A Case Study of the Effectiveness of Agricultural Subsidies Policies: Theory and Evidence from Huangpi District, Hubei, China[*]

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Abstract

The policy of agricultural subsidies for the farmers and farmers' behaviors were investigated in this paper. We first set up a labor supply model and based on which, designed survey questionnaires from Huangpi District in Wuhan, Hubei Province. The results showed that, in the present price system, agricultural subsidies can surely promote the agricultural labor supply, then the agricultural output. From the aspect of increasing agricultural income for households, the policy can improve their welfare. The empirical analysis based on our questionnaire and ordered logistic model, shows that the subsidies cannot affect much as the limited subsidy level and diminishing ratio of agricultural income to total income for the household. Overall, the rapid rise of agricultural goods price and fewer opportunities to agricultural investment are the main restrictions of agricultural development.

JEL classification：Q12; Q18; H20

Key words: farmers, agricultural subsidies, farmers' behaviors, questionnaire, ordered logistic model

I. Introduction

The rapid development of economy in china is a major challenge for agriculture: the existence of urban-rural dual structure could hinder the growth of economy. To this end, the central government gradually adopted a policy to support agricultural development. Since 2000, the tax reform policy is first been administered in Anhui Province and then across the country; since 2006, agricultural tax has been abolished, and subsidies have been provided to agricultural sector according to the "green box" policy of WTO. However, the substitution effect of agricultural subsidies may reduce farmers' investment to agricultural production because of the income increase compared with the income effect. Income effect means that agricultural subsidies will encourage farmers to increase investment, which has a positive impact on agricultural production. While the substitution effect means though farmers receive a higher income but they will reduce agricultural inputs and pay more time for leisure.

Which of these two effects is more obvious, or that the ultimate effect has a positive or negative effect on production? Do Subsidies have a real effect on agricultural production or farmers' behaviors?

If so, the effect is long-term or short? What is its role in the mechanism? If the subsidy policy is ineffective, whether there may be further optimized? Thus, it is necessary to track the current policy of agricultural subsidies to conduct further study on farmers' behaviors and welfare to propose further measures. Research on subsidies has aroused concerns in macroeconomics and public economics, including theoretical study and empirical evidence.

As for theoretical study, analysis of possible welfare effects of subsidies and study on relevant policies is highlighted; whereas empirical study focuses on the evaluation of the real effects of subsidies in certain sectors or projects.

First of all, the welfare effects of subsidies in the labor market have been concerned. Snower, Dennis J. (1994) first put forward that although unemployment benefits systems vary from country to country in the world, they all tend to reduce unemployment but lead to the increase in unemployment actually. Welfare policy has pushed up wages and expanded the market failure. Such market failure may have more serious dynamic effects. Based on this, they made plans for the BTP-service, in which three different types of subsidy rate have been supplied for trainings of employed workers, short-term unemployed workers and long-term unemployed workers and the subsidies have been granted to enterprises in the form of vouchers, in order to expand the choice set of workers who search for jobs as well as enterprises which employ workers. The difference between widely recognized wage and the pay is unemployment insurance, which turns to employment subsidies. The plan strengthens the incentive for workers to acquire skills and thus in theory, improves the social welfare. Phelps, E. (1994) criticized the side effects of the welfare system and then raised the controversy over the effects of low-wage employment subsidy. He proposed that low-wage employment subsidy generated social benefit that exceeded the net private benefit, thus promoting social welfare through three channels including social equity, alleviating issues of unemployment and idle labor resources as well as public effects.

Chéron, Arnaud, Jean-Olivier Hairault et. al. (2008) evaluated the effects of payroll tax subsidies for low-wage workers using French data. Their analysis was made from the perspective of searching the equilibrium in labor market, taking level wages and specialized human capital investment into consideration and also taking the unemployment and the distribution of wages and productivity as endogenous. It was found that current minimum wage can increase investment in human capital trainings and enhance productivity, which means that in order to avoid work with low efficiency, subsidizing payroll taxes can promote welfare better to sub-optimal situation, compared with the reduction in minimum wage. However, Card, David and Dean R. Hyslop (2005) explored the benefits of time-bound income subsidy based on cases in Canada and showed that SSP experiments had great influence over benefits. However, such effects may disappear slowly after 18 months, which won't change benefits in the long run and have no long-term impact on wages either. Of course, whether their conclusion is robust generally is uncertain as the research is based on the cases of Canada. At present, there is still controversy over the effects of subsidies in the labor market and issues like means of subsidies and the attribution need further exploration.

Under the policy of temporary investment tax subsidies, House, Christopher L. and Matthew D. et al (2008) made a general equilibrium analysis of different subsidies and their impact on capital investment based on changes in tax laws and regulations in the United States. Although the overall effect was not obvious, dividend depreciation policy had significant impact on the economy in 2002 and 2003. In other words, temporary tax subsidies served as a strong incentive to change the response time of investment. The incentive was so strong that the shadow value of the long-term capital can fully respond to the tax subsidies regardless of the elasticity of capital supply.

Despite the tremendous impact on investment, it had very small positive effects on the total employment and outputs, because investment may drop significantly followed by the decrease of outputs and employment after the period of granting subsidies.

With regard to research on subsidy policy, Dani Rodrik (1987) attempted to explore the decision on the optimal level of subsidy. David Card, and Erdal Tekin (2004) studied the effects of child care subsidies since 1990 in the United States. The subsidy system underwent a number of adjustments and amendments during the 1990s in the United States. In 1996, Child Care Development Fund, which collected the subsidies originally distributed, was founded as a part of encouraging self-development of low-income families who no longer completely relied on subsidies. He analyzed the impact of child-rearing subsidies on the job options of single mothers and child-rearing patterns (eg. Child-rearing by relatives, parents and collective childminder, etc.). He analyzed the survey data of U.S. households in 1999 and results showed that the probability of employment grew by 15.3 percent after receiving subsidies while raising mode also tended to prefer collective childminder. The point of view that child-rearing by parents or relatives would improve the child-care quality is difficult to be confirmed.

Guy Laroque (2005) analyzed the optimal tax subsidy scheme and applied it to the labor-force market. He also drew the famous "Laffer Curve" using semi-parametric estimation based on the cases in France and showed that current welfare situation in France got close to sub-optimal conditions.

As for the empirical analysis of subsidies, López, Ramón and Gregmar I. et al (2007) discussed the negative impact of government subsidies for private goods on the supply of public goods, thus restricting economic development. Through econometric methods they verified that increasing the government's expenditure on public goods or reducing private subsidies or lowering the ratio of subsidies for private goods to expenditure on public goods will bring about economic efficiency, resulting in the growth of GDP per capita in rural areas and reducing negative external effects of economic development on the environment, thereby helpful to reduce poverty. López et.al summarized the negative impacts of subsidies for private goods on the economy as private goods investment: 1) crowding-out the supply of public goods by the government budget constraint, human and institutional constraints; 2) likely to crowd-out private investment directly; 3) may crowd-out private investment indirectly in the short term or in the long term. On the other hand, through the model derivation and econometric method, they also verified that the expansion of the demand for agricultural land inspired by direct subsidy policy, resulted in the destruction of the forest, which was not conducive to the development of the economy as a whole. Once the ratio of subsidies is adjusted, use of agricultural land will change significantly. It illustrates that the policy of agricultural subsidies has not brought about the improvement of agricultural productivity and would not lead to the structural optimization of agriculture either.

There are also some studies on subsidies worth reference in China. Shen Xiaoming, Tan Zaigang, Wu Zhaohui (2002) and Lin Wan-Long, Zhang Liqin (2004) carried out an analysis of the efficiency of the government's subsidies and taxation policy on agricultural listed companies. Shen Xiaoming, Tan Zaigang, Wu Zhaohui(2002) suggested that the government's fiscal and subsidy policy covered up the difficulties in companies' operation, making listed companies rely on government's subsidies and taxation policy, which is not conducive to the improvement of production efficiency. They also put forward the principle of subsidy marketization and gave some suggestions on the adjustment of shares, development strategies and business strategy for listed companies in agriculture.

Lin Wanlong, Zhang Liqin (2004) proved that the government's fiscal and taxation policies has not brought about significant growth in the output of agricultural listed companies using econometric methods and proposed the implication of support aspects and ways of agricultural subsidies. Hu Xia (2007) analyzed the effects of direct agricultural subsidies in Japanese mountain and mid-levels areas.

The effects of agricultural subsidies combined with industrial organization in agriculture, were discussed from the perspective of village agreement and results indicated very significant effects. However, as for the villages without signing any agreements and those unorganized mountains and mid-levels areas, they were not entitled to enjoy the policy of agricultural subsidies as a result of the aging of the population and the shortage of human resources in agriculture.

Without organized institutional change, agricultural research and development, cultivation of human capital in agricultural sector and public infrastructure would not improve at all. As a result, subsidies are more likely to become a compensation for revenue without any significant effects. Feng Jikang (2007) predicted the future direction of agricultural subsidies according to the policy changes in agricultural subsidies for nearly 70 years in the United States and gave empirical understanding of the effectiveness of agricultural subsidies. Li Chuanjian (2007) emphasized the importance of selecting proper ways of agricultural subsidies with a view to realizing the multifunctional nature of agriculture. He mainly demonstrated the significance of agricultural subsidies from economic, ecological, social and cultural aspects. The current study shows that agricultural subsidies may be effective, but the policy effect is not yet clear. As the economic environment, economic stages and the different forms for the effect of subsidies, so it needs to combine theoretical models to analyze China's agricultural subsidy policy. Therefore, this article first established an equilibrium model of labor supply, and then related the price system, agricultural productivity, inputs, outputs and farmers' welfare through core variable, namely labor supply to analyze the effect of inputs, output and farmers' behaviors.

Secondly, we try to design a targeted questionnaire to obtain a certain amount of random samples. Since the years of the implementation of agricultural subsidies are short, and the data is relatively small, so we established questionnaires in Huangpi District of Wuhan based on theoretical models and then conducted descriptive analysis.

Third, using ordered logistic measurement method to verify the effect of the policies on agricultural subsidies.

Our research shows that direct subsidies to some extent could adjust the price mechanism, and under certain conditions they will affect the behavior of households, but at the present, due to the small amount of agricultural subsidies and the decrease of households' agricultural income compared to the total, the current agricultural subsidy policy has no significant effect. Overall, the rapid rise of agricultural goods and few investment opportunities have restricted the expansion of agricultural production.

II. Labor Supply Model and the Impact of Agricultural Subsidies

In the agricultural production process, labor is the main factor for investment, so we focus our analysis on the household's labor supply to analyze the allocation of resources with or without subsidies. In order to maintain the consistency to theory and experience, we focus on the impact of labor input, agricultural output and households' welfare.

1. The Assumption and the Nature of the Model

Assumption 1: There is only one factor, namely labor with total quantity T. the labor supply is denoted by $l = (l_1, \; l_2)$ where $l_i = (0, T)$ for $i = 1, 2$ denotes labor supply of aggent in agricultural and non-agricultural sector respectively.

Assumption 2: The production function of agricultural sector $f_1 = l_1^{\alpha}$ is of decreasing return where $0 < \alpha < 1$ and the prices of agricultural products is p. The production function of non-agricultural sector $f_2 = l_2$ is of constant returns where the wage in non-agricultural sector is w.

Assumption 3: the price system: the price of agricultural goods is denoted by p, the wage rate of non-agricultural sector is denoted by w, and the level of subsidies to the agricultural sector is S.

Similarly, refer to the current agricultural subsidies, the agricultural subsidies is put out in accordance with the land area, while in fact the number of land area is divided according to population. Assume that land area per person is the area that a single worker owns, so the agricultural subsidies are in fact the agent's individual subsidies with the difference of the manner of subsidy: subsidizing by price or by amount.

Refer to the usual settings, assuming that household's utility makes up of consumption and leisure, and the total utility function is $U = \ln C + b \ln(T - l_1 - l_2)$.

In order to facilitate analysis, we set the valorem subsidies refer to the subsidies for price of the agricultural products, or the indirect subsidies for the means of production, so the price of agricultural products becomes $p + s$ from p. Quantity subsidies refer to the direct subsidies for personal income, namely $s l_1$.

The benchmark for single agricultural sector is

$$U = \ln C + b \ln(T - l), \quad s.t. C \le y, y = p l^{\alpha}, 0 < \alpha < 1 \qquad (1)$$

The benchmark for two-sector is

$$U = \ln C + b \ln(T - l_1 - l_2), \quad s.t. C \le y, y = p l_1^{\alpha} + w l_2, 0 < \alpha < 1 \qquad (2)$$

The difference of the implementation of ad valorem subsidies and specific subsidies is the change of budget constraint. The partial optimum condition is the marginal income of agricultural labor supply is equal to the marginal income of non-agricultural labor supply. If one sector's marginal income is always greater than the other one, then there is no labor supply in that sector.

Nature 1: In case of a single sector, there is no real effect of ad valorem agriculture subsidies on labor for agriculture and the income effect is greater than the substitution effect. This also means that, in the case of two sectors, if the division of labor factor is complete and there is no flow for factors, there is no real effect for the labor supply but the change of pricing system, labor supply will not produce. About the specific subsidies of the labor supply, it will have real effects and increase the supply of labor. Because the specific subsidies increase households' income and the income effect is greater than the substitution effect.

Nature 2: in the two-sector model, there may have labors fully engaged in agricultural labor situation, or there may have labor transfer from agricultural sector to non-agricultural sector. The effects of agricultural subsidies depend on the relative relationship of the price system w, p, s and the technical efficiency of agricultural production α. Once the marginal income production of agricultural sector is greater than the marginal income production of non-agricultural sector, there will be a complete division of labor, and the agricultural labor force does not flow to non-agricultural sector. When the wage is greater than the sum of price and subsidies in the non-agricultural sector, it will not appear the phenomenon of no labor in the agricultural sector, and ad valorem agriculture subsidies could promote greater agricultural labor increase than the specific subsidies, but this time the equilibrium labor supply remains at a low level.

From the optimal solution process, the effect factors of the Balance configuration of labor allocation could be derived: in the two-sector model, the elasticity of agricultural labor supply is less than 1, due to the decrease return to scale of agriculture.

If there exists only the labor supply of agricultural sector, then the supply level not only depends on the level of technical efficiency of agricultural production but also the farmers' substitution effect b between the consumption and leisure.

Therefore, we must not only examine the price system WPS and technical efficiency of agricultural production, but also investigate the substitution effect.

2. The Effect of Subsidies on Labor Supply, Agricultural Output, Household's Consumption (welfare)

2.1 The Effect of Subsidies on Labor Supply

From the above theoretical analysis we know that the optimal choice of rural households, first depends on the price system and parameters of agricultural production technology, and the two decide the income of rural households at the same time. Therefore, when we consider the rational behavior of farmers, we must first begin to measure the income effect. In order to facilitate analysis, we will list the parameters deciding the household's labor behavior which are been listed in Appendix 1. From the appendix table we draw the following conclusions:

First, when $w < p$, specific subsidy will generate full supply of agricultural labor, labor will not be transferred to non-agricultural sector, compared with the case of no subsidies; When the agricultural production technology is higher, ad valorem subsidies will also generate full supply of agricultural labor; when the agricultural production technology is lower, there exist labor supply between the two sectors at the same time and the specific subsidies could generate more effect than the ad valorem subsidies could.

Second, when $w > p$, if $w < p + s$ the specific subsidies will generate full supply of agricultural labor when the agricultural production technology is higher, compared with the case of no subsidies; the ad valorem subsidies will generate full supply of agricultural labor only under the condition of $\dfrac{w}{p+s} < \alpha < 1$, and the effect of specific subsidies is better than that of ad valorem subsidies. If $p < p + s < w$, then the situation is completely reversed, and the two kinds of subsidies will make the labor supply existed in two sectors, namely, the labor force could transfer from the agricultural sector to the non-agricultural sector, but the labor supply in the agricultural sector still increased compared with the case of no subsidies and the specific subsidies is more beneficial for the increase of labor supply.

Based on actual experience, the condition of $p < p + s < w$ is more fitted for the actual situation of the price system: the labor force transfer to the non-agricultural sector significantly. Though subsidies can increase the supply of agricultural labor, but the new equilibrium level is still $(0,1)$. Compared to the available supply of labor time T, the subsidies have little effect, and the substitution effect of leisure and consumption does not affect the labor supply.

2.2 The Effect of Subsidies on Output - Comparative Static Analysis

Since we set the form of agricultural output $f_1 = l_1^{\alpha}$, the corresponding, under the conditions of $p < p + s < w$, the degree of the increase of agricultural production distinguished by ad valorem subsidies and specific subsidies could be specified as:

$$f_1^1 / f_1^0 = \left(l_1^1 / l_1^0 \right)^{\alpha} = \left[\frac{(p+s)\alpha}{w} \frac{w}{p\alpha} \right]^{\frac{\alpha}{1-\alpha}} = \left[(p+s)/p \right]^{\frac{\alpha}{1-\alpha}} \qquad (3)$$

$$f_1^2 \big/ f_1^0 = \left(l_1^2 / l_1^0 \right)^{\alpha} = \left[\frac{p\alpha}{w-s} \frac{w}{p\alpha} \right]^{\frac{\alpha}{1-\alpha}} = \left[w \big/ (w-s) \right]^{\frac{\alpha}{1-\alpha}} \qquad (4)$$

So, both of the subsidies could increase the output level. Because $l_1^0 < l_1^2 < l_1^1$, we have $f_1^2 \big/ f_1^1 = \left[pw \big/ (pw + s(w - p - s)) \right]^{\frac{\alpha}{1-\alpha}} < 1$. In summary, both of the subsidies could increase the equilibrium output and the effect of ad valorem subsidies is stronger.

set up $q_1 = (p+s)/p$, $q_2 = w/(w-s)$, then we get $1 < q_2 < q_1$ and

$$\frac{\partial (f_1^1/f_1^0)}{\partial s} = \frac{\partial (f_1^1/f_1^0)}{\partial q_1} \frac{\partial q_1}{\partial s} = \frac{\alpha}{1-\alpha} q_1^{\frac{2\alpha-1}{1-\alpha}} \frac{1}{p} > 0 \qquad (5)$$

$$\frac{\partial (f_1^2/f_1^0)}{\partial s} = \frac{\partial (f_1^2/f_1^0)}{\partial q_2} \frac{\partial q_2}{\partial s} = \frac{\alpha}{1-\alpha} q_2^{\frac{2\alpha-1}{1-\alpha}} \frac{w}{(w-s)^2} > 0 \qquad (6)$$

from the above expression, the two subsidies will increase the output. It indicates that, when $p < p + s < w$ agricultural subsidies continuous increase subsidies is more benefit for the increase of output, which indirectly shows the lower intensity of agricultural subsidies.

2.3 The Effect of Subsidies on Welfare

Subsidy policy does not change the objective function but change the household's budget constraint. In fact, by changing the household's budget constraint, agricultural subsidies expand the scope of a feasible solution. Under the condition of expanding the scope of a feasible solution without changing the objective function, rational people must not reduce the optimal objective function. Therefore, in general, most farmers' living standards should be improved. From that sense, the agricultural subsidies can indeed improve the welfare of farmers.

Under the condition of $p < p + s < w$, we will investigate the effect of subsidies on welfare.

If the subsidies are ad valorem subsidies, then the agricultural labor supply is $l_1^1 = \left[\frac{(p+s)\alpha}{w} \right]^{\frac{1}{1-\alpha}}$, and

the non-agricultural labor supply $l_2 = \frac{1}{b+1} \left(T - \frac{\alpha+b}{\alpha} l_1 \right)$.

We get

$$\frac{\partial U}{\partial s} = \frac{\partial U}{\partial l_1} \frac{\partial l_1}{\partial s} = (\alpha/w)^{\frac{1}{1-\alpha}} (p+s)^{\frac{\alpha}{1-\alpha}} \frac{b+1}{\alpha T + (1-\alpha)l_1} > 0 \qquad (7)$$

Thus, the greater the b is, the greater increase the welfare is of under the condition of ad valorem subsidies .

If the subsidies are specific subsidies then the impact on households' welfare can also be analyzed

accordingly. At this time agricultural labor supply is $l_1^2 = \left(\frac{p\alpha}{w-s} \right)^{\frac{1}{1-\alpha}}$, and non- agricultural labor supply

is $l_2 = \frac{1}{b+1} \left[T - \left(1 + \frac{bs}{w} + \frac{b}{w} \frac{w-s}{\alpha} \right) l_1 \right]$.

Thus,

$$\frac{\partial U}{\partial s} = \frac{\partial U}{\partial l_1}\frac{\partial l_1}{\partial s} = \left(\frac{p\alpha}{w-s}\right)^{\frac{1}{1-\alpha}}\frac{\alpha(b+1)}{\alpha wT + (1-\alpha)(w-s)l_1} > 0 \qquad (8)$$

From the above equation we can see that the greater the households' leisure substitution coefficient is, the greater increase the welfare is of under the condition of specific subsidies.

2.4 Some Basic Conclusions of Theoretical Models

In the model, we found that the price system WPS and the technical efficiency of agricultural production α determines the structure of labor supply, so effective methods of increasing agricultural production and increasing farmers' production enthusiasm can be obtained in two ways: one is to increase the level of subsidies to achieve the price relationship adjustments, and to change the optimal equilibrium conditions; the other is to increase technology coefficient α in the long term which is a fundamental problem. Of course, our model can not explain the deviation from equilibrium and this can be seen as a friction of labor force in the inter-conversion. If the friction is large enough, the agricultural labor force can not be transferred to non-agricultural sector, then we could only consider the agricultural sector which exists in the structure change modle. Proposition 1: If the wage is much greater than the sum of price and subsidies and the case of investment in the non-agricultural sector agriculture, the production subsidies for farmers have a positive incentive, to some extent, to stimulate the enthusiasm of farmers as well as the production, but the effect is very weak. This is relative to the size of WPS under the price system.

To verify the model's persuasiveness, namely whether China's agricultural subsidies can actually increase the enthusiasm of farmers to improve agricultural production, or encourage peasants to increase income, we obtain the corresponding micro-level data to verify the model.

III. The background of Investigation, the Description of the Data and the Choice of Econometrical Method

The general idea of empirical analysis is as follows: first we show the status of our investigation, and then describe the relevant variables, including the rate of agricultural labor supply, wage levels, the level of direct subsidies, the level of indirect subsidies, the level of agricultural output, agricultural prices, the price of agricultural production materials evaluation of policy on subsidies, living standards , the response to the increase of subsidies and the anticipation of policies. Last, ordered logistic model is estimated to verify the correlation between economic variables.

3.1 The Background of the Investigation

The purpose of the survey is to detect farmers' behavior with or without subsidies and analyses the effect of subsidies on agricultural inputs and production. Refer to theoretical hypothesis, we designed questionnaire. In data collection, we use "home to home" methods to collect information on households with random sampling. In the sample selection, we selected samples in Huangpi district in Wuhan, Hubei Province. As a major agricultural province, its typical industry is farming, while Huangpi District is near the provincial capital of Wuhan. So farmers have more choice for work, and we believe that the samples selected is representative to reflect the feedback from farmers on subsidies.

In the questionnaire, we tried to obtain information on multiple levels. First, about farmers' family situation and living conditions, household's economic status, capital surplus situation, the input and output of production are designed. For the agricultural input(including the number the amount), we have taken the method of orderly interval distribution, namely: increase, fairness and reducing. food production for farmers, planting area and income for working outside are also accurately accounted.

Second, the data on government subsidies are investigated especially the accurate amount of subsidies. Third, the detection of policy evaluation for farmers, and the options are: "policy has been very good," "General and there is nothing for real benefits", "suffering losses"., the proportion of agricultural subsidies to household's total income is set as follows: about or less than5%(low), 6% -10% (high), 11% -20% (high), equal to or more than 20% (very high). Similar problems are: Is it because whether the living standards improves as the subsidies increases, whether the current subsidies can make up for the higher prices of agricultural factors, whether the investment in agriculture will increase if the agricultural subsidies are doubled up, what percentage of subsidies will be used for agricultural input, what the first response when get the subsidies and so on.

3.2 The Preliminary Findings of the Questionnaire

3.2.1 Farmers' Age Distribution and Economic Conditions

The survey shows that the average age of farmers who engage in farming is 54.7 years old, among whom the youngest is 25 years old whereas the oldest is 75-year-old with the standard deviation of 10.44 years old. Farmers aged over 50 account for 69.5 % and 7.6% of farmers are between 40-year-old and 50-year-old. However, young labor forces only occupy 1.4% of the total workforce. The "inverted pyramid" structure of age distribution demonstrates the loss of labor forces in agricultural production.

As to the economic conditions of farmers, the survey reveals that more than half of the farmers have to borrow money or on credit (most of them rely on credit, which is mainly limited to acquaintances) to buy means of production such as seeds, fertilizer and pesticides. We also design some more direct options about household income and expenditure, including "loose budget, balance of payment and tight budget". The results show that about 45% farmers are able to make both ends meet and the number of farmers with loose budget is quite similar to that of farmers with tight budget. Generally speaking, farmer's income and expenditure is break-even.

3.2.2 The Situation of Agricultural Production

We have provided three options for the question "whether there is surplus in grain output in 2008": "surplus for sale," "self-sufficient" and "not self-sufficient". The first option is a meaningful reflection of the effectiveness of the policy of agricultural subsidies on farmers because costs and benefits of grain production are directly related to the policy of agricultural subsidies. From the table we can see that farmers with surplus for sale account for 62.5% of the total samples and one third of farmers achieve self-sufficiency with only a small fraction of farmers falling short of grain supply, which verifies that agricultural subsidies have great impact.

As for production condition, we make a survey of the amount and quantities of inputs in means of production by farmers including seeds, fertilizers, and pesticides with three options of "increase" "unchanged" and "decrease". The results show that inputs in seeds level off generally; only one-third farmers increase inputs in fertilizers with the other two thirds of farmers remaining unchanged. However, the majority of farmers raise their inputs in pesticide. At present, great progress has been made in agricultural cultivation technology, so the use of seeds does not change significantly. However, the rising trend of using chemical fertilizers and pesticides is likely to be related to the decline in natural soil fertility caused by continual use of inorganic fertilizers. On the other hand, the rise in the prices of seeds, fertilizer and pesticide leads to increasing costs of agricultural production.

On the importance of agricultural production, we set up three options" very important and the main source of income," "not so important and for self-sufficient" and "unprofitable and unwilling to do farming".

The results reveal that 43.1% of farmers consider agriculture production as the principal source of income while more than half of farmers do farming only for self-sufficiency or give up farming. Among them, farmers for sake of self-sufficiency account for 38.2 %, with an increase compared with the percentage in 2008, which reflects that farmers lower down their psychological evaluation on agricultural production to some extent.

3.2.3 Farmers' View on Agricultural Subsidy Policy

We have designed the questionnaire (as seen in Table 1) to explore farmers' evaluation on the policy of agricultural subsidies as well as the effects of subsidy policy on farmers' behavior. The results show that more than half of the farmers indicate that they really benefit from the agricultural subsidy policy, but two thirds of farmers complain that the agricultural policies are not transparent enough and whether agricultural subsidies may be expected to increase or decrease is uncertain. As for the impact of subsidies on households, nearly 60% farmers are unsatisfied with the intensity of agricultural subsidies, which only accounts for less than 5% of total household income; while one third of households feel their standard of living has been improved because subsidies reach as high as 6%-10% of total household income. As the prices of seeds, chemical fertilizer and pesticide rise higher than the amount of subsidies, farmers choose to spend all the subsidies on agricultural production directly upon receipt of subsidies.

The above analysis of the effectiveness of agricultural subsidy policies is made from statistic description and then we make a quantitative analysis of the effectiveness of policies in a more accurate sense, focusing on the impact of agricultural subsidy policy on agricultural inputs and outputs.

Table 1: The descriptive statistics of questionnaires on the effectiveness of agricultural subsidies (unit: %)

variable	condition						
labor	0	1	2	3	4	5	6
percentage	0.014	0.215	0.708	0.028	0.021	0.007	0.007
percentage	9.7			23.6		66.7	
Condition of household income and payment	Loose budget			Balance of payment		Tight budget	
percentage	25.0			45.1		29.9	
Whether there is surplus in grain output in 2008	surplus			Self-sufficient		Not self-sufficient	
percentage	62.5			33.3		4.2	
Inputs in agricultural materials	increase			unchanged		decrease	
The quantity of the purchase of seeds	16.7			81.3		2.0	
The amount of the purchase of seeds	84.0			13.9		0.7	
The quantity of the purchase of fertilizers	36.1			63.9		0	
The amount of the purchase of fertilizers	93.0			6.9		0	
The quantity of the purchase of pesticides	83.3			14.6		2.1	
The amount of the purchase of pesticides	94.4			4.9		0.7	
Importance of agricultural production	very important and the main source of income			not so important and for self-sufficient		unprofitable and unwilling to do farming	
percentage	43.1			38.2		18.7	
Evaluation on the policy	the policy really benefits the farmers			just so so and there is no real advantage		disadvantageous to farmers	
percentage	58.3			22.9		18.8	
Expectation about agricultural subsidies	Good policy and Expected			uncertain		No expectation, disappointed with the implementation of policy	
percentage	27.1			68.1		4.8	
the proportion of agricultural subsidies in total household income	Less than 5%			6%——10%		11%—20%	
percentage	57.6			33.3		9.1	
The impact of subsidies on living conditions	Improve living conditions			Almost unchanged		Seem to get worse	
percentage	56.3			38.2		5.5	
Comparison of subsidies with rise in prices	Prices rise faster			Generally make up for the rise in prices		Subsidies are more than the rise in prices	
percentage	85.4			13.2		6.4	
Response to the doubling of agricultural subsidies	Make use of all subsides to increase inputs			Unchanged and still unsatisfied with the less amount of subsidies		Continually reduce inputs	
percentage	70.2			25.0		4.8	
First response after receiving subsidies	Increase agricultural expenditure			Not worried about the harvest		Spend in other fields	
percentage	81.3			8.3		10.4	
the proportion of subsidies used for inputs	Spend all the subsidies on the purchase of inputs			Spend some subsidies on the purchase of inputs		Spend no subsidies on the purchase of inputs	
percentage	84.7			8.3		7	

3.3 The Choice of Econometrical Method——Ordered Logistic Model

What we should prove is that in the extent to which the agricultural subsidies change the farmers' behavior, and then calculate the effect of subsidies especially the effect on input and output. The ordered logistic model will be used. As the statistics are all non-continuous data obtained from questionnaire survey, the dependent variable is a categorical rather than continuous variable, and the traditional OLS method is no longer applicable at this time so we use the order logistic model for analysis. The basic model is as follows

$$\pi_i = \Pr o(Y = i \mid X) = \frac{e^{\beta_n x_n}}{1 + \sum_{m=1}^{M} e^{\beta_m' x_m}} \qquad (9)$$

Where X=($x_1, x_2...., x_M$), β_n, β_m' are the determination coefficient of independent variables x_n and x_m. Equation（9）can also be written as：

$$\log(\frac{\pi_i}{1 - \pi_i}) = \beta_0 + \sum \beta_j X_j \qquad (10)$$

All the logistic models we have analyzed currently are binary variable model, but the ordered logistic model does not only restricted to it. We often see the variables measured by "Likert" type scale, such as "strongly oppose, oppose, neutral, support, and strongly support" or "never, occasionally, often, always" or "poor, general, good, very good "and so on. These reactions are usually encoded in accordance with the sequence 1,2,3,4,5 and so on. The measurement of Likert type is often treated as a "continuous" variable. One way to establish models for ordinal response variables is the ordered logistic regression model, and Ordered logistic regression model is the development of binary logistic regression model. It is defined as follows:

$$y^* = \alpha + \sum_{k=1}^{K} \beta_k x_k + \varepsilon \qquad (11)$$

Where y^* is the latent variable, which is used to observe the inherent tendency phenomena of variables. It can not be directly measured and the error term is ε.

When the observed response variables have J types of response (j = 1,2, ..., J), the corresponding values for the y = 1, y = 2, ..., y = J, and the relationship between the various values is (y = 1) <(y = 2) <... <(y = J). There are J-1 discontinuities (threshold) to separate the adjacent categories. Namely:

If $y^* \le \mu_1$, then $y = 1$; if $\mu_1 \le y^* \le \mu_2$, then $y = 2$; ... ... If $\mu_{J-1} \le y^*$, then $y = J$. Where μ_j is cutoff point, and there are J-1 values, namely $\mu_1 < \mu_2 < \mu_3 < ... < \mu_{j-1}$. In the parameter estimation process, the statistical software will report out μ_1, μ_2, …, μ_j, they are called threshold parameter. As ordered logistic model is nonlinear model, we usually use the maximum likelihood estimation to obtain parameters. The difference of the estimations in the corresponding ordered models are just concentrated in the distribution issues, so long as the statistics program which could generate latent variable information is known and properly has set likelihood ratio, the maximum likelihood estimator is consistent and asymptotically efficient. Since we only need the probability of occurrence and relationship between variables, therefore, ordered logistic model used in the conclusion is appropriate.

IV. The Experiential Verification Based in Huangpi District ——the Effect of Agricultural Subsidies on Labor Input, Output and Welfare

Combined with theoretical models, we will verify the input, output and welfare of farmers respectively. Because there are many factors, we can only try to select some of the more influential factors as explanatory variables to detect policy effects of agricultural subsidies.

4.1 The effect of Subsidies on farmers' labor input.

We have designed the Questions as follows to investigate farmers' labor input: if agricultural subsidies double, will you increase agricultural inputs? If there is 100 yuan subsidized for one mu of land, how much you will use for input, such as to buy more fertilizer and pesticides?

Denote sex, living standards, the proportion of subsidies to total income, the loan, the importance of agricultural production, the proportion of agricultural labor to total household population and Cash on hand by Gender, Subtoliving, Subtotic, Finacfp, sap, Laborrate to detect each variable's impact to explanatory variables.

In view of the years involved are short, we use trends in labor supply, namely sap, instead of the rate of labor supply, and then indicate the relevant economic variables' impact on labor supply.

Table 2: the regression equation on the importance of agricultural production

variable	Sap	Sap	Sap	Sap	Sap
Subtoliving	0.6314 (0.2986)	0.4291 (0.3021)	0.4146 (0.3010)	0.4018 (0.3025)	
Subtitic	1.8932 (0.3420)	1.8644 (0.3432)	1.8528 (0.3421)	1.8344 (0.3445)	1.8744 (0.3417)
Cash	-0.5117 (0.2552)	-0.1970 (0.2747)			
Ifgrainselling		1.6428 (0.3532)	1.7013 (0.3456)	1.7035 (0.3445)	1.7678 (0.3446)
Finacfp				0.1288 (0.3021)	
Amount of samples	143	143	143	143	143
Pseudo R^2	0.1751	0.2579	0.2562	0.2568	0.2498

Note: standard errors in brackets

From Table 2 we can see farmers' attitude to the importance of agricultural production has advanced, due to the increase of agricultural subsidies which stimulate the increase of income and then the promotion of welfare. That is to say, the subsidies do upgrade the position in the family income. The situation of Financing of farmers for the production is of no significant impact on the decision of whether to sell foodstuff, but the farmers' cash on hand has a significant impact on production decisions. It's possible for two reasons: one is the investment for production of households is small. Though restricted by credit constraints, they can use guarantees of farm produce to get loans, so the liquidity constraint does not significantly affects production decisions. But, if we can improve mobility, the subsidy policy can increase the enthusiasm of farmers.

4.2 Farmers' Response in Subsidies and Effect to Input

We next analyze farmers' reaction after the increase in agricultural subsidies. Where: Fuads means farmers' first reaction after receiving subsidies:"1" denotes subsidies used to other places, "2" denotes do not worrying that whether the harvest is good, "3" denotes that increasing the investment in agriculture; Rads means the response after the increase of subsidies: "1 "denote the reduction of agricultural input, " 2 "denotes the same," 3 " denotes the increase of investment in agriculture; Radsp is the share used for the production after the increase of subsidies: " 1 "denote part used for input or part of the reduction of the original input, "2" means maintaining the original investment, "3" denotes all used for input;

Subtoprise means the level of agricultural subsidies compared with the increase of prices of agricultural goods: "1" denotes sufficiency of agricultural subsidies, "2" denotes the two offset, " 3 "denotes the multi-material prices have gone up; Exptop means the expectation of the increase of agricultural subsidies: " 1 "denotes no increase," 2 "denote unkonwn," 3 "denotes it will continue to increase the long run. See Table 3.

Table 3: the part of the increase of agricultural subsidies used for production

variable	Radsp	Radsp	Radsp	Radsp
Rads	0.8400 (0.4357)	0.8392 (0.4419)	0.943 (0.4057)	0.9371 (0.4176)
Fuads	1.2263 (0.3299)	1.2222 (0.2859)	1.3227 (0.3165)	1.3207 (0.3182)
Subtoprise	0.0969 (0.6332)			
Cash			-0.6547 (0.3561)	-0.6532 (0.3570)
Exptop				0.0192 (0.3119)
Amount of samples	143	143	143	143
Pseudo R^2	0.1674	0.1672	0.1891	0.1891

Note: standard errors in brackets

From Table 4 we found that farmers' reaction after receiving subsidies could decide the final the part of subsidies used for agricultural production. While the liquidity constraint and the expectations of the increase of subsidies to a certain extent effect the dominant role of farmers for subsidies. It is interesting that the level of agricultural subsidies compared with the increase of prices is not very significant, this is an question. As farmers are recipients for the market prices. Even if aware of the increase of the prices of agricultural goods, the factors are not controllable, so it is not taken into account. From the option "whether there are extra money on hand," we find the slope coefficient is negative. Faced by liquidity constraints, farmers are more likely to use the agricultural subsidies for other purpose, for example, tuition for their children. About expectations of policy it shows a long-term policy of agricultural subsidies is expected to help farmers to expand production, but this factor is not significant.

4.3 The Policy of Agricultural Subsidies on the Welfare of Farmers

First we look at whether the welfare of rural households increased the level of benefits farmers and the factors related we design the question: whether your living standards has been increased with the increase of agricultural subsidies? A: increased; B: no feeling, there is almost no subsidies; C: it seem to be down. And the result is in Table4.

Table 4 shows that farmers' evaluation of policy is only related to the improvement of welfare, but not significant with the agricultural labor supply. After t test, it is showed that agricultural subsidies actually increase the households' welfare by way of increasing their income. So the greater the proportion of agricultural subsidies to total income is, the more important the status of agricultural production for farmers. However, we return to the fourth row, it should be noted that the option "whether there is extra money on hand" is negative to the evaluation of policy. As far as liquidity constraints faced by farmers, subsidies actually increased the welfare of farmers through the income effect. Denoting men by "1" and women by "0", then we can see the male have higher evaluation of subsidies, due to the fact that the male labor force transfer between the two sectors more easily, so they are more sensitive for the subsidy increase.

Table 4: the regression equation of the evaluation of agricultural subsidy policy

variable	evalutop	evalutop	evalutop	evalutop	evalutop
Subtoliving	1.3617 (0.3088)	1.2465 (0.3117)	1.2358 (0.3118)	1.2988 (0.3165)	1.2326 (0.3184)
Subtotic	1.3625 (0.3539)	0.9405 (0.3773)	0.9480 (0.3784)	1.0258 (0.3941)	0.9316 (0.3941)
Sap		0.6875 (0.2890)	0.6539 (0.2936)	0.5708 (0.2981)	0.5770 (0.3025)
Laborrate			0.5073 (0.841)		
Cash				-0.5236 (0.2813)	-0.5769 (0.2845)
Gender					0.6961 (0.3813)
Amount of samples	143	143	143	143	143
Pseudo R^2	0.1563	0.1771	0.1784	0.1895	0.2017

Note: standard errors in brackets

The findings are not only consistent with the economic theory proved in part Ⅱ, but also accurately depict the basic policy of agricultural subsidies on production decisions of farmers: agricultural subsidies directly increase households' incomes and then further increase the welfare of rural households; the increase of income has further enhanced the enthusiasm of farmers' production with the precondition of farmers' persistence in grain production. In the statistical description, we see that the proportion of farmers selling grain has dropped to 25%, the remaining farmers have chosen to buy grain or producing for self-sufficiency. From this we see the limitations of the current agricultural subsidy policies. The decision-making after the increase in agricultural subsidies is impacted by farmers' first reaction after getting subsidies. If subsidies are used to increase investment in agriculture, it could promote production. The above analysis shows the relationship between farmers' production decisions and the policy of agricultural subsidies.

Although the absolute increase of the amount of subsidies and the expansion of the State's investment in agriculture in recent years, The marginal income gap in urban and rural areas and the marginal income gap of labor supply in agricultural and non-agricultural sectors have been exacerbated due to the increase of prices of agricultural factors and the lower prices of agro-products ,which lead to the transfer of labor factor. China's current agricultural support policies, especially agricultural subsidies for farmers, is of great significance to improve production and promote farmers' increase of agricultural investment and improve the financing channels for farmers' producing.

Conclusions and Directions for Further Research

Based on the analysis of the labor supply model, we have analyzed the agricultural subsidies and designed the corresponding questionnaire on account of the conditions of rural production in Huangpi District in Wuhan City, Hubei Province and then examines the effect of agricultural subsidies on farmers' decision-making of production.

Studies have shown that the econometric results and theoretical analysis are of the same and we have:

First, although agricultural subsidies increased the welfare of farmers, but the effect is not significant on increasing production. By increasing the cash income of farmers, Agricultural subsidies could increased households' welfare, and the higher the substitution coefficient of consumption and leisure, the greater the improvement of such benefits. Since farmers' production is constrained by liquidity, agricultural subsidies are more likely to improve the mobility to promote production. In contrast, changing the pricing system is better to promote framers' enthusiasm, enhance the production and increase their income. Second, the reactions on farmers after the increase of agricultural subsidies could reflect the effect of policy. Faced with Liquidity Constraints, farmers are more likely to use the subsidies for investment, so the subsidies could increase the enthusiasm of farmers, which in turn explain the inadequate supply of government subsidies. If the Government's policy objective is to slightly improve the living standards of farmers, the current subsidy level has made the implementation; if the Government's policy objective is to promote the development of agriculture to increase production enthusiasm, then the subsidy policy should be executed continues, and the value of these subsidies should be enhanced.

Due to the liquidity constraints, a possible direction for further research is the subsidies for production loans. As the number of this group is low, most of the farmers are really difficult to find investment opportunities. In the long term, studies of these groups' financial needs and situations will be worth to further study.

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Appendix 1:

If $w<p$, then

WPS system : W<P	Agricultural technical effieiency parameter α	Equilibrium of l_1^0	Equilibrium of l_1^1	Equilibrium of l_1^2	The relations of size among l_1^0, l_1^1, and l_1^2
S=0	$0<\alpha<\frac{w}{p}$	$l_1^0=\left(\frac{p\alpha}{w}\right)^{\frac{1}{1-\alpha}}$	———	———	———
	$\frac{w}{p}<\alpha<1$	$l_1^0=\frac{\alpha}{\alpha+b}T$	———	———	———
0<w<s	$0<\alpha<\frac{w}{p+s}$	$l_1^0=\left(\frac{p\alpha}{w}\right)^{\frac{1}{1-\alpha}}$	$l_1^1=\left[\frac{(p+s)\alpha}{w}\right]^{\frac{1}{1-\alpha}}$	$\frac{\alpha T}{\alpha+b}<l_1^2<\frac{T}{1+b}$	$l_1^0<l_1^1$
	$\frac{w}{p+s}<\alpha<\frac{w}{p}$	$l_1^0=\left(\frac{p\alpha}{w}\right)^{\frac{1}{1-\alpha}}$	$l_1^1=\frac{\alpha}{\alpha+b}T$	$\frac{\alpha T}{\alpha+b}<l_1^2<\frac{T}{1+b}$	$l_1^1<l_1^2$
	$\frac{w}{p}<\alpha<1$	$l_1^0=\frac{\alpha}{\alpha+b}T$	$l_1^1=\frac{\alpha}{\alpha+b}T$	$\frac{\alpha T}{\alpha+b}<l_1^2<\frac{T}{1+b}$	$l_1^0=l_1^1<l_1^2$
s<w<p+s	$0<\alpha<\frac{w-s}{p}$	$l_1^0=\left(\frac{p\alpha}{w}\right)^{\frac{1}{1-\alpha}}$	$l_1^1=\left[\frac{(p+s)\alpha}{w}\right]^{\frac{1}{1-\alpha}}$	$l_1^2=\left(\frac{p\alpha}{w-s}\right)^{\frac{1}{1-\alpha}}$	$l_1^0<l_1^1<l_1^2$
	$\frac{w-s}{p}<\alpha<\frac{w}{p+s}$	$l_1^0=\left(\frac{p\alpha}{w}\right)^{\frac{1}{1-\alpha}}$	$l_1^1=\left[\frac{(p+s)\alpha}{w}\right]^{\frac{1}{1-\alpha}}$	$\frac{\alpha T}{\alpha+b}<l_1^2<\frac{T}{1+b}$	$l_1^0<l_1^1$
	$\frac{w}{p+s}<\alpha<\frac{w}{p}$	$l_1^0=\left(\frac{p\alpha}{w}\right)^{\frac{1}{1-\alpha}}$	$l_1^1=\frac{\alpha}{\alpha+b}T$	$\frac{\alpha T}{\alpha+b}<l_1^2<\frac{T}{1+b}$	$l_1^1<l_1^2$
	$\frac{w}{p}<\alpha<1$	$l_1^0=\frac{\alpha}{\alpha+b}T$	$l_1^1=\frac{\alpha}{\alpha+b}T$	$\frac{\alpha T}{\alpha+b}<l_1^2<\frac{T}{1+b}$	$l_1^0=l_1^1<l_1^2$