# Quantitative Assessment of the Impact of China's Direct Grain Subsidies on Grain Yield——Based on the Empirical Analysis of Panel Data Pertaining to 29 Provinces in the Period 2004 -2007

**SUN Shun-qiang*, ZHU Gui-ying**

College of Economics and Management, Southwest University, Chongqing 400715, China

**Abstract** We build the influence function empirical model of China's grain production at the present stage in view of the factors influencing direct grain subsidies, using Cobb-Douglas production function model. And we estimate the elasticity coefficient of impact of China's direct grain subsidies on grain yield, using the panel data pertaining to 29 provinces in the period 2004 -2007; comparatively analyze the validity and limitation of policy factors of direct grain subsidies on China's grain yield. The results show that at the present stage, the elasticity coefficient of impact of China's direct grain subsidies on grain yield is 0.002 3, and under the existing subsidy system and level, direct grain subsidies play a positive role in increasing grain yield, but the role is limited; the elasticity coefficient of impact of the food price on grain yield is much larger than that of impact of direct grain subsidies on grain yield. Therefore, the government should strengthen and improve direct grain subsidy policies; in the mean time, pay full attention to the use of market mechanism to consolidate the basic role of the food price in promoting food security to a great extent.

**Key words** Direct grain subsidies, Grain yield, Food price, Elasticity coefficient

The direct grain subsidies are the grain-production-oriented financial support by one country to achieve food security and other political, economic and social objectives. Under the conditions of market economy, we should pay particular attention to the social commonality and necessity of food production, and especially in the context of tight balance of China's grain supply and demand, the public nature of food production labor as socially necessary labor is particularly prominent. The use of public finance to implement direct grain subsidies is of great significance to promoting food production safety. Since 2004, issues concerning direct grain subsidies have become the focus and emphasis of domestic agricultural economic management theory and practice studies[1-3], but there is a shortage of studies of evaluating the comprehensive and holistic performance of China's direct subsidies to grain production, using econometric model in accordance with the provincial panel data. Through quantitative evaluation of the impact of direct grain subsidies on grain yields, we conduct quantitative analysis of the validity, limitation and other issues concerning direct grain subsidies, and propose to adhere to and improve China's direct grain subsidy policies to help the Chinese government to make better use and improve the policy tool of direct grain subsidies, in order to promote the healthy development of China's grain industry, ensure China's food security, increase grain growers' income, promote the fair income distribution for the agricultural laborers in society, and achieve continuous, stable, balanced and healthy development of national economy.

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* Corresponding author. E-mail: youxiangshijie@126.com

## 1 Overview of literatures

Since 2004, in the study field of domestic economic management of agriculture and forestry, issues concerning direct grain subsidies have become the focus and emphasis of domestic agricultural economic management theory and practice studies[1-3]. From the existing research literature, there is a shortage of systematic studies of evaluating the comprehensive and holistic performance of China's direct subsidies to grain production, using econometric model in accordance with the provincial panel data[4]. Taking the demand-supply curve of food as the theoretical analysis tool, Xiao Guoan analyzes the impact of direct grain subsidy policies on the food producers, food consumers, food operators and the government, and the loss of total social welfare through the welfare economics[5]. On the basis of the survey data regarding 340 rural households in 5 counties of 3 provinces (Hebei, Henan and Shandong), Wang Jiao conducts quantitative evaluation of the impact of grain direct subsidy policy and a variety of subsidy forms on grain yield and farmers' income, using empirical mathematical programming model (PMP model)[6]. Ye Hui and some researchers holds that for the research of China's direct grain subsidies, we should not only consider the implementation effect of policy, but also take into account the fulfillment costs of policy, thereby the subsidy policy has the operability and sustainability. They use the standard method of researching the efficiency issues (Data Envelopment Analysis, DEA), to study the subsidy efficiency from "system efficiency" and "scale efficiency"[7]. Han Xiping, *et al.*, conduct the dynamic analysis based on the function of food production, food cost curve, and grain output, in order to test the yield effect of direct grain subsidy policy. Using this method, they come to the conclusion that in the case of the government paying the same cost, the implementation of direct grain subsidy policy is more effective

than the implementation of subsidy policy of means of production, in increasing grain yield[8]. In terms of grain production research, Ma Wenjie, *et al.*, generally believe that the factors influencing grain yield include land, agricultural labor, fertilizer, agricultural machinery power, technological progress and so on[9]. Zhou Yingheng, *et al.*, hold that rise in prices is one of the main reasons for increasing the grain yield in the period 2004 –2006, and the new domestic support policies make one fourth of the contribution to increase in yield, when applying the global trade analysis project (GTAP) to the study and assessment of the current major domestic agricultural support policies in China[10].

## 2 Basic assumption, selection of the model variables and data explanation

**2.1 Basic assumption** By integrating the relevant researches of predecessors, the factors influencing grain yield can be summarized as follows: first, the inputs of production factors, including the growing area of grain, the labor input, application rate of chemical fertilizer, and use of agricultural machinery; second, agricultural technology progress; third, the national policy, food production support policy, policies for protecting interests of the grain growers; fourth, natural disasters; fifth, the level of grain yield per unit; sixth, the change of food prices.

The basic assumption in this study is as follows. First, according to the characteristics of China's current situation and food production, the planting area of grain is the main factor influencing grain yield. The greater the growing area of grain, the higher the grain yield. At the present stage, China's direct grain subsidies are mostly the subsidies for grain (including rice, wheat, corn), so in the following analysis and estimate, we substitute the grain yield data for food yield data, the planting area of grain for the planting area of food. Second, the cost of food production is an important factor affecting food production, and the income of farmers. Third, under conditions of market economy, the sensitivity of farmers to price is getting higher and higher, and the change in the food price is one of the important factors affecting food production and supply. Fourth, the factor of policy system is an important factor affecting food production. The policy of direct subsidies to grain production is one of important institutional factors affecting grain yield at the present stage.

**2.2 Selection of the model variables and data explanation**

In accordance with Cobb-Douglas production function model and the above basic assumption, the influence function empirical model of China's grain production at the present stage can be expressed as follows:

$$Y_{it} = AG_{it}^{b1} P_{it}^{b2} J_{it}^{b3} Z_{it}^{b4} e^{U_{it}} \quad (1)$$

where $Y_{it}$ is the total grain output; $G_{it}$ is the planting area of grain; $P_{it}$ is the cost of grain production; $J_{it}$ is the food price; $Z_{it}$ is direct grain subsidies; $A$ refer to the technical efficiency and other influencing factors; $e^{U_{it}}$ is random term; $b_1$, $b_2$, $b_3$, $b_4$ are the elasticity coefficients of all variables; $i$ is the province in China; $t$ is time. After taking the logarithm of all variables, the model is transformed into:

$$\ln Y_{it} = \ln A + b_1 \ln G_{it} + b_2 \ln P_{it} + b_3 \ln J_{it} + b_4 \ln Z_{it} + U_{it} \quad (2)$$

Model (2) is a logarithmic form of multiple regression model, where $\ln A$ is intercept of model, denoted by $C$ in the estimation results.

For the estimation and calculation of the coefficients of the model, we can use the panel data pertaining to provinces of China in the period 2004 – 2007 to estimate the coefficients of the model. At the present stage, China's direct grain subsidies are mostly the subsidies for grain (including rice, wheat, corn), so in the following analysis and estimate, we substitute the provincial grain yield data for food yield data, the provincial planting area of grain for the planting area of food. The cost of food production is replaced by the provincial average annual total cost of grain (including rice, wheat, corn); the food price is replaced by the provincial average annual selling price of grain (including rice, wheat, corn); the direct grain subsidy data are replaced by provincial annual subsidy data. Due to lack of unified data released, the data of direct grain subsidies are incomplete statistics, and the samples only involve 29 provinces (municipalities) (excluding Hong Kong, Macao, Taiwan, Hainan and the Tibet Autonomous Region). The related panel data are from *China Statistical Yearbook and Collection Data of Costs and Returns of National Agricultural Products* (2004 – 2008).

## 3 Results and analysis

By referring to the relevant research experience and case, since the sample data are panel data, and there is difference in the annual grain yield of all the provinces (municipalities) in this study (in addition to the impact factors assumed above, there are also climate, soil conditions and other factors), we directly use the variable intercept model, having not conducted F-test of the sample data. As for choosing the fixed effect or random effect model, some researchers believe that if only taking the effect of samples as condition for the study, it is fit to use the fixed effect model. Since we conduct research only on the basis of data concerning China's provinces (cities) using the model, the fixed effect model is chosen for estimation[11-13].

In order to reduce the impact of heteroscedasticity due to the cross-sectional data (period data), we choose to use generalized least squares (GLS) in estimation on the basis of sample data, and conduct model regression estimate of variable intercept fixed effect, using panel data processing program of econometric software Eviews 5.0, to get the variable regression equation of grain yield:

$$\ln Y_{it} = -0.265\ 947 + 0.877\ 506 \ln G_{it} + 0.008\ 246 \ln P_{it} + 0.113\ 253 \ln J_{it} + 0.002\ 262 \ln Z_{it} \quad (4)$$

(−0.670 433) (18.178 700) (0.279 380) (2.980 757) (0.604 168) The determination coefficient after the adjustment of equation (4) reaches 0.999 989, indicating that goodness of fit of the model is high; the DW test value is 2.235 163, proving that the there is no serial correlation in residual. From the estimation results of the model, we can find that the planting area of grain has the greatest impact on the fluctuations in grain yield, and when the planting area of grain increases or decrea-

ses by 1 percentage point, the output will increase or decrease by 0.877 506 percentage point; the food price has the second greatest impact on the fluctuations in grain yield, and when the food price rise or fall by 1 percentage point, the output will increase or decrease by 0.113 253 percentage point; the costs of grain production and direct subsidies have little impact on grain yield, and when the costs of grain production increases or decreases by 1 percentage point, the output will increase or decrease by 0.002 262 percentage point.

## 4 Conclusions and policy recommendations

**4.1 Conclusions** The planting area of grain is the most important factor currently affecting China's grain production, with elasticity coefficient reaching 0.877 506; the food price is an important factor affecting grain yield, with elasticity coefficient reaching 0.113 253; the elasticity coefficient of grain production costs is 0.008 246, indicating that the impact of price on grain yield at the present stage is important; the elasticity coefficient of impact of direct grain subsidies on grain yield at the present stage is 0.002 262, and the impact is positive but not prominent.

The elasticity coefficient of the impact of food price is much larger than that of the impact of direct grain subsidies on grain yield. Under the existing subsidy system and level, direct grain subsidies play a positive role in increasing grain yield, but the role is limited. The basic role of increasing the food price in promoting food security can not be ignored. Therefore, the government should strengthen and improve direct grain subsidy policies; in the mean time, pay full attention to the use of market mechanism to consolidate the basic role of the food price in promoting food security to a great extent[13].

**4.2 Policy recommendations** First, direct grain subsidies mainly give play to the role of lever. China should increase financial input into agricultural infrastructure construction; drive the development of the related investment subjects; strengthen investment in rural transport, communications, energy network construction; increase investment in irrigation and water conservancy construction; increase input to land consolidation and transformation of medium-and-low-yield field; increase investment in agricultural resources and ecological environment protection.

Second, in view of the positive impact of direct grain subsidies, China should expand the range of direct subsidies for grain production, promote the level of subsidies. It should extend subsidies to all varieties of grain, to all food producers, and promote the direct subsidies for food production to a stimulative, effective and appropriate level.

Third, China should establish the long-term mechanism of direct subsidies for grain production; incorporate the grain production subsidies into the orbit of the rule of law; improve the organizational system of food production subsidies; establish subsidy funds of grain production; levy the taxes of grain production subsidies; use the fund exclusively for its designated purpose; improve the national budget revenue and expenditure control system of food production subsidies.

Fourth, the state should improve the information-based service level of food production subsidy system, establish sound and specialized information service network platform of food production subsidy, to timely release the related information of national grain production subsidies, and provide relevant information inquiry service; carefully gather opinions and suggestions of the majority of food producers, establish and improve decision-making feedback service mechanism of the grain production subsidy policy.

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