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The General and Structural Effect of "Four Agricultural Subsidies" on Grain Yield: Empirical Analysis of Chongqing City

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Abstract On the basis of empirical data concerning "four agricultural subsidies" in Chongqing City, we establish panel data model to analyze the general effect of "four agricultural subsidies" on grain yield, and the structural effect of "four agricultural subsidies" on grain yield. Based on the F-test and Hausman test, we estimate the model using GLS or FGLS method. The results show that "four agricultural subsidies" have significant positive effect on grain yield; the structural effect of "four agricultural subsidies" on grain yield is different (comprehensive subsidies for means of agricultural production has the strongest effect on grain yield, followed by subsidies for promotion of improved variety of seed; the effect of subsidies for purchase of agricultural machinery on grain yield is not significant). Therefore, governments at all levels should continue to strengthen the support efforts in "four agricultural subsidies", and continually optimize the structure to increase grain yield.

Key words "Four agricultural subsidies", Panel data model, Grain yield

Chongqing City integrates the spatial structure of "big city", "big village", "big mountainous area", and "big reservoir area" into a whole, with particularly prominent dual structural problem and regional disparities; urban-rural development gap looms large, and the development of agriculture, countryside and farmers is still bottleneck to economic and social development. With advance of the development level of industrialization and urbanization, the constraints of arable land resources are increasingly serious, thus promoting grain yield and ensuring the security of food production has become a thorny task. The policy of "four agricultural subsidies" is an important measure in the context of "coordinating urban and rural development, ensuring supply" [1-4]. To have an insight into the performance of "four agricultural subsidies" in Chongqing City, and analyze the existing problems, we research the general effect of implementation of the policy of "four agricultural subsidies" on grain yield, and difference in the structural effect of various factors of "four agricultural subsidies" on grain yield, in order to provide a theoretical reference for ensuring food security and promoting balanced development of urban and rural areas.

1 Model setting and data sources

1.1 The model setting of general effect of "four agricultural subsidies" on grain yield The method using factors as the variables to study the level of total output is called production function method. The study follows the analytical frame-

work of the CD production function to analyze the general effect of "four agricultural subsidies" on grain yield. At the same time, it is assumed that technological progress is neutral; labor, capital and other resource factors are in the state of optimal allocation. Based on this, the analytical framework of production function is introduced as follows:

$$LSCL_{it} = f(SXBT_{it}, LABR_{it}, \mu_{it}) \quad (1)$$

where i is region, $i=1,2,\dots,36$; t is time, $t=2006,\dots,2009$; $LSCL_{it}$ is the grain yield; $SXBT_{it}$ is the sum of "four agricultural subsidies" in region i in year t ; $LABR_{it}$ is the number of agricultural labor in region i in year t ; μ_{it} is the random error term.

Taking total differential of expression (1):

$$dLSCL_{it} = \frac{\partial LSCL_{it}}{\partial SXBT_{it}} dSXBT_{it} + \frac{\partial LSCL_{it}}{\partial LABR_{it}} dLABR_{it} \quad (2)$$

where $(\partial LSCL_{it})/(\partial SXBT_{it})$, $(\partial LSCL_{it})$, $(\partial LABR_{it})$ signify the elasticity coefficient of impact of "four agricultural subsidies", agricultural labor input on grain yield, respectively.

Adding intercept to the model, and simplifying it:

$$dLSCL_{it} = \beta_0 + \beta_1 dSXBT_{it} + \beta_2 dLABR_{it} + \mu_{it} \quad (3)$$

where $\beta_0, \beta_1, \beta_2$ are parameters to be estimated; μ_{it} is the random error term.

To expand the sample size in order to make the analysis conclusions more credible, we use the panel data analysis method. Firstly, we use F-test and Hausman test to test the individual fixed effects and random effects of the model.

$$F = \frac{SSE_r - SSE_u}{SSE_u/(NT - N - k)} \quad (4)$$

$$H = \frac{(\hat{\beta}_{FE} - \hat{\beta}_{RE})^2}{s(\hat{\beta}_{FE})^2 - S(\hat{\beta}_{RE})^2} \quad (5)$$

where SSE_r is the residual sum of squares of the constraint model; SSE_u is the residual sum of squares of the non-con-

Received: March 11, 2012 Accepted: May 30, 2012

Supported by supported by the Special Fund for General Project of Basic Scientific Research of Central Colleges (SWU1209457).

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straint model; N is cross section; T is period; k is the number of explanatory variables; $\hat{\beta}_{FE}$ is the OLS estimator; $\hat{\beta}_{RE}$ is the FGLS estimator.

Among indicators involved in this paper, the indicator data of $SXBT_{it}$ are sorted according to the relevant text material of "Survey and Research on Implementation of 'Four Subsidies' in Chongqing's Districts and Counties", conducted by the Chongqing Municipal People's Congress; $LSCL_{it}$, $LABR_{it}$ and other indicator data are all from the *Chongqing Municipal Statistics Yearbook* (2007–2010), the relevant statistical bulletin materials, and the official website of statistical agencies in all districts and counties. In the process of empirical analysis, we conduct logarithmic processing on the relevant data according to the need.

1.2 The model setting of structural effect of "four agricultural subsidies" on grain yield In accordance with the existing statistical standards in Chongqing City, "four agricultural subsidies" in Chongqing City mainly include comprehensive subsidies for means of agricultural production, subsidies for promotion of improved variety of seed, and subsidies for purchase of agricultural machinery. Therefore, when analyzing the effect of "four agricultural subsidies" on grain yield, we can

further decompose expression (3), to get the structural effect model:

$$dLSCL_{it} = \alpha_0 + \alpha_1 dNZBT_{it} + \alpha_2 dLZBT_{it} + \alpha_3 dNJBT_{it} + \alpha_4 dLABR_{it} + \varepsilon_{it} \quad (6)$$

where $\alpha_1, \alpha_2, \alpha_3, \alpha_4$, are the parameters to be estimated; $NZBT_{it}$ is the comprehensive subsidies for means of agricultural production in region i in year t ; $LZBT_{it}$ is subsidies for promotion of improved variety of seed in region i in year t ; $NJBT_{it}$ is subsidies for purchase of agricultural machinery in region i in year t ; ε_{it} is the random error term.

$NZBT_{it}$, $LZBT_{it}$, $NJBT_{it}$ and other indicator data are sorted according to the relevant text material of "Survey and Research on Implementation of 'Four Subsidies' in Chongqing's Districts and Counties", conducted by the Chongqing Municipal People's Congress; $LSCL_{it}$, $LABR_{it}$ and other indicator data are all from the *Chongqing Municipal Statistics Yearbook* (2007–2010), the relevant statistical bulletin materials, and the official website of statistical agencies in all districts and counties. Statistical description of various indicators concerning the structural effect of "four agricultural subsidies" on grain yield can be seen in Table 1.

Table 1 Statistical description of various indicators concerning the structural effect of "four agricultural subsidies" on grain yield

Indicator	Mean	The median	Maximum	Minimum	Standard deviation
$LSCL_{it}$	286 980.5	301 478	721 611	472	176 411.9
$NZBT_{it}$	3 013.688	3 258.24	6 726.4	14.37	1 854.941
$LZBT_{it}$	625.365 9	550.47	4 259.234	1.43	568.163 4
$NJBT_{it}$	710.524 8	402.7	5 346.22	6.335	1 025.935
$LABR_{it}$	35.4727 8	34.74	76.76	1.17	19.581 91

Note: The results in table are calculated by E views 6.0 software, and we do not take the logarithm of the above data.

2 Results and analysis

2.1 Analysis of the general effect of "four agricultural subsidies" on grain yield Since the panel data involve spatial dimension and temporal dimension, it easily gives rise to the spurious regression phenomenon. Therefore, in order to avoid the spurious regression phenomenon in modeling, we adopt three methods, Levin, Lin & Chut, ADF – Fisher Chi – square and PP – Fisher Chi – square, to test the stationarity of variables, and the results can be seen in Table 2. As seen from Table 1, the corresponding variables have no panel unit root at significance level of 1% and 5%, thus they are stationary.

Table 2 Stationarity test of indicators concerning general effect

Variable	Levin, Lin & Chut	ADF – Fisher Chi – square	PP – Fisher Chi – square
$LSCL_{it}$	–995.340 *** (0.0000)	333.454 *** (0.0000)	392.607 *** (0.0000)
$SXBT_{it}$	–3.35764 *** (0.0004)	30.8932 ** (0.0218)	42.5967 ** (0.0381)
$LABT_{it}$	–937.470 *** (0.0000)	274.149 *** (0.0000)	274.149 *** (0.0000)

Note: The above data are calculated according to E views 6.0 software; the data in brackets denote P-value; ***, ** mean significant at level of 1% and 5%, respectively.

In order to analyze the general effect of "four agricultural subsidies" on grain yield, we conduct general regression on the data of 36 districts and counties in Chongqing City (not inclu-

ding Yuzhong District, Bishan County, Fengdu County, Dazhu County) in the period 2006–2009. (I), (II), (III) in Table 3 give the estimation results of mixed model, individual fixed effects model, and individual random effects model, respectively. From the individual fixed effects test and the individual random effects test, we can find that there are no individual fixed effects and individual random effects in the model, that is, establishing the mixed model to analyze the general effect of "four agricultural subsidies" on grain yield is more appropriate. Therefore, we conduct general estimation on the model using GLS or FGLS method. (I) in Table 3 gives the estimation results of the mixed model.

Table 3 shows that the general effect of "four agricultural subsidies" and the agricultural labor factor inputs, on grain yield is significant. And the slope is greater than 0, indicating that "four agricultural subsidies" and the agricultural labor factor inputs have significant positive effect on grain yield. Since we have conducted logarithmic processing of $LSCL_{it}$, $SXBT_{it}$ and $LABR_{it}$, the influence coefficient is the elasticity. From the results, we can find that the elasticity of "four agricultural subsidies" on grain yield is 0.442, that is, for each additional one percentage point in "four agricultural subsidies", the grain yield will increase by 0.442%. The elasticity of labor inputs on the grain yield is 0.861, that is, for each additional one percentage point in the labor inputs, the grain yield will increase by 0.861%. The elasticity of labor is far greater than that of "four

agricultural subsidies", indicating that the increase in grain yield in Chongqing City at present is still mainly dependent on agricultural labor inputs, and "four agricultural subsidies" have huge potential for increasing grain yield.

Table 3 The general effect of "four agricultural subsidies" on grain yield

Variable	Estimate of mixed model (I)	Estimate of individual fixed effects model (II)	Estimate of individual random effects model (III)
Sample size	144	144	144
Constant	5.686 337*** (25.503 9)	7.102 470*** (25.743 69)	5.638 817*** (26.069 78)
$LNSXBT_{it}$	0.441 848*** (9.079 472)	0.261 619*** (6.632708)	0.454 426*** (9.604948)
$LNLABR_{it}$	0.861 477*** (11.586 29)	0.871 644*** (12.543)	0.845 271*** (11.743 26)
R^2	0.914126	0.996 193	0.915 734
Adjusted R^2	0.912 908	0.994 864	0.914 538
F	750.470 2	749.670 8	766.133 9

Note: The above data are calculated according to E views 6.0 software; the data in brackets under variable influence coefficient denote T-value; the data in brackets under test of individual fixed effects and random effects are P-value; ***, ** and * mean significant at level of 1%, 5% and 10%, respectively.

2.2 Analysis of the structural effect of "four agricultural subsidies" on grain yield

We test the stationarity of the panel data of variables in Table 1, using Levin, Lin & Chut, ADF – Fisher Chi – square, PP – Fisher Chi – square, and other methods. The results can be seen in Table 4. Table 4 shows that the corresponding variables have no panel unit root at significance level of 1%, 5%, and 10%, which makes the regression results more reliable, avoiding the spurious regression phenomenon.

Table 4 Stationarity test of indicators concerning structural effect

Variable	Levin, Lin & Chu t	ADF – Fisher Chi – square	PP – Fisher Chi – square
$NZBT_{it}$	-158.728 *** (0.000 0)	23.506 6 *** (0.009 0)	24.986 8 *** (0.005 4)
$LZBT_{it}$	-10.988 5 *** (0.000 4)	18.758 6 * (0.094 5)	19.538 1 * (0.076 3)
$NJBT_{it}$	-1.617 46 *** (0.052)	7.884 03 *** (0.024 6)	8.810 47 * (0.104 5)

Note: The above data are calculated according to E views 6.0 software; the data in brackets denote P-value; ***, **, * mean significant at level of 1%, 5% and 10%, respectively.

In order to analyze the structural effect of "four agricultural subsidies" on grain yield, we conduct regression of data concerning 36 Chongqing's districts and counties in the period 2006 – 2009. From the individual fixed effects test and the Hausman test, we can find that there are no individual fixed effects and individual random effects in the model, thus we should establish mixed model for analysis. Therefore, we estimate the model using GLS or FGLS method. (1), (2), (3) in Table 5 give the estimation results of the mixed model, the individual fixed effects model, and the individual random effects model, respectively.

Table 5 shows that the coefficient of elasticity of comprehensive subsidies for means of agricultural production, and

subsidies for promotion of improved variety of seed, to grain yield is 0.171 and 0.025, respectively, that is, for each increase of 1 percentage point in comprehensive subsidies for means of agricultural production and subsidies for promotion of improved variety of seed, the grain yield will grow by 0.171% and 0.025%, respectively. The main reason is that the increase in the price of means of agricultural production is always an important factor affecting farmers' enthusiasm of grain planting. Constant rise in the price of means of agricultural production has increased the costs of grain planting and land inputs, and dampened farmers' enthusiasm of grain planting. Taking the case of the ammonium bicarbonate that is used most by the farmers, the wholesale price in Chongqing City was 575 yuan/t in March 7, 2011; 580 yuan/t in March 8, 2011; 595 yuan/t in March 9, 2011. In a month ago, the wholesale price of ammonium bicarbonate was 530 yuan/t. The highest price of it in 2010 was 450 yuan/t, but the price of it in 2009 was just 380 yuan/t. Moreover, the seed prices have also increased substantially. The price of some rice seed varieties in 2011 increased nearly one-fold as against that in 2010. Through comprehensive subsidies for means of agricultural production, it has offset the negative impact arising from high prices of means of agricultural production to some extent, reduced the farmers' costs of grain growing, and enhanced farmers' enthusiasm for growing grain, thereby achieving increase in the grain yield.

Table 5 The structural effect of "four agricultural subsidies" on grain yield

Variable	Estimate of mixed model (I)	Estimate of individual fixed effects model (II)	Estimate of individual random effects model (III)
Sample size	144	144	144
Constant	5.959 337*** (29.614 42)	14.277 18*** (21.236 17)	6.592 905*** (23.620 08)
$LNNZBT_{it}$	0.347 975*** (4.506 52)	0.066 828 * (1.500 18)	0.489 864*** (9.356 134)
$LNLZBT_{it}$	0.170 854 ** (2.2645 32)	-0.676 328*** (-6.427 951)	-0.175 541*** (-2.829 180)
$LNNJBT_{it}$	0.0248 43 (0.659767)	0.172 148 ** (1.929 181)	0.161 353*** (2.892 258)
$LNLABR_{it}$	0.713 759*** (9.628 536)	0.100 107 * (1.885 759)	0.583 450*** (8.696 239)
R^2	0.928 54	0.993 33	0.956 974
Adjusted R^2	0.926 484	0.990 828	0.947 103
F	451.536 9	397.113	66.554 34

Note: The above data are calculated according to E views 6.0 software; the data in brackets under variable influence coefficient denote T-value; the data in brackets under test of individual fixed effects and random effects are P-value; ***, **, * mean significant at level of 1%, 5% and 10%, respectively.

At the same time, in Chongqing City, especially some remote mountainous areas, most of crop varieties are "farm" varieties, with low level of yield. Through offering subsidies for improved varieties, introducing and promoting improved and advanced varieties, it has accelerated the upgrading of the varieties, thus contributing to significant increase in grain yield. The impact of subsidies for purchase of agricultural machinery

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unemployment insurance for land-expropriated farmers, to remove their worry. Furthermore, it is required to implement severe punishment mechanism in times of disorder. In a society where the corruption is prevalent, the distribution of resource can not do without people. Comprehensive administration of institutional innovation and executive subjects is a long-term issue for central government. Standardizing economic acts of officials in land circulation is favorable to reducing governance cost and economic performance.

3.2.3 Setting up recognition mechanism of the public to local government. In view of farmers' low social organizational ability and congenital dependence on government, as well as local officials having the action of taking advantage of public resources, central government should mobilize social forces and public opinion to supervise local officials, to overcome legitimate crisis brought about by local bureaucrats to the ruling party, so as to reduce investment in public trust and save cost for expansion of state apparatus. Besides, it is preferred to combine construction of public trust and construction of a clean government, together with grant of equal property right and civil

right to farmers.

References

- [1] LI YN. The practice and exploration of Chengdu mode[J]. Review of Economic Research, 2010(15): 11–18. (in Chinese).
- [2] SUN XY. Unfair of rural land compensation distribution should be introduced into negotiate mechanism[N]. The Beijing News, 2010–3–26. (in Chinese).
- [3] YU CG. Chinese rural land transition way, cost and performance management[J]. Jiangnan Tribune, 2011(6): 82–87. (in Chinese).
- [4] LU N. Expropriation instead of demolition and government compromise[J]. Phoenix Weekly Hong Kong, 2010(2). (in Chinese).
- [5] LIU XY. The operation mechanism and performance of system arrangement[J]. Economic Review, 2002(4): 48–50. (in Chinese).
- [6] NORTH. System, system transition and economic performance[M]. Shanghai: Joint Press, 1994. (in Chinese).
- [7] KUNG JK. Off-farm labor markets and the emergence of land rental markets in rural China[J]. Journal of Comparative Economics, 2002.
- [8] ZHANG WF, MAKEHAM J. Recent developments in the market for rural land use in China[J]. Land Economics, 1992, 68(2).

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on grain yield is not significant, mainly because there are great differences of the geographical conditions in Chongqing's regions (63% of land in whole city is the mountains; more than 25% of land is the hills; less than 12% of land is flat land). And it has a large population in a small area, the farmland is dispersed, and the level of agricultural mechanization base is weak, limiting the development of agricultural mechanization and causing inconspicuous effect.

3 Conclusions and policy recommendations

Through the establishment of panel data model, this study analyzes the general effect and structural effect of "four agricultural subsidies" in Chongqing City on grain yield. The results show that on the one hand, the general effect of "four agricultural subsidies" on grain yield is significant, with coefficient of 0.442, that is, for each additional one percentage point in "four agricultural subsidies", the grain yield will increase by 0.442%; on the other hand, there are differences in the structural effect of "four agricultural subsidies" on grain yield (comprehensive subsidies for means of agricultural production has the strongest effect on grain yield, followed by subsidies for promotion of improved variety of seed; the effect of subsidies for purchase of agricultural machinery on grain yield is not significant).

Based on this, in future policy selection, the Chongqing municipal government should further implement the policy of "four agricultural subsidies", give full play to the positive effect of "four agricultural subsidies" on grain yield, play the role of effect in cumulating, fully mobilize farmers' enthusiasm for growing grain, to ensure the safety of grain production. At the same time, due to differences in the structural effect of

four agricultural subsidies" on grain yield, when implementing policies, it is required to not only make unified planning so as to take into consideration every aspect, but also ensure that emphasis is laid on one particular field based on actual situation of development in Chongqing City. It should further increase comprehensive subsidies for means of agricultural production and subsidies for promotion of improved variety of seed, to lay a solid foundation for grain production. Further, in view of the problem of inconspicuous role of subsidies for purchase of agricultural machinery in increasing grain yield, it requires Chongqing City to speak or act with a well-defined objective in mind in the implementation of the policy, avoid "one size fits all"; according to the resource endowment and geographical conditions in various regions, rationally determine the geographical range suitable for offering subsidies for purchase of agricultural machinery, and reduce blind obedience to the policy, to ensure that the policy effects come into play.

References

- [1] GAO F, WANG XZ, YANG WH. The subsidy policy to agricultural inputs: a theoretical framework[J]. Issues in Agricultural Economy, 2004(8): 49–52. (in Chinese).
- [2] HAN XP. An economic analysis on the policy for direct subsidy to grain growers in China[J]. Journal of Agrotechnical Economics, 2007(3): 20–22. (in Chinese).
- [3] LIAO XJ, LIANG SF, LV J. Economic analysis on grain direct subsidy policy[J]. China Business: Economic Theory Research, 2007(11): 80–82. (in Chinese).
- [4] ZHONG FN, GU HJ, JI YQ. The income distribution of farmers role differentiation and agriculture subsidy policy[J]. Management World, 2008(5): 65–70. (in Chinese).
- [5] CHEN GG. Speech in agricultural mechanization work conference of whole city[R]. Chongqing: General Office of Chongqing People's Government, 2005. (in Chinese).