Food Subsidies: Incentive Benefit and Competitive Design

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Abstract Firstly, the evolution process of grain subsidy policy in China was introduced. In the first stage, the nation carried out grain policy of unified purchase and sale. In the second stage, the nation carried out price subsidy for grain purchasing. In the third stage, the nation carried out direct subsidy for grain production. Secondly, the incentive mechanism of grain subsidy was analyzed under two conditions based on the basic hypotheses. Under the condition of complete information, the effects of grain subsidy policy are optimal. Under the condition of information asymmetry, there are two cases. Grain subsidy policy shows zero effect when information is completely opaque. When information is translucent, the effect of the policy will be suboptimal due to the problem of adverse selection. The adjustment design for incentive mechanism of subsidy was made in order to improve the effects of subsidy policy. The grain production choice of farmers was also analyzed according to evaluation function of farmers' achievements. Finally, the causes why the productive positivity of farmers was not improved with the development of economy and society were discussed.

Key words Grain subsidy; Incentive efficiency; Competitive design, China

The original intention of direct grain subsidy was to increase the income of farmers and arouse their enthusiasm in grain production, which could ensure grain safety of the nation. But in recent years, some of the farmlands were abandoned for the following reasons: grain subsidy didn't exert its role of promotion and stimulation, and it didn't arouse the enthusiasm of farmers in grain production either. In essence, the problem lies in information transparency in the implementation process of grain subsidy policy. Based on the conditions of complete information and information asymmetry, this paper tries to analyze the effect of subsidy and put forward a proper adjustment scheme of innovation policy.

1 Evolution of grain subsidy policy in China

China is a great agricultural country, and agriculture plays a supporting role in its economic development, while the production and consumption of grain are always the focus of the public. Since the first implementation of grain financial subsidy in 1960, China has experienced 32 years of planned supply for par grain (consumer subsidy), and 11 years of grain acquisition at protective price (producer subsidy), which approximately accomplished the transition from indirect subsidy to direct subsidy.

(1) In the first stage, the nation carried out grain policy of unified purchase and sale from 1960 to 1985 roughly. Due to the implementation of planned economy system, grain was purchased at a low price by the nation before storing and transacting. The nation controlled and steadied the purchasing price of grain, and carried out the policies of supply with tickets and consumption subsidy for urban residents. In this stage, grain has become the "tribute" of farmers and the "welfare" of urban residents.* The subsidy at this time was indirect, and the direct beneficiaries were urban residents and grain enterprises, not the farmers.

(2) In the second stage, the nation carried out price subsidy for grain purchasing. From 1986 to 1993, protective price policy of quota grain and special grain reserves were carried out. The nation decided to raise the prices of purchase and sale in 1992, which led to the same price both in purchasing and selling. The scope of price increase was enlarged to the "surplus grain" after quotas in August, 1997. After the implementation of "three policies" in May, 1998, all "surplus grain" was purchased at a high price, which aimed to sell at the "favorable price" (cost plus fee and profit) after the monopolization of grain sources. "Subsidy for grain producer" in the form of protective price produced an effect of supply increase, which benefited farmers slightly. Then the nation narrowed the scope of protective price year by year, contracted the varieties of protective price, lowered the level and made strict quality standard for protective price afterwards. The nation purchased the grain at the additional price within the quotas of contract, and purchased the surplus grain at the minimum protective price, which subsidized farmers in the form of price.

(3) In the third stage, the nation carried out direct subsidy for grain production. Direct grain subsidy policy was put on trial in Anhui and Jilin Province in 2002. China has fully opened up the grain purchasing market and given direct subsidy to grain producers since 2004. Grain subsidy was shifted into the process of production formally at the time, which transformed the "indirect subsidy" into "direct subsidy". There are four forms of grain subsidy in China at present, i.e. direct subsidy, seed subsidy, agricultural machine subsidy, comprehensive and direct subsidy for agricultural material increment. The
"NO.1 Document" issued by the Central Committee of the CPC in 2009 put forward that "efforts should be made to improve agricultural subsidy methods based on the requests, including clear target, simpleness and convenience, beneficial for encouraging grain production. The subsidies for grain production of specialized households and household farms should be increased based on the actual conditions of the new subsidy".

2 Analysis on incentive mechanism of grain subsidy

2.1 Basic hypotheses This paper assumes that farmers only have two choices, i.e. plant grain or not. If they choose planting, it is assumed that a is planting area, and the relevant profit is \( S(a, s') > 0, s' < 0, s(0) = 0 \). Fixed input per capita of grain production is \( F \), and the marginal cost is \( m \in R = \{ m_1, m_2 \} \). Where \( m \) is the marginal cost of grain planter with large area, \( m_1 \) is the marginal cost of grain planter with small area, and \( m_2 > m_1 \). The probabilities of the two kinds are \( p \) and \( 1-p \) respectively, and the areas of the two kinds are \( a_1 \) and \( a_2 \) respectively. Compensation proportions for encouraging grain production, which are \( b_1 \) and \( b_2 \) respectively, are determined according to the area. Hence, the real subsidies of the two are \( a_1 b_1 \) and \( a_2 b_2 \) respectively.

2.2 Mechanism analysis According to the above hypotheses, it is assumed that \( G = \{ ab, ab, ab \} \), \( a \in R, b \in R \), where \( b \) is the subsidy proportion of farmers, \( R \) is real number. \( G_1 = (a_1 b_1, a_1), G_2 = (a_2 b_2, a_2) \). It is also assumed that above variables could be observed and measured by the third party (assumed as rural officers). Therefore, the punishment rules for defaulting party (not plant grain) could be written into the contract between government and farmers (i.e., urged farmers to plant grain forcibly). Government encourages farmers to plant grain by providing various subsidies, so as to enable the planting area to meet the maximum effect condition of government and farmers.

2.2.1 Case of complete information Considering the case that there isn't information difference between government and farmers, the optimal programming problem of government is:

\[
\begin{align*}
\text{Max} \ p(s(a_1) - a_1 b_1) + (1-p)(s(a_2) - a_2 b_2) \\
\text{subject to} \ a_1 + a_2 = \text{fixed}
\end{align*}
\]

In order to complete the scheduled cultivated area and output, the subsidy provided by government should at least exceed the level when there is no large area planting. That is, the constraints of the planting choice are \( a_1 b_1 - m_1 a_1 - F \geq 0 \) and \( a_2 b_2 - m_2 a_2 - F \geq 0 \).

Due to the complete information, the values of \( a_1 \), \( b_1 \), \( a_2 \) and \( b_2 \) will not influence the result. Therefore, effective grain yield could be obtained when marginal utility of government equals to marginal cost of farmer, and the first order conditions of optimal subsidy level are \( s'(a_1*) = m_1 \) and \( s'(a_2*) = m_2 \).

The optimal grain planting area can be obtained if the farmer chooses planting. Meanwhile, the profits of the two kinds of farmers are 0. If the welfare \( D_1 = s(a_1*) - m_1 a_1 - F \) and \( D_2 = s(a_2*) - m_2 a_2 - F \) produced by effective planting area \( a_1* \) and \( a_2* \) respectively were nonnegative, both of them could be realized. When \( a_1 = a_1* \), the maximum welfare \( D = s(a_1) - m_1 a_1 - F \) can be realized, and \( m_2 > m_1 \).

Hence, it can be concluded as \( D_1 > D_2 \). So long as the labor of peasant household with small planting area has social value, government and farmers can make a deal. That is, it meets the demand of \( D_1 \geq 0 \).

It can be concluded that under the condition of complete information, so long as the subsidy level could ensure the profit of the grain planter with least planting area, the contractual relation between government and farmers can be kept. In other words, farmers will plant grain positively for profit, and they will try to plant more in order to benefit more. But strict information completeness is almost impossible in reality, so the subsidy can not realize the expected effect.

2.2.2 Case of information asymmetry.

(1) Complete information opacity. Complete information asymmetry of grain production subsidy means that farmers don't know the subsidy policy. Under such a circumstance, farmers have many choices and grain subsidy policy shows zero effect.

(2) Information transluence. Before the release of a policy, various interests can basically reach "equilibrium" or "perceptual equilibrium" in the long-term game. When a new policy is released and the status of government and farmers are unequal, government may withhold the policy (withhold benefit) to ensure its benefit. Based on the contract \( \{ (a_1 b_1*, a_1*), (a_2 b_2*, a_2*) \} \), it is assumed that grain planter with small planting area can obtain higher subsidy for encouraging grain production or the enlargement of planting area, that is \( a_2 b_2* > a_1 b_1* \); government hopes the farmers of \( m \) type choose \( (a_1 b_1*, a_1*) \), the farmers of \( m_2 \) type choose \( (a_2 b_2*, a_2*) \). In fact, grain planting area and marginal cost are the personal information of farmers to some extent. Farmers can falsely declare their planting area, which leads to adverse selection. Due to insignificance of fixed input \( F \) of grain planting for the analysis, we assume \( F = 0 \) for convenience, the optimal programming problem of government is:

\[
\begin{align*}
\text{Max} \ p(s(a_1) - a_1 b_1) + (1-p)(s(a_2) - a_2 b_2) \\
\text{subject to} \ a_1 + a_2 = \text{fixed}
\end{align*}
\]

The constraint conditions of incentive compatibility are:

(3) \( a_1 b_1 - m_1 q_1 \geq a_2 b_2 - m_2 q_2 \)

(4) \( a_2 b_2 - m_2 q_2 \geq a_1 b_1 - m_1 q_1 \)

The constraint conditions of grain planting choice are:

(5) \( a_1 b_1 - m_1 q_1 \geq 0 \)

(6) \( a_2 b_2 - m_2 q_2 \geq 0 \)

From conditions (3) and (4), the implementing condition is concluded as \( a_1 > a_2 \).

The conception of information rent is introduced for deeply understanding the choices under the circumstance of incomplete information. It is assumed that \( U_1 = a_1 b_1 - m_1 a_1 \) and \( U_2 = a_2 b_2 - m_2 a_2 \) denote the information rent of the two types of farmers. Under the condition of complete information, the client (government) can enable all types of agents (farmers) to obtain zero effect by all means, that is, the relevant effects of the two respectively meet the demands of \( U_1 = a_1 b_1 - m_1 a_1 = 0 \) and \( U_2 = a_2 b_2 - m_2 a_2 = 0 \). Under the condition of incom-
plete information, we assume $\triangle m = m_e - m$, in a nexus of contract\{(a, b, a_1); (a, b, a_2)\}. Considering the probable effect level when agent $m$ imitates $m_1$, the contract should meet the demand of $a_2 b - m_a a_2 = U_2 + \triangle m a_2$. Even if the client can make the withholding utility $U_1$ of agent $m_1$ equal to 0, agent $m$ can also obtain the utility $\triangle m a_1$ from the imitation of low-yield agent, and the profit is called information rent. So the conditions (2) – (6) become:

$$
\begin{align*}
\max &; p_i (s_i (a_i) - m_i a_i) + (1 - p_i) [s_i (a_i) - m_i a_i] - p U_i + (1 - p) U_i \\
U_i &\geq U_i + \triangle m a_1 \quad (7) \\
U_i &\geq U_1 - \triangle m a_1 \quad (8) \\
U_{i_1} &\geq 0 \quad (9) \\
U_{i_2} &\geq 0 \quad (10) \\
\end{align*}
$$

Because the grain planter with large planting area falsely declares that his planting area is small, condition (9) is not the essential one at this moment. Therefore, only the conditions (8) and (11) are relative. According to the solution of optimal incentive programming problem, when the constraints are stricter, that is, the conditions (8) and (11) are proved, and the optimal solution can be attained. At this moment, $U_i = 0$, $U_i = \Delta m a_i$, condition (7) can be simplified as:

$$
\max \beta (s_i (a_i) - m_i a_i) + (1 - p_i) [s_i (a_i) - m_i a_i] - p \Delta m a_i \quad (12)
$$

From condition (12), the suboptimal result of the farmers with small planting area is $s_i (a_i, a_1) = m_1$; the suboptimal result of the other type of farmers is $(1 - p) [s_i (a_i, a_2) - m_2]$, i.e. $p \Delta m$. Where $\beta$ denotes the suboptimal solution that is relatively optimal.

Comparing with the optimal solution of conditions (5) and (6) under the condition of complete information, we can conclude as follows under the condition of incomplete information.

1. There isn’t a distortion of planting area for farmers with large planting area, $a_i = a_i$; due to adverse selection, there is a distortion of planting area for farmers with small planting area, $a_i < a_i$, and it meets the demand of $s_i (a_i, a_2) = m_2 + (p / (1 - p)) \Delta m$. 2. High-yield farmers will obtain a strictly positive information rent, which is $U_i = \Delta m a_i$. 3. Suboptimal compensations are $b_i = (m_i a_i + \Delta m a_i) / a_i$ and $b_i = m_i a_i a_i / a_i$ respectively. From this, it can be seen that due to the information asymmetry, there is adverse selection in reality, which could not lead to optimal result, but suboptimal result at the most. The targets for designing incentive mechanism of subsidy are to encourage planting and enable the planting benefits to be suboptimal.

Above analysis shows that in spite of the probable information asymmetry, the grain subsidy policy of government is effective, which could encourage farmers to plant more grain without forcible measures.

3 Design adjustment based on the incentive mechanism of subsidy

A village is assumed as an economic subject in the above analysis, the subsidy for grain planter is offered inside the subject. But farmers also have the other choices besides planting grain in reality. That’s why farmers are still not active in planting, although government offers various subsidies. The author considers that diligent and high-yield farmers should be offered some awards, farmers who abandoned land should be punished, and farmers who plant other crops should assume sole responsibility. That is, simple “carrot + stick” strategy is carried out for all the farmers, meanwhile, the competitive and incentive mechanism is introduced, which will enhance the effect. Analytical model of incentive mechanism is:

$$
F = g_i (R_i, R_i, \gamma, RH, P) \quad (13)
$$

Where $R_i$ is the profit of grain production; $R_i = \max \{ RL, R_i \}$; $R_i$ is the opportunity cost, i.e. the profit when plant other crops; $RL$ is the minimum profit of grain production; $RH$ is the maximum profit, $P$ is the proportion of grain planters who have foremost harvest and will get the awards. In the model, a reasonable incentive level and proportion $P$ should be made for exerting the effect of incentive mechanism. The incentive level and proportion should be moderate, because exorbitant level may cause the increase of financial burden, and too low level may cause vicious competition or damon farmers’ enthusiasm, as a result, the proportion hardly plays a role in encouragement and will lead to ineffectiveness of the policy.

The implementation of rewards and punishment (i.e. the proportion $b_i$ and $b_i$ under the condition of information transfluence) should be viewed as the most simple and direct method, but the fact that moral hazard of rural administrators in the assistance for rural areas and farmers could not be ignored, the problems lead to low expected benefit of farmers, which destruct the function of national incentive measures. Hence, under new economic environment, subsidy policy for grain planters doesn’t radically change the situation that farmers don’t plant grain, so the incentive mechanism for encouraging grain production is lacking and deficient. Generally speaking, human’s opportunistic behaviors are inevitable in the environment of transition economy. This is mainly because there aren’t normative principles for evaluating performance in the relevant systems of rural areas, which can hardly measure and evaluate the efforts of farmers objectively, so it’s hard to sort scientifically and reasonably. The opportunistic behaviors can be modeled so as to further expound and analyze the causes of opportunistic behaviors of above people. It is assumed that there are three persons, including A, B, and C, where C is the main administrator or officer in village (i.e. client), A and B are the two types of grain planters. Meanwhile, it is assumed that the evaluation function of each planter’s performance in the village is $V = aP + bE + cS$. Where $V$ is the comprehensive sorting index of farmer’s relative performance; $P$ is the evaluation index of labor achievement, i.e. grain yield; $S$ and $E$ are sorting indices of non-labor performance, such as the environment of land, economic condition of farmers and so on; $a$, $b$ and $c$ are the weights of $P$, $S$ and $E$ respectively. Due to the introduction of grain yield in the above function, index $P$ will encourage farmers to choose positively planting for good harvest. Therefore, index $P$ has the incentive compatibility of grain production while index $S$ and $E$ don’t have the characteristic. In order to
encourage farmers to choose planting, value of a must be tremendously bigger than the values of b and c. Values of b and c are determined by the "discretion" of administrator in the village (officer). On this basis, if non-uniform behaviors are made by farmers in order to obtain subsidy and awards, that is, one person plants grain and the other one doesn’t plant or rents the land to others, so the achievement of the two will be significantly different. According to the evaluation function, farmers who plants grain will obtain grain subsidy and relevant awards. But when the two farmers make a uniform choice which is planting or not uniformly, the difference of their achievements won’t be significant, and concrete difference is determined by the values of b and c. Due to the punishment of un-planting, farmer will choose planting based on the hypothesis of reasonable man, but some measures should be introduced to prevent opportunistic behaviors in the implementation process of awards and punishment.

4 Conclusion

To sum up, China’s grain subsidy policy has made great achievements in practice, but there are still many limitations. Although grain subsidy decreases the productive cost of farmers to some extent, and plays a role in encouraging the positivity of farmers, but with the constant changing of economic and social environment, the relative planting positivity of farmers is not enhanced. This can be attributed to: ① in spite of the relative higher income of migrant workers in cities and various subsidies form the central government, the comparative advantages of farmers are still very low; ② the shift of rural labor force changes the population structure of rural areas, which leads to the sharp decrease of grain consumption and the relative weakening of purposiveness in grain production; ③ different standards of subsidies can not show the justification and incentive; ④ single mechanism of subsidy can not take the advantage of subsidy funds to the maximum extent; ⑤ there are some problems about rural administrators, which weaken the effect of subsidy mechanism in the implementation.

Therefore, effective measures to improve the grain subsidy system should be adopted with the combination of the actual conditions in China. In addition, grain subsidy should have definite directivity and clear policy goals. ① Grain subsidy scale should be expanded according to the financial strength of China. ② Efforts should be devoted to increase the input in rural areas, encourage farmers to plant, and advocate the "side working" of migrant worker, especially under the new environment of global economy. ③ Diversified subsidy mechanisms should be carried out. Different areas should adopt different subsidy standards, and the farmers of "high yield and high quality" should get more subsidies. "High yield" means that the inputs should be increased in big planting household and counties, and "high quality" means that the improvement of grain yield and optimization of quality can be promoted by the increase of seed subsidy. ④ Maximum efficiency, minimum cost and strong incentive effect of the current subsidy can be realized by standardizing the offering procedure of central subsidy and eliminating the diseconomy in the implementation.

References


粮食补贴：激励效益及竞争设计

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摘要: 首先，介绍了中国粮食补贴政策的演变过程。第一阶段是国家对粮食实行统购统销制度时期，对粮食的直接补贴是城市居民或粮食企业，农民没有得到补贴利益。第二阶段是国家对粮食收购实行价格补贴时期，在合同定购任务内国家对粮食实行加价收购，在任务外实行最低保护价收购, 将粮食补贴以价格形式给予农民。第三阶段是国家对粮食实行直接补贴时期，粮食补贴正式转入生产过程。其次，在给定基本假设的基础上，分两种情况分析了粮食补贴的激励机制。在完全信息条件下，只要补贴水平能够保持粮食种植面积最小的农户不亏损或有利可图，那么，政府与农户之间的契约关系就是存在的，即粮食补贴会产生利益和积极的激励，但在现实中，严格的完全信息情况几乎是不存在的。在信息不对称条件下，可分为两种情况考虑。当信息完全不透明时，粮食补贴政策呈零收益性；当信息不透明时，存在逆向选择问题，不能达到最优结果，只能达到次优结果。为提高补贴政策的效果，对补贴激励机制进行了调整设计，对粮食收购好的农户给予一定的奖励，对于不种植的农户给予一定的惩罚。根据补贴收益的评价函数，分析了农户的种植选择。最后，探讨了随着经济和社会的发展，农户种植积极性没有提高的原因。

关键词: 粮食补贴；激励效益；竞争设计