

Scheme of Constructing CGE Model of China's Direct Grain Subsidy Policy

WANG Can*

Economics & Management College, Henan Agricultural University, Zhengzhou 450002, China

Abstract This paper introduces the model of China's direct grain subsidy policy, adopts computable general equilibrium (CGE) theory, and advances the scheme of constructing the model of China's direct grain subsidy policy. On the basis of some assumptions, such as conforming to the complete competition of market, inexistence of move of capital and labor forces among countries, unchanged exchange rate and incomplete substitution, and the main body of behavior comprising representative households, producers, local government and central government, the model established in this paper includes production module and demand module. Moreover, the model takes into account equilibrium structure, the definition of profiting and macro condition for closure, the related coefficients this CGE model needs include Armington substitution elasticity of intermediate composite product, investment composite product and consumption composite product between import and domestic production; substitution elasticity among production factors; conversion elasticity of total sales between domestic absorption and export; elasticity of residents' expenditure; elasticity of price; elasticity of export demand; the relative share of all sectors in capital stock. This paper also points out the advantages and limitations of CGE model in analyzing direct grain subsidy policy.

Key words Direct grain subsidy policy, CGE model, Model construction, China

Since the year 2003, China's government has implemented a series of new agricultural support policies. Consequently, China's agricultural subsidy policy once again attracts wide attention. At present, China's agriculture is in the stage of "industry nurturing agriculture and cities driving rural areas", so it is necessary for us to offer subsidy for agriculture, so as to promote the agricultural sector to achieve well-off level, and further achieve national well-off level. Therefore, the study of agricultural subsidies is important. I describe the model of China's direct grain subsidy policy, advance the strategy to construct Computable General Equilibrium (CGE) model concerning China's direct grain subsidy policy, and discuss the limitations of the model.

1 The model of grain direct subsidy policy in China

The key of China's policies of developing agriculture, countryside and farmer is to implement agricultural tax reform. Since 2004, the central government has formulated agricultural subsidy system with "four subsidies" as main content, that is, the direct subsidy for grain growers, comprehensive agricultural subsidy concerning means of agricultural production, subsidy for improved varieties and subsidy for purchasing farm machinery. Grain subsidy is one of the key contents of current direct grain subsidy policy. This policy, acting in concert with the subsidy policy formulated during the reform of grain circulation system, is to convert the formerly indirect subsidy for the chains of purchase and sales into the direct subsidy for farmers, aimed at reducing the impact of price fluctuation of agricultural prod-

ucts on farmers' income, and increasing farmers' income.

The capital of direct grain subsidy is from the venture capital. Due to different subsidy scales and different subsidy areas in various provinces, the standards of direct grain subsidy in various regions are different. The subsidy is distributed based on the measurement on grain production in various provinces, so the standard of subsidy per mu between the main producing areas and non-dominant producing areas, between different provinces, is different to some extent. The general principle is that the areas with bigger planting area of grain, more grain yield and higher amount of goods, will get more subsidies. Since 2004, the subsidy standards of various provinces have been greatly improved, and there is a relatively great flexibility of policies in various provinces, varying according to the specific circumstances of each county.

At present, the direct grain subsidy in China mainly adopts 4 ways. The first is the subsidy according to taxation area. Henan, Jiangxi, Anhui, Hunan, Inner Mongolia, Sichuan, Guizhou, Zhejiang and other provinces (regions) practise this subsidy system. This subsidy model, on the basis of land area of agricultural taxation checked and ratified by the reform of rural taxes and fees, is to determine the amount of subsidy per household enjoys. The second is the subsidy according to the planting area of grain. Jiangsu, Guangdong, Shandong and other provinces implement such subsidy system. This subsidy model, on the basis of the actual area of grain crops planted by the rural households, is to determine the amount of subsidy per household enjoys. The third is the subsidy according to the taxation of general yield. The subsidy according to the taxation of general yield, on the basis of the agricultural taxation of general yield checked and ratified by the reform of rural taxes and fees, is to determine the amount of subsidy per household enjoys. The fourth is the subsidy according to the amount of commodity

grain sold by farmers. Hebei, Xinjiang, Hubei and other provinces (autonomous regions) take such subsidy system. In addition, as for China's direct grain subsidy, the scope of subsidy and varieties of subsidy are increasingly expanding. In 2004, there were 29 provinces and municipalities implementing direct subsidies for grain growers, in 2006, all provinces implemented direct grain subsidy policies, and all provinces expanded coverage of subsidy. The subsidy for varieties in all provinces is also expanding, from initial corn, rice, and soybean, to all food varieties including grains and beans. As for the subsidy for varieties, in response to the policy objective of ensuring food security established by the state, all provinces increase support for characteristic industries, and inform the farmers of the goal of supporting the traditional characteristic industries in the province.

2 Establishment of CGE model of grain direct subsidy policy in China

2.1 Introduction of CGE model Computable General Equilibrium (CGE) model, from Walrasian's general equilibrium theory, is a popular major tool for quantitative analysis of economics and public policy in the world. It uses the socio-economic data of national economic sectors and accounts, to conduct forecasts and analysis on policy and economic activity. The basic data of CGE model is Social Accounting Matrix (SAM), and CGE model establishes the relations between accounts of SAM into a set of simultaneous nonlinear equations, by using the modern general equilibrium theory.

Internationally, CGE model is most widely used for agricultural trade policy. In China, the application of CGE model mainly concentrates in the areas of trade liberalization and trade opening, while there are few researches used for agricultural policy and so on. At present, the researches regarding China's agricultural subsidy policy focus on the following aspects: first, the necessary research on the implementation of agricultural subsidy policy in China^[1]; second, the research on the agricultural subsidy policy in developed countries and its reference significance^[2]; third, the analysis on the implementation effect of agricultural subsidy policy (some researches use Cobb-Douglas production function to analyse implementation effect of agricultural subsidy policy^[3] and some researches use data envelopment analysis method to analyse the efficiency of agricultural subsidy policy^[4]); fourth, the quantitative analysis of agricultural subsidy policy. Some scholars have used CGE model, combined with DSS, database and other design and simulation systems, to conduct empirical simulation analysis on agricultural subsidy policy in China^[5]. But generally speaking, the quantitative analyses of the impact of China's agricultural subsidy policies are still short.

Based on the above considerations, based on general equilibrium theory, I use CGE model, to analyse the impact on agricultural production and farmers' income after implementing direct grain subsidy policies in China profoundly, from the perspective of correlation between agriculture and other industries, and combination of domestic research and foreign research, and examine the brunt of variation of policy variables on macro-

economic indicators and other industry sectors.

2.2 The framework structure of CGE model of grain direct subsidy policy in China As the implementation standards, subsidy coverage and types of China's direct grain subsidy policy in various provinces are different, so we need to establish regional CGE model for analysis. The model is designed as 36 industrial sectors, and 3 factors of production, namely labour force, land and capital. The main body of the distribution of income includes residents, businesses, local government, central government and extrabudgetary accounts. The balance of the distribution of income enters savings account. As for residents, according to areas, they are divided into urban category and rural category. In terms of trade, a "foreign" account is set up, that is, regarding all foreign trade countries as a whole. The supply of products in the domestic market and international market is characterized by using CET function.

2.2.1 Model assumption. Construction of the model is based on the following assumptions: the first is that the market is with competition, that is, the net profit of production and sale activities of goods is zero; the second is that capital, labour force and so on do not move between countries; the third is that the exchange rate does not change; the fourth is that the model conforms to Armington assumption, namely the incomplete substitution characteristic of products; the fifth is that the main body of behaviours contained by the model is composed of representative households, producers, local governments, and central government, and the government implements some policies such as agricultural subsidies. The subsidy sum for sector i is as follows: $T_i = tp_i X_i$, where t is subsidizing rate.

2.2.2 Sub-module of model.

2.2.2.1 Production module. In the process of establishing the model, as the amount of resources in sectors is difficult to calculate, so we still adopt the traditional input factors: capital, labour force and land. Production process adopts multi-layered CES production function. According to CES production function, in the first layer, the total output is determined by the initial elements and other intermediate inputs jointly. In the second layer, other intermediate inputs is described by using Leontief structure, that is, we assume that there is no substitutability among them. In each layer, all the composite beams are to use CES function to describe the substitutability relationship, and substitutability degree hinges on the elasticity of substitution and the respective share in the process of production in the base year. The model assumes that each production sector has a competitive business, and each enterprise produces a product. Land, labor and capital substitute each other, and it can be replaced between the labor forces. Through the use of intermediate inputs, labour, capital and other factor inputs, constituted by composite commodities (import products, export products and domestic products according to Armington assumption, by using CES to conduct transformation), each production sector produces the goods or services for the consumption in the region, consumption in other regions at home or export. The overall production function is described by using Leontief's multi-layered CES production function.

2.2.2.2 Demand module. According to the actual situation of China's dual urban-rural structure, we assume that there are two types of family groups with different characteristics, urban residents and rural residents, and under the constraints of total consumer budget, the resident utility is maximized. Consumption demand of residents is composed of composite commodities, allowing the imperfect substitution among different composite commodities. Other final demand, such as government consumption, public and private investment demand, is to use Cobb-Douglas utility function to describe the demand for various goods, while the intermediate demand of enterprise, residents' consumption, government consumption, investment, and exports, form the demand for composite commodities. Demand structure is divided into two levels: at the first level, the total consumption demand of the residents for composite commodity is Stone-Geary function; at the second level, the consumption demand of the residents for various composite commodities, is the synthesis of CES function of domestic consumer goods and import consumer goods.

2.2.3 Equilibrium structure. The equilibrium in the model is the balance between supply and demand in each market, that is, the demand for all goods and factors is tantamount to supply. In the mean time, the profit of each sector is zero, and the total investment is equal to the total savings. Based on the above estimation, we can get the relation expression of balance between supply and demand of products, and the relation expression of balance between production factors.

2.2.4 The definition of profiting. As for the impact of implementation of policy of agricultural subsidies in China on agriculture and farmers, as well as the impact on China's overall economy and all industries, we mainly use the change of utility level brought by the variation of this policy, to conduct specific calculation.

2.2.5 Macro condition for closure. The macro closure of this model adopts the principle of new classical macro closure. This model assumes that the investment is not freely given, and the investment is the endogenous variable, which should be equal to planned savings. The balance between investment and savings is adjusted by the interest rate adjustment mechanism without the model. The characteristic of the model is that we assume that the operation of overall economic activity is driven by the savings, transforming all the savings in economy into investment. Under the assumption of such closure, the government's actual expenditure and actual savings are exogenous, and the total investment is determined by all components of the savings and endogenous characteristic.

2.3 Determination of model coefficient Under the structure of CGE model and specific function form, the solution of the model is determined by the parameters of model. The model parameters are determined by elasticity parameters and base year SAM, estimated by using econometric method. Therefore, the uncertainty of relevant elasticity parameters and the choice of base year have the impact on the robustness of the model results.

The related parameters needed by CGE model include

Armington substitution elasticity of intermediate composite products, investment composite products and consumption composite products between import and export; substitution elasticity between factors of production; conversion elasticity of total sales between the domestic absorption and the export; residents' expenditure elasticity; price elasticity; the elasticity of export demand; the relative share of capital stock in each sector. In theory, these parameters can be estimated by using econometric time-sequence estimation methods or calibration method. However, due to data limitations, currently, according to other researchers' research results or experience in general, we conduct setting on elasticity coefficient of CES equation and elasticity coefficient of CET equation in advance, and then according to the presetting value, calibrate other coefficients of CES equation and CET equation. Therefore, we cannot exclude the sensitivity of the simulation results on the relevant parameters to some extent.

3 Discussion and conclusion

In the process of analyzing the impact brought about by direct grain subsidy policy, we should not only pay attention to short-term effects, but also focus on long-term effects. We should not focus on the impact on one country, and should not ignore the impact on other countries. We should not merely linger in the impact on the agricultural production sectors, and should take into account the impact on other related industrial sectors. We should not only consider the impact on the development of the domestic industry in one country, but also consider the impact on the international trade. CGE model has unique advantages in this respect, which not only can be used to analyze the impact of the existing policies, but also can help design better, and even "optimal" policy. By conducting policy simulation, CGE model can explore the impact of combined policies under a variety of sub-optimal environments. From the perspective of policy makers, CGE model provides a simulation laboratory, to help verify the applicability of policy in a similar real-world.

But different from any modeling technique, CGE model has its limitations, such as data acquisition and processing. Since the operation of computable general equilibrium model needs a large amount of data, in order to reduce the demand for data, most of the computable general equilibrium models are to get the necessary data by conducting calibration on the base data set in a year, so that it makes the computable general equilibrium model have great sensitivity to the data in the base year. In this model, using econometric methods to estimate the parameters of behaviour equation in the model, coupled with the constant improvement of existing statistical data, the reliability of computable general equilibrium model will be greatly increased.

References

- [1] CHENG GQ. Agricultural protection and economic development[J]. *Economic Research Journal*, 1993(4): 26-34. (in Chinese).
- [2] LI CG. Direct subsidies to grain can not Instead of price support - EU, the U.S. experience and China's choice[J]. *Chinese Rural Economy*, 2004(8): 54-57. (in Chinese).

reach the equilibrium of urban-rural public service supply, the long existed urban-rural dual system should be broken. In the first place, the fairness of governmental fiscal expenditure should be guaranteed. The rural demands on finance should be given more attention to. The public service resources should be allocated according to actual needs, rather than according to urban and rural areas to break through the dual system, reach the balanced arrangement and optimized supply of public services and promote the equal supply of urban-rural public service supply. In the second place, the governmental department should conduct deep investigation to master the farmers' actual needs on rural public services and the imperatively needed public services, so as to rationally allocate the limited capital and public products to satisfy the basic public service level of farmers and narrow down the urban-rural gap. In the third place, the government should provide long lasting and effective fiscal subsidies, spherical funds and tax returns to rural public services; encourage local governments to launch the rural public services undertakings. And then, the proportion of input on rural public services can be improved. At the same time, the strategic plan of motivating rural areas by urban areas should be launched. The advantages and resources of urban areas should be made full use of to assist rural areas, by such way to enhance the level of rural public services and reach the equilibrium development of urban-rural public services.

3.4 Perfecting rural diversified public service system and the functions of public services The demands of rural public services are huge and have the features of difference and quality. So the single reliance on government can not satisfy the actual farmers' demand of on public services. Establishing and perfecting rural diversified public service supply system is a ration choice on the perspective of government and citizens. In the first place, the government should encourage and support social organization, philanthropic organizations, and volunteer groups, citizens to participate in the supply of rural public services to solve the tense status of governmental finance and supplement the inadequate rural public services. In the second place, the role definition and right-duty relations between governments and other main bodies of public service supply should be defined through the form of laws and regulations, to clarify the functions of each party and cooperate together. They should work together to avoid the vacancy, disposition and off-side of rural public services. In the third place, the integrated mechanism of rural public services should be established to rationally and orderly operate rural diversified public service system. The supply of rural public services should be perfected and improved through governmental support, direct and cooperation with each party and on the basis of farmers' various

kinds of actual needs.

3.5 Facilitating the market process of rural public services and improving the supply efficiency of public services

The government should change the thought pattern and methods on the supply of rural public services as soon as possible; get rid of traditional idea that the government is the only main body of rural public service supply; and accelerate the market process of rural public service. In the first place, the governmental decision-makers should set up the market awareness, transform the prejudice on market and take market as a powerful supplementation and perfection in the governmental supply of rural public services, so as to take the market into full consideration when making decisions on rural public services and launching rural public services. In the second place, the governmental departments should improve the approaches of supplying rural public services; change the traditional administrative way; encourage enterprises to produce and supply rural public products and services by the way of governmental bid and governmental purchase to improve the efficiency and interests of public services. In the third place, the government should clarify the market supervision functions and create benign market competition atmosphere for rural public services. In addition, the government should scientifically and strictly supervise the market to avoid the monopoly on the supply of rural public services to guarantee farmers' actual interests. In the meantime, fiscal subsidies, material and spiritual awards should be given to the legal and profit-making enterprises, so as to stimulate them to provide comprehensive and high-quality public services for rural areas and foster the win-win status among governments, enterprises and farmers.

References

- [1] YANG GH. Discussion on marketization of rural public service supply [J]. *Journal of Anhui Agricultural Sciences*, 2010, 38(34): 19722 – 19723. (in Chinese).
- [2] ZHANG KY. The supply of social organization to rural public services; the evaluation of the present and policy orientation [J]. *Jiangxi Social Sciences*, 2010(11): 219 – 225. (in Chinese).
- [3] HE HH, NAN Y. Discussion on the supply of rural public product in the construction of new rural [J]. *Journal of Anhui Agricultural Sciences*, 2007(5): 6615 – 6616. (in Chinese).
- [4] LEI YQ, LIU D. Analysis on rural public service supply, demand and cause [J]. *Statistics and Decision*, 2010(4): 71 – 73. (in Chinese).
- [5] ZHANG DS, JIAO YQ. Implementing subject and its dynamic mechanism in new countryside construction [J]. *Asian Agricultural Research*, 2009, 1(6): 13 – 15.
- [6] ZHENG ZW, ZHANG CH. Development of agriculture industrialization under the background of socialist new countryside construction [J]. *Asian Agriculture Research*, 2009, 1(8): 40 – 43.

(From page 49)

- [3] HOU LL, MU YY, ZHANG CH. A study on agricultural subsidy policies and their impacts in China [J]. *Chinese Agricultural Science Bulletin*, 2007(10): 165 – 171. (in Chinese).
- [4] YE H, WANG YP. Grain direct subsidy efficiency and policy based

on DEA Model [J]. *Research of Agricultural Modernization*, 2006, 27(5): 356 – 359. (in Chinese).

- [5] LI ZG, FU ZT, ZHENG ZA, *et al.* Research of policy simulation system based on CGE model [J]. *Journal of China Agricultural University*, 2006, 11(5): 98 – 102. (in Chinese).