Influences of Agricultural Insurance Policies on Farmer Household’s Planting Scale
—Taking corn farmer households in Inner Mongolia Autonomous Region for example

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Abstract

Theoretically, agricultural insurance policies can change the probability distribution of a farmer household’s net income, affect his expected return, and make him reallocate resources to improve the utility level, thus exerting influences on his investment of agricultural production factors, such as land, capital and labour force. This paper carries out an empirical research on whether the policy-oriented agricultural insurance in Inner Mongolia Autonomous Region has influences on corn farmer households’ motivation by means of “Logit” model and maximum likelihood estimation. The study shows that farmer households’ planting decisions are closely related with the market risks, agricultural insurance policies, as well as their personal and family characteristics, of which market risks are the primary factors and policy-oriented agricultural insurance is also key factors taking effect, that is, the better an agricultural insurance participating farmer household’s on the policy-oriented agricultural insurance is, the more likely he will maintain or expand planting area.

Keywords: Agricultural, Insurance, Planting, Behaviour “Logit”, Model.

1. INTRODUCTION

In 2007, China implemented the agricultural insurance premium subsidy pilot project in six provinces with a budget of 2150 million RMB from the central government funding, and the following years saw a continuous increase in agricultural insurance subsidies, subsidy varieties, subsidy proportion and subsidy area. Currently, China ranks only second to the United States in agricultural insurance scale. In 2015, the central government implemented the agricultural insurance premium subsidy project nationwide, with subsidy varieties increasing from five crop varieties to 15 kinds of crops and 6 breed varieties, or 738 agricultural insurance products in total, covering the major primary agricultural products. Will this policy exert influences on farmer households’ planting behaviour, or has the policy gained the expected effect? This study provides theoretical support and policy orientation for the reform and improvement of agricultural insurance policies, and has great practice significances in protecting farmer households’ planting initiative and national food security.

2. LITERATURE REVIEW

Current studies paid attention to the influences of agricultural insurance and premium subsidy policies on farmer households’ production resource allocation and operation behaviours, that is, agricultural insurance and government premium subsidies could lead to changes in farmer households’ production and operation scale, improve their planting initiative, change their planting structure and increase the planting area of crops covered by high subsidy proportion. Some scholars thought that agricultural insurance and premium subsidy policies had some influences on crop planting area, and crop insurance scheme contributed to farmer households’ expanding planting area. Some scholars thought agricultural insurance and premium subsidy policies had few influence on crop planting area.

According to Young, Vandeveerand Sehnepf (2001), agricultural insurance with premium subsidy only
contributed to a 0.4% increase in the planting area of major crops. With an empirical analysis of the influence of agricultural insurance on planting area, Goodwin, Vandeveerand Deal (2004) proved that agricultural insurance had different influences on the planting area of different crops. After an investigation into the corn and bean farmer households in mid-western America and barley and wheat farmer households in northern plain district, they found that a 30% decrease in agricultural insurance cost contributed to a 1.1% increase in barley planting area, less than 0.5% increase in corn planting area and non-significant changes in bean and wheat planting area.

so premium subsidy policies worked little in encouraging crop planting. Tronstad and Bool (2010) analysed the relationship between cotton planting and agricultural insurance in America, finding that “high premium subsidies would encourage cotton farmer households to maintain or expand cotton planting area”. Miao, Feng and Hennessy (2011) studied the influence of government premium subsidy on farmer households’ utilization of land, finding that 5% decrease in government premium subsidy rate led to 0.6% decrease in the planting area of agricultural insurance-covered land, 5% decrease in price, and 1.01% decrease in agricultural insurance-covered land. According to the analysis of other scholars, crop premium subsidies would lead to the utilization of marginal lands and extensive growth. Domestic scholars studied the influences of agricultural insurance on production resource allocation from different angles. According to the study carried out by Zhong Funing, etc.(2007), agricultural insurance could influence the use of farm chemicals and chemical fertilizers, namely, farmer households buying agricultural insurance would use less farm chemicals but more chemical fertilizers and agricultural films. As far as Xu Longjun was concerned, agricultural insurance covering more yet with a lower rate had greater influences on farmer households’ production resource allocation, because in that case, farmer households would put more labour force into crop planting, accelerating the growth of the large farmer-households, Liu Wei and Sun Rong (2016) analysed the transmission mechanism of premium subsidy policy on farmer household behaviour and planting structures based on the panel data across China before and after the implementation of agricultural insurance premium subsidy policy. The result indicated that agricultural insurance premium subsidy policy encouraged farmer households to participate in agricultural insurance, led to adjustment in planting structures and thus affected demand for agricultural insurance. With premium subsidy, agricultural insurance stabilized agricultural income, which, to some extent, solidified farmer households’ production activities and planting structures, and then impelled the planting structure to transfer from low insurance crops to high insurance ones. As can be seen, foreign scholars carried out more studies about the influences of agricultural insurance and premium subsidy policy on farmer households’ planting decision behaviour. However, further empirical tests need to be done to see whether it is the same case in China since the situations that foreign farmer households and Chinese farmer households face are different. In china, only Liu Wei and Sun Rong (2016) carried out an empirical study on the effects of agricultural insurance and premium subsidy policy from the perspective of farmer households’ planting behaviour. Based on field studies, this paper analyses farmer households’ production and operation features with survey data, and makes an empirical test on the influences of current agricultural insurance policy on farmer households’ planting scale.

3. DESCRIPTIVE STATISTICS OF FARMER HOUSEHOLDS

All the data used in this paper were from the questionnaire survey of Inner Mongolia planting industry insurance. Investigators carried out field survey through household interview and questionnaires in 4 leagues (cities) (including Hohhot CityBaotou CityHulunbeier City and Hinggan League), 7 banners (counties), 15 townships and 25 villages in Inner Mongolia, collected 287 valid samples, of which 182 were corn farmer households participating in planting industry insurance from 4 leagues (cities), 6 banners (counties), 10 townships and 18 villages. Among the farmer households under survey, corn farmer households participating in agricultural insurance accounted for 63.41%.The questionnaire involved basic information on a farmer household, his family and agricultural production activities, his participation in agricultural insurance, damages caused by natural disasters, as well as his cognition and estimate of agricultural insurance.

4. THEORETICAL ANALYSIS AND VARIABLE SELECTION

4.1 Theoretical Analysis

This paper selected corn farmer households participating in agricultural insurance as object of study. Utility farmer household school advocated that farmer households should pursue utility maximization, for whom the primary factor influencing farmer households’ decision behaviour was corn crop yield. As agriculture is a special industry, its yield is greatly influenced by both natural and market factors, as well as policy and economic factors. This study mainly focuses on the affective variables on agriculture from the four aspects. First of all, natural disaster risks factors. Based on years of experience, farmer households tended to have a subjective estimate about natural disaster risk, believing that more natural disaster risks could lead to higher expectation for losses in
agriculture production which made it harder for them to maintain or expand planting area, yet by participating in agricultural insurance, they could lower their expectation for losses, which contributed to their maintaining or expanding planting area. Based on this analysis, natural disaster risks wouldn’t have obvious influences on farmer households’ planting decision, so this paper excludes the influences of natural disaster risks factors on farmer households’ decision. Second, market risks factors. Corn crop yield was determined by revenue and cost, with the former mainly influenced by production and price. Since there was usually no great fluctuation in corn production in a short term, so corn price would be the major factor influencing revenue. The higher the corn price was, the greater the revenue expectation would be. However, the higher the cost was, the lower the revenue expectation would be. This paper takes revenue and cost of corn per mu as market risks indicators, finding that market factors were major basis for farmer household decision and the government usually indirectly influenced farmer households’ behaviour by changing market signals through market transmission mechanism. Corn cost per mu mainly involved the field management cost of corn, including top dressing, irrigation, weed and pest control costs. Third, policy factors. The more farmer households knew about agricultural insurance policies and the higher their estimate was, the lower their loss expectation would be, which would further influence their planting decision. At last, according to behavioural economics theory, it was not only economic factors but also non-economic factors that had influences on one’s behaviour. Therefore, as for non-economic factors, the personal and family features of the decision-maker should be taken into consideration as variables.

4.2 Variable Setting

4.2.1 Selection of Explained Variable

This paper is to find out the reaction of farmer households’ planting decision to agricultural insurance policies. In order to make an accurate estimate about whether agricultural insurance policies had improved farmer households’ crop planting initiative, the study selects farmer households’ selection of future crop planting area as performance evaluation indicators. Since the aim of agricultural policies was to encourage crop planting, maintain and expand planting scale, the author selected the farmer households’ not reducing corn planting area next season as the explained variable of the model.

4.2.2 Selection of Control Variable

4.2.2.1 Personal and Family Features

According to behavioural economics theory, non-economic factors including personal and family features also had influences on farmer households’ behaviour. Older farmer households were more conservative than young farmer households, so they had neither the desire nor the strength or energy to farm more land; highly cultivated farmer households were more open to new things, which brought them more job opportunities, so they were more likely to work in the cities, resulting in less desire for maintaining or expanding planting area. Farmer households usually made production decisions in line with their current land resources. The larger the crop operation scale was, the larger the proportion of agricultural income in family income would be, and further crop production would gain more income, and thus they were more likely to maintain or expand planting area.

4.2.2.2 Market Risks

According to the principle of utility maximization, the major motive for farmer households to plant corn was to pursue revenue maximization, so sales revenue and field management cost of corn per mu were the main factors affecting farmer households’ decision on whether to maintain or expand planting area. In a short term, corn production usually stabilized, so the higher the sales price of corn was, the bigger its sales revenue would be, which would drive farmer households to expand planting area, or, considering limitations in farming land and labour force, at least maintain planting area rather than reduce planting area. However, on the contrary, the higher the cost was, the less desire the farmer households would have to expand planting area.

Natural risks also had a lot to do with farmer households’ planting decision, however, as the object of this study is farmer households participating in agricultural insurance, they would deal with natural risks by means of agricultural insurance, which to a certain extent, weakened the influences of natural risks on farmer households’ planting decision, so this study excludes natural risks from variables.

4.2.2.3 Selection of Explanatory Variable and Research Hypothesis
According to the above statistics analysis, as far as the cognition and estimate about agricultural insurance policies were concerned, 12.64% of the farmer households participating in agricultural insurance had no idea about agricultural insurance policies. The survey indicates that the reason why some farmer households still participated in agricultural insurance without any knowledge on agricultural insurance policies was that they are encouraged by other farmer households’ benefits from participating in it. 88.45% of the farmer households participating in agricultural insurance expressed “very satisfied”, “fairly satisfied” and “basically satisfied”, indicating that agricultural insurance policies were affirmed by farmer households. Therefore, it is believed that farmer households’ cognition and estimate about agricultural insurance policies may exert certain influences on large farmer-households in maintaining or expanding planting area. Based on the above analysis, the following hypotheses were raised.

Hypothesis 1: The more cognition of agricultural insurance farmer households got, the stronger their desire for diversifying natural risks through participating in agricultural insurance would be, and the more likely farmer households would maintain or expand planting scale for more benefits.

Hypothesis 2: The more satisfied the estimate about agricultural insurance policies was, the stronger their desire for diversifying natural risks through participating in agricultural insurance would be, so was their willingness to maintain or expand planting area (namely, the less likely they will reduce corn planting area next season). Table 5 shows the names and definitions of different variables.

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>explained</td>
<td>Planting decision</td>
<td>next year(whether not to reduce planting area in 2015)</td>
</tr>
<tr>
<td>variables</td>
<td>behaviour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>farmer household’s</td>
<td>age, farmer household’s actual age of householder (years)</td>
</tr>
<tr>
<td></td>
<td>personal feature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>farmer household’s</td>
<td>farmer household’s number of years for householder’s education</td>
</tr>
<tr>
<td></td>
<td>family feature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ThePrecentof</td>
<td>the Precent of non-agricultural income in family income</td>
</tr>
<tr>
<td></td>
<td>non-agricultural income</td>
<td></td>
</tr>
<tr>
<td></td>
<td>corn planting area</td>
<td>the actual sowing mu of the year</td>
</tr>
<tr>
<td></td>
<td>market factors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>corn sales revenue</td>
<td>sales revenue of corn per mu</td>
</tr>
<tr>
<td></td>
<td>corn management cost</td>
<td>field management cost of corn per mu</td>
</tr>
<tr>
<td></td>
<td>agricultural insurance</td>
<td>the cognition of agricultural insurance policies</td>
</tr>
<tr>
<td>explanatory</td>
<td>factors</td>
<td></td>
</tr>
<tr>
<td>variable</td>
<td>the estimate</td>
<td>1=very satisfied 2=fairly satisfied 3=basically satisfied 4=basically</td>
</tr>
<tr>
<td></td>
<td>about insurance</td>
<td>dissatisfied 5=not satisfied at all</td>
</tr>
</tbody>
</table>

5. MODEL SPECIFICATION AND EMPIRICAL RESULTS

5.1 Logistic Regression Model Specification

With the variable defined as farmer household’s planting decision behaviour, namely, whether the farmer household not to reduce planting area next season(Y), the data range of the explained variable Y was limited between 0 and 1, namely, “not reduce” defined Y as 1 and “reduce” defined Y as 0. Individuals only had two choices. Since discretization couldn’t be regressed with OLS, this paper tries to use binary choice model, with “Logit” model reporting odds ratio, meaning the fold change in odds ratio caused by one unit increase of explanatory variable. Considering that Probit model couldn’t give similar explain to its coefficients, this paper uses “Logit” model to estimate it with maximum likelihood method and test the significance of regression coefficients by means of Z statistics of all the variables.

Suppose the independent variables in the model were $x_1$, $x_2$, $x_3$...$x_k$, there are I groups of observed data in regression model, namely, $x_{i1}$, $x_{i2}$,$x_{i3}$...$x_{ik}, Y_i=1,2,3...n$, and there is the Logistic regression function:
\[ f(p_i) = \frac{e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_k x_{ik}}}{1 + e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_k x_{ik}}} \] (1)

After Logit changed, made likelihood estimation on it, and here is the formula:

\[ \text{Logit}[P(Y = 1)] = \ln \frac{p(y=1)}{1-p(y=1)} = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} \] (2)

P represented the probability of farmer household not to reduce corn planting area; \( x_i \) represented the i factor contributing to farmer household’s not reducing corn planting area; \( \beta_i \) represented the regression coefficient of i factor.

5.2 Regression Analysis of “Logit” Model

5.2.1 Descriptive Statistics of the Variables

Here makes a regression analysis of the data from 182 farmer household samples with stata12.0 software to first get descriptive statistics of relative variables using data in table 6. Notably, the minimum and maximum crop sowing area of the farmer households in samples were 2 mu and 300 mu respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>code</th>
<th>N</th>
<th>minimum</th>
<th>maximum</th>
<th>average</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>whether not to reduce planting area next year</td>
<td>Y</td>
<td>182</td>
<td>0</td>
<td>1</td>
<td>0.80</td>
<td>0.49</td>
</tr>
<tr>
<td>age of householder</td>
<td>Age</td>
<td>182</td>
<td>22</td>
<td>75</td>
<td>50.54</td>
<td>12.16</td>
</tr>
<tr>
<td>farmer household’s education</td>
<td>Education</td>
<td>182</td>
<td>0</td>
<td>14</td>
<td>7.39</td>
<td>3.02</td>
</tr>
<tr>
<td>the Precent of agricultural income</td>
<td>Precent</td>
<td>182</td>
<td>0.12</td>
<td>1</td>
<td>0.84</td>
<td>0.27</td>
</tr>
<tr>
<td>corn planting area</td>
<td>Area</td>
<td>182</td>
<td>2</td>
<td>300</td>
<td>51.79</td>
<td>54.53</td>
</tr>
<tr>
<td>corn sales revenue</td>
<td>Revenue</td>
<td>182</td>
<td>275</td>
<td>1892</td>
<td>1161.42</td>
<td>364.50</td>
</tr>
<tr>
<td>corn management cost</td>
<td>Cost</td>
<td>182</td>
<td>0</td>
<td>900</td>
<td>97.82</td>
<td>101.78</td>
</tr>
<tr>
<td>the cognition of agricultural insurance</td>
<td>Cognition</td>
<td>182</td>
<td>1</td>
<td>5</td>
<td>3.43</td>
<td>1.73</td>
</tr>
<tr>
<td>the estimate about agricultural insurance</td>
<td>Estimate</td>
<td>182</td>
<td>1</td>
<td>5</td>
<td>2.35</td>
<td>0.92</td>
</tr>
</tbody>
</table>

5.2.2 Regression Result of the Model

Here makes estimation about binary response model parameters with stata12.0 software to get the coefficients of different variables, so as to know whether the variables had significant influences on dependent variables and the magnitude of influences. To regress relative variables with model estimating would get empirical results shown in Table 7. The significance P value of chi-square was less than 0.001, and the overall predication accuracy of the samples reached 88.40%, indicating a good match of the model. The Logistic model regression of 182 farmer households indicated that farmer households’ cognition of agricultural insurance, corn management cost, the Precent of agricultural income in total income and the householder’s age had no obvious influences at 0.10. None of the variables showed significant correlation with whether farmer households to maintain or expand corn planting area next year (Y=1), and the above variables were excluded in the process of regression. In the regression model, the regression coefficient symbol of corn sales revenue was positive, and was significant at 0.10, and the regression coefficient symbol of corn planting area was negative, and also passed the test in 95% confidence interval. However, farmer household’s education and agricultural insurance estimate of which their regression coefficient symbols were both negative, passed 1% significance test and showed significance for corn planting decision behaviour next year.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression coefficient value</th>
<th>standard</th>
<th>Z value</th>
<th>significance</th>
</tr>
</thead>
</table>

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### 5.3 Empirical Result Analysis

#### 5.3.1 The influences of market risk factors on farmer households’ planting decision.
Corn sales revenue per mu showed significant positive correlation with whether to maintain or expand crop planting area next year, that is, the higher corn sales revenue per mu was, the stronger the desire not to reduce planting area would be. Production and price were the two major factors influencing sales revenue. Suppose there was little fluctuation in crop production in a short term, then price would be the primary factor influencing farmer households’ planting decision.

#### 5.3.2 The influences of householder features on farmer households’ planting decision.
Among personal features, only “farmer household’s education” had significant influences on farmer households’ decision not to reduce planting area, yet the influence symbol was negative, indicating that suppose other conditions didn’t change, the higher the farmer households’ education level was, the more job opportunities farmer households would have, and they were more likely to work in the cities, which is in line with the author’s expectation. The analysis of farmer households’ age and education level indicated that over half of the interviewed farmer households in villages were over 50 years old and the proportion of farmer households with education below middle school accounted for 81.86% of the total samples, meaning that the farming labour force were featured with elder age and low education level. According to the field survey, better educated young people tended to gain benefits from working in the cities, thus showing little desire for maintaining or expanding crop planting area.

#### 5.3.3 The influences of family features on farmer households’ planting decision.
Among the family feature variables, corn planting area had significant influences on farmer households’ decision not to reduce planting area next year and the coefficient was negative. This empirical result contradicted with theoretical expectation, for which there may be two reasons: on one hand, larger planting area may be more vulnerable to market and natural risks, yet there is no price index insurance in agricultural insurance, which weakens farmer households’ desire for maintaining or expanding planting area; on the other hand, the survey found that “agreement claims” was applied in many places, in which the low payout couldn’t match the actual loss damaged by disasters and farmer households were so dissatisfied as not willing to maintain or expand crop planting area.

#### 5.3.4 The influences of agricultural insurance policies on farmer households’ planting decision.
“Farmer households’ agricultural insurance estimate” showed significant influences on farmer households’ planting decision in a negative way, indicating that the less satisfied farmer households’ estimate about agricultural insurance policies was, the greater the probability for them to reduce planting area would be, vice versa.

### 6. CONCLUSION AND POLICY SUGGESTIONS

Farmer households’ planting decision was closely related with market risks, agricultural insurance policies, personal and family features of farmer households, which led to the following conclusion and suggestions:

Firstly, market risks had significant influences on farmer households’ planting decision, and therefore, corn price index insurance would help farmer households cope with market fluctuations and improve their ability to withstand market risks. Although many farmer households expressed demands for this insurance, yet it posed great challenges for insurance companies since price risks are systematic risks. So the academic circle should carry out deeper researches with supports from the government to find out how to meet farmer households’ demands when taking into account the benefits of insurance companies.
Secondly, farmer household’s education and planting scale also had certain influence on farmer households’ planting decision. The fact that farmer household’s education had negative influences on maintaining or expanding planting area did not mean that the lower education level farmer households received, the better it was to encourage maintaining or expanding planting area, because comparatively speaking, farmer households were more willing to work in the cities, yet the elder farmer households were, the fewer job opportunities they would receive, so the elder were more likely to gain from maintaining or expanding planting area. Therefore, agricultural insurance policies and relative benefiting policies need to be improved to maintain or improve farmer household revenue and attract better educated farmer households to maintain or expand planting scale. Similarly, planting scale also had negative influences on maintaining or expanding planting area in that larger scale were vulnerable to more risks, which would weaken farmer households’ desire for maintaining or expanding planting area if they were not strong enough to withstand risks. If price index insurance could improve withstand risks ability to withstand risks and the claim amount of planting insurance was attractive enough, driven by scale effect, scale and specialization would be the trend.

Third, agricultural insurance with premium subsidy did have some positive influences on farmer households’ planting decision, in that the more satisfied farmer households’ estimate about agricultural insurance policies was, the greater the probability for them to maintain or expand planting area would be; the more comprehensive agricultural insurance policies were, it would be more probable for the policies to meet their goals. In fact, agricultural insurance policies included insurance responsibility rationality, insurance amount, exemption clause, claim provision, insurance sale and insurance survey. As was indicated in the survey, farmer households were mainly dissatisfied with insurance amount, because agricultural insurance could not meet their needs for stabilize revenue and diversify risks with insurance amount only matching their insurance cost. Therefore, more work needs to be done to enable agricultural insurance policies to stabilize farmer households’ revenue, and at the same time, some improvements need to be made in insurance service.

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