output value	63524.92	64867.00	81816.00	44276.00	11700.40	-0.11	1.97	12
(O)insurance depth	0.04	0.03	0.07	0.01	0.01	0.24	3.10	12
(O)compensation	372.56	438.20	599.07	40.22	168.81	-0.47	2.24	12

3.2.2. Output variables

(1) Because Beijing's leisure agriculture accounts for a large part of the whole income of farmers,I use the average output value of each farmer created from agriculture, forestry, animal husbandry, and fishery as an

output indicator of the agricultural insurance. (2) The depth of agricultural insurance, which equals agricultural insurance premium income divided by total output value, reflecting the support of agricultural insurance to agricultural production. The higher the insurance depth, the better the insurance development. (3) The insurance indemnities refers to the amount actually paid by the insurance company for agricultural insurance accidents within a year, reflecting the extent to which agricultural insurance compensates for the losses of farmers. Table 1 contains summary statistics about the input variables and output variables.

3.3. Empirical Results and Analysis

Table 2: Results of DEA-BCC model

Output-oriented DEA-BCC model				
DMU	PTE	TE	SE	RTS
2007	1.00	1.00	1.00	Constant
2008	1.00	1.00	1.00	Constant
2009	0.97	1.00	0.97	Decreasing
2010	0.94	0.98	0.96	Decreasing
2011	0.84	0.97	0.87	Decreasing
2012	1.00	1.00	1.00	Constant
2013	0.95	1.00	0.95	Decreasing
2014	1.00	1.00	1.00	Constant
2015	0.89	0.98	0.91	Decreasing
2016	1.00	1.00	1.00	Constant
2017	1.00	1.00	1.00	Constant
2018	1.00	1.00	1.00	Constant
Mean	0.97	0.99	0.97	

Note: PTE refers to pure technical efficiency, TE refers to comprehensive technical efficiency, SE refers to scale efficiency, and RTS refers to return to scale.

In the DEA-BCC model of policy-oriented agricultural insurance, pure technical efficiency represents the government's subsidy design and management efficiency under the current agricultural production level and insurance level, the service of insurance companies and the publicity cost are included. It can be interpreted from three aspects: the government, farmers, and insurance companies. The average pure technical efficiency of Beijing's agricultural policy insurance from 2007 to 2018 is 0.994, slightly higher than the national average of 0.963, indicating that Beijing's agricultural insurance policy is formulated reasonably and implemented effectively. The farmers' enthusiasm for insurance is high and the risk of agricultural production is also reduced; the service level of insurance companies is also relatively high.

Scale efficiency refers to the effectiveness of government subsidy funds under the condition of certain pure technical efficiency. It measures whether the amount of subsidies and the scope of coverage are appropriate under the subsidy system, and whether there is a waste of resources or insufficient subsidies. If the scale efficiency is effective, it means that the government investment funds are at the optimal scale and the investment funds have been used efficiently. If not, it means that it is not at the optimal scale of subsidies, and there is insufficient capital or a waste of capital. The average scale efficiency of Beijing's agricultural policy insurance from 2007 to 2018 is 0.971, while the national average is 0.809, indicating that Beijing government subsidies for agricultural insurance are relatively reasonable, the subsidy scale is adapted to the actual agriculture development, and the allocation efficiency of subsidy funds is high.

Comprehensive technical efficiency represents the degree of maximum output under a given input or minimum input under a given output under the current agricultural production level and insurance level. Comprehensive efficiency is the product of pure technical efficiency and scale efficiency, and two factors are considered comprehensively. The average comprehensive technical efficiency of Beijing's agricultural policy insurance from 2007 to 2018 is 0.966, while the national overall average is 0.780. The efficiency of Beijing's policy-oriented agricultural insurance has basically achieved maximum. Experience can be learned from it and provide support for the formulation and implementation of policy-oriented agricultural insurance policies in other provinces and cities.

4.CONCLUSION

From the above analysis, it can be seen that the implementation efficiency of Beijing's policy-oriented agricultural insurance is high, and it has a significant role in promoting agricultural production. Beijing is one of the first cities in China to implement policy-oriented agricultural insurance. At present, there are more than 30 types of insurance, covering planting, breeding, and forestry, and the implementation effect has always been at the leading level in the country. In terms of agricultural insurance innovation, Beijing has also given full play to its pioneering role. In 2019, Beijing launched a pilot program for the electronic reform of the entire process of policy-oriented agricultural insurance underwriting; in 2020, Beijing will be the first to start the electronic informationization of agricultural insurance claims, which conforms to the development trend of urban modern agriculture, and promotes the innovation and improvement of insurance technology. It also can improve the service level and supervision level of agricultural insurance.

REFERENCES

[1] Cao Lei & Zhao Jing. (2019). Research on welfare changes when government intervene agricultural machine insurance market. J. Journal of Chinese Agricultural Mechanization，40(12), 200-206.

[2] Fabian. C., Maria. B. D, Carlo.C. & Felice. A. (2011). Does market competitiveness significantly affect public intervention in agricultural insurance: the case in italy. J. Applied Economics, 43(27), 4149-4159.

[3] Fei Youhai. (2005).The Roots of China's Agricultural Insurance Development Dilemma From the Perspective of Welfare Economics. J. Journal of Finance(03),133-144.

[4] He Xiaowei，Tuo Guozhu & Li Wenzhong. (2014). Government Intervention, Rent － seeking Competition，and Efficiency of the Agriculture Insurance Market: A Case Study on Huaian City of Jiangsu Province. J. Insurance Studies(08), 36-41.

[5] Liu Chunguang & Liu Yuelin. (2010). A Reflection on the Practices for Establishing the Policy-oriented Agricultural Insurance System in Beijing. J. Insurance Studies(03), 72-77.

[6] Long Wenjun. (2021). Agricultural Insurance in the 14th Five-Year Plan Period: Trend Judgment, General Ideas and Guarantee Mechanism. J. China Insurance(02), 8-13.

[7] Lu Fei, Zhang Jianqing & Liu Minghui. (2017). A Study on Policy Agricultural Insurance: Its Effect on the Growth of Farmers' Incomes. J. Insurance Studies(12), 67-78.

[8] Lusk & Jayson, L. (2017). Distributional effects of crop insurance subsidies. J. Applied Economic Perspectives and Policy, 39, 1-15.

[9] Qian Zhenwei，Zhang Yan & Gao Dongxue. (2014). Subsidy Efficiency Evaluation of Policy- oriented Agricultural Insurance based on the Three Stage DEA Model. J. Commercial Research, (10), 58-64.

[10] Shao Quanquan & Guo Mengying. (2020). Can Agricultural Insurance Promote Agricultural Economic Growth? J. Economic Perspectives(02), 90-102.

[11] Wang Liyong, Fang Hongyu & Xie Fuzheng. (2020). Researches on the Effectiveness of China's Agricultural Insurance Fiscal Subsidies Policy:Evidences from Quasi-experiments. J. Journal of Central University of Finance & Economics(09), 24-34.

[12] Zhang Haijun. (2019). The Connotation of High Quality Development for Agricultural Insurance in China and the Execution Path. J. Insurance Studies(12), 3-9.

[13] Zhang Wei, Yi Pei, Xu Jing & Huang Ying. (2019). Incentivizing Effect of Policy Agricultural Insurance on Grain Output. J. Insurance Studies(01), 32-44.

[14] Zhang Yuhuan. (2018). Enhance the Ability of Agriculture Risk Coverage and Implement the Strategy of Rural Vitalization. J. Social Scientist(11), 39-46.

[15] Zhang Zurong. (2020). Study on the usage efficiency of agricultural insurance premium subsides. J. Gansu Social Sciences(02), 179-184.

[16] Zheng Jiamei. (2020). The Impact of Policy Agricultural Insurance on Agricultural Output Based on the DID Model. J. Practical Rural Technology(02), 29-30.

[17] Zhou Yanli. (2019). Promote the High-quality Development of Agricultural Insurance. China Finance(23), 19-20.

[18] Zhu Junsheng. The Dilemma of Financially Subsidised Agricultural Insurance. N. China Insurance News, 2016-06-30(003).

[19] Zhu Rui & Jiang Shengzhong. (2019). An Analysis of Poverty Alleviation Effectiveness of Policy-Oriented Agricultural Insurance in China. J. Insurance Studies(02), 51-62.