Impacts of the Minimum Purchase Price Policy for Grain on the Planting Area of Rice in Hubei Province Based on a Mixed Linear Model

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Abstract Impacts of the minimum purchase price policy for grain on the planting area of rice in Hubei Province were analyzed based on a mixed linear model. After the indicator system containing the minimum purchase price policy and other factors influencing the planting area of rice was constructed, principal component analysis of the system was conducted, and then a mixed linear model where the planting area of rice was as the dependent variable was established. The results show that after the exclusion of the interference from other factors, the minimum purchase price policy for grain had a positive impact on the planting area of rice in Hubei Province. That is, the minimum purchase price policy significantly stimulated the growth of rice planting area in Hubei Province.

Key words The minimum purchase price, Rice in Hubei Province, Planting area, Principal component analysis, Mixed linear model

1 Introduction

To increase farmers' income, arouse farmers' enthusiasm for planting grain, stabilize grain price, and ensure food security, the minimum purchase price policy for grain has been implemented since 2004. In recent years, many scholars have assessed the minimum purchase price policy for grain and have analyzed its benefit, and there are more qualitative studies than quantitative studies. These studies show that the minimum purchase price policy for grain has obvious effects on grain yield and farmers' income, and the goal of ensuring food security and increasing farmers' income can be realized under the policy. Meanwhile, lots of scholars proposed that the policy of price protection might cause a series of problems. Very few researchers studied impacts of the minimum purchase price policy for grain on the planting area of grain. Grain yield may be affected by grain yield per unit area and technical progress, and impacts of the minimum purchase price policy for grain on the planting area of grain can reflect its roles more accurately than influences on grain yield.

Factors influencing the planting area of rice are complex. To study impacts of the minimum purchase price policy for grain on the planting area of rice, it is necessary to find other possible factors influencing the planting area of rice. For example, based on data of questionnaires and Logistic model, Li Wei[1] analyzed farmers' will to plant rice and its influencing factors. The results showed that general environmental factors had most obvious effects on farmers' will to plant rice, followed by family environment factors, while the impacts of individual quality factors were the smallest. In addition, based on regression models, Xiao Shuangxi *et al.* [2] Analyzed cotton planting area in some regions of China from cost and income factors. The results indicated that the planting area of cotton in the last year, income of migrant workers, income from corn planting per unit area, and income from cotton planting per unit area affected the planting area of cotton greatly.

At present, few scholars studied the positive effects of the minimum purchase price policy for grain on grain production in China. For example, after testing the co-integration and Granger causality between grain price and yield as well as grain price and farmers' income, Zhang Shuping[3] concluded that increase of grain price could stimulate improvement of grain yield obviously and increase of farmers' income, so it is suggested that the government should continue to control grain price to promote increase of grain yield and farmers' income. However, some scholars proposed different views. For instance, Zhong Yu *et al.* [4] use difference-in-difference method to analyze the influences of price support policy on rice production in main rice producing areas of China during 2004 - 2006, and found that price support policy had no obvious positive effects on the increase in the planting area of rice.

Most foreign scholars study the minimum purchase price policy for grain under the support of agricultural policies. For instance, Grden[5] studied influences of the minimum purchase price policy for grain on corn price based on correlation analysis. Besides, Andrew[6] studied the policy on supporting wheat price in Pakistan based on models. Main views of foreign scholars about China's grain policies are shown as follows: it is needed to strengthen the implementation of grain policies, protect grain farmers, improve agricultural quality, and insist on reforming marketing orientation. Based on the above analysis, it is clearly seen that material input, labor input, purchase price, natural disasters, institutional change, crop sowing area, non-agricultural income, income from substitutes, *etc*. Can affect the planting area of grain.

Since the implementation of the minimum purchase price policy for grain in 2004, the minimum purchase prices of rice and wheat have increased in each region of China on the whole. For instance, the minimum purchase price of rice in Hubei Province

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has always risen in recent years, but its planting area tended to decrease from 1995 to 2014 on the whole. The planting area reduced from 2.08402 million hm^2 in 2004 to 1.97894 million hm^2 in 2008, decreasing by 5.31%. Moreover, the planting area increased or decreased since 2004 but did not exceed that in 2005. Therefore, people question the minimum purchase price policy for grain and suggest that the policy can not protect farmers' enthusiasm for rice production in Hubei Province effectively. In this paper, based on a mixed linear model, effects of the minimum purchase price policy for grain on the planting area of rice in Hubei Province were analyzed when impacts of other factors on the planting area of rice were eliminated.

2 Data and methods

2.1 Selection of variables Based on previous studies[7-8], factors influencing the planting area of rice in Hubei Province were divided into family, environmental and social feature factors, including 13 independent variables (Table 1).

Table 1 Factors influencing the planting area of rice in Hubei Province

First-grade variable	Symbol	Secondary variable	Accounting method	Property
Family feature variable	x_1	Agricultural labor force population	Employed population in the primary industry in Hubei Province	Current variable
	x_2	Farmers' level of education	Farmers' average years of education per capita in Hubei Province	Variable in the lagging period
	x_3	Urban-rural income gap	Ratio of urban residents' per capita disposable income and rural residents' per capita pure income in Hubei Province	Current variable
	x_4	Family burden	Sum of the largest expense of a peasant household in Hubei Province	Variable in the lagging period
	x_5	Non-agricultural income	Difference between annual operating income per capita and annual agricultural income per capita of a rural family in Hubei Province	Variable in the lagging period
Environmental feature variable	x_6	Expected price of rice	Market price of rice in Hubei Province	Variable in the lagging period
	x_7	Production cost of rice	Production cost of rice per mu (1 hm^2 is equal to 15 mu) in Hubei Province	Variable in the lagging period
	x_8	Relative benefit competitiveness of rice	Difference between net incomes per mu from rice and cotton in Hubei Province	Variable in the lagging period
	x_9	Sowing area of crops	Total sowing area of crops in Hubei Province	Current variable
	x_{10}	Damage caused by disasters	Ratio of covered area to affected area by drought in Hubei Province	Variable in the lagging period
	x_{11}	Net export of rice	Difference between export volume and import volume of rice in China	Current variable
Social feature variable	x_{12}	Urbanization level	Proportion of urban population to total population in Hubei Province	Current variable
	x_{13}	The minimum purchase price policy for grain	Implementation of the minimum purchase price policy for grain in China	Current variable
Dependent variable	y	Planting area of rice	Planting area of rice in Hubei Province	Current variable

Family feature variables mainly refer to variables reflecting the farming level of a peasant household. For instance, agricultural labor force population may affect the planting area of crops obviously, because the more the agricultural labor forces are, the larger the contribution of land use and crop planting are. Farmers' level of education can reflect the level of human capital, and farmers' with high level of education can manege a large area of crops. Urban-rural income gap may affect the loss of agricultural labor force population and may lead to changes in the occupation nature of a family. Family burden can reflect the economic situation of a peasant household, and too big burden may affect agricultural production of a family to a certain extent and then the planting area of crops. Non-agricultural income includes income from industry and service industry, and farmers' outside income is common. In comparison with urban-rural income gap, non-agricultural income can influence the situation of farmers engaged in agriculture.

Environmental feature variables mainly refer to the natural environment and market environment of rice planting area. Firstly, according to experience, farmers often estimate the price of agricultural products to determine their seeding density and land allotment of various crops, so the expected price of rice will affect the sowing area of rice. Expected production cost of rice means the cost of seeds, pesticides, agricultural machinery, chemical fertilizer, *etc.* consumed in agricultural production according to prices, and it may affect the planting area of rice. For relative benefit competitiveness of rice, the planting season of cotton and rice is similar in Hubei Province, so there is a competitive relation between them. Farmers determine their planting area according to their benefit, so income from cotton will also influence the plant-

ing area of rice. Drought appeared frequently in recent years has certain impacts on the planting area of rice in Hubei Province.

Social feature variables include macroscopic variables about society except for the above variables. Net export of rice can reflect the dependence of a country on rice, and annual net export of rice also influences rice production in the country. On the one hand, improvement of urbanization level in recent years has resulted in the decrease of agricultural labor forces; on the other hand, after rural population moves into cities, the government increases farmland area through land reform, so influences of urbanization level on the planting area of rice are uncertain. As a agricultural protection policy, the minimum purchase price policy for rice will change farmers' selection and expected income from agricultural products to a certain degree. It will affect farmers' selection of sowing types and land allotment among various agricultural products protected by the price policy or among agricultural products protected by the price policy and other agricultural products. Meanwhile, it may affect the planting area of rice.

2.2 Data sources Data used in this paper are from Hubei Statistical Yearbook (1995 – 2015), *China Rural Statistical Yearbook* (1995 – 2015), *Compilation of Data on Cost and Income from Agricultural Products in China* (1995 – 2015), Brick database of agricultural products, and database of Food and Agriculture Organization of the United Nations (FAO). Farmers' level of education was calculated as follows: illiteracy and semi-illiteracy, primary school, junior high school, high school, technical secondary school, junior college or above mean farmers received education for one, five, eight, 11, 11 and 15 years respectively[9].

In Brick database of agricultural products, net incomes per mu from rice and cotton in Hubei Province were negative in some years, so relative benefit competitiveness of rice was also negative in these years. The minimum purchase price policy for grain is a qualitative variable, and A means a country has not implement the minimum purchase price policy for rice, while B means a country has implemented the minimum purchase price policy for rice. Besides, the minimum purchase price policy for grain is also a property variable. China did not implemented the minimum purchase price policy for grain during 1995 – 2003, so the variable was zero during 1995 – 2003. China implemented the policy during 2004 – 2014, and the minimum purchase price policy for rice was implemented the policy for rice in Hubei Province, so it was 1 during 2004 – 2014. Statistical data of the other variables are shown in Table 2.

Table 2 Statistical data of factors influencing the planting area of rice in Hubei Province

Year	Agricultural labor force population x_1 // $\times 10^4$	Farmers' level of education x_2 // a	Urban-rural income gap x_3	Family burden x_4 // yuan	Non agricultural income x_5 // yuan	Expected price of rice x_6 // yuan/t	Production cost of rice x_7 // yuan/mu	Relative benefit competitiveness of rice x_8 // yuan/mu	Sowing area of crops x_9 // $\times 10^3$ hm^2	Damage caused by disasters x_{10}	Net export of rice x_{11} // $\times 10^3$ t	Urbanization level x_{12}	Planting area of rice y // $\times 10^3$ hm^2
1995	1697.0	5.681	2.658	1478.31	628.16	1526.5	335.47	−239.30	7431.71	1.860	−3744.0	0.3120	2408.66
1996	1677.1	5.805	2.334	1815.75	761.70	1495.3	414.27	−96.04	7579.01	2.926	−958.0	0.3374	2448.58
1997	1663.2	5.879	2.223	2060.63	933.94	1308.4	411.08	−195.69	7739.21	1.821	445.0	0.3124	2467.51
1998	1612.5	5.966	2.222	2135.85	879.11	1215.0	380.54	−149.44	7695.98	2.906	5554.0	0.3190	2244.74
1999	1612.6	6.084	2.351	2260.42	867.90	1028.0	361.55	68.84	7788.66	2.157	6692.0	0.3352	2284.98
2000	1625.1	6.287	2.435	2257.56	920.43	996.9	364.22	−241.16	7584.07	1.503	6459.0	0.4047	1995.29
2001	1639.0	6.538	2.490	2422.68	964.26	1059.2	353.63	−146.13	7488.99	1.388	3669.0	0.4080	1953.77
2002	1652.6	6.760	2.778	2520.42	964.15	996.9	352.19	−250.20	7281.61	1.967	3479.0	0.4140	1888.75
2003	1661.5	7.063	2.853	2587.25	964.46	1090.3	353.43	−555.39	7153.24	1.442	4643.0	0.4200	1808.75
2004	1672.9	7.362	2.776	3180.49	1041.44	1495.3	433.19	−289.80	7225.13	1.930	2037.0	0.4260	2084.02
2005	1687.3	7.613	2.835	3675.73	1233.45	1433.0	463.32	−245.53	7391.30	2.028	−414.0	0.4320	2162.39
2006	1694.7	7.801	2.867	3999.48	1181.72	1514.0	488.61	−227.33	7100.59	1.259	218.0	0.4380	1975.07
2007	1697.0	7.929	2.873	4565.40	1426.73	1564.0	522.29	−246.65	7130.01	2.502	1052.0	0.4430	1978.82
2008	1707.9	7.938	2.825	5402.06	1741.65	1830.0	619.92	188.03	7272.33	1.408	1025.0	0.4520	1978.94
2009	1702.3	7.916	2.853	5537.59	1797.68	1890.0	641.93	−139.53	7527.50	3.973	460.1	0.4600	2045.08
2010	1691.1	7.683	2.753	6131.23	1961.98	1968.0	702.17	−884.72	7997.57	2.082	259.4	0.4970	2038.17
2011	1678.1	7.465	2.664	7971.52	2451.73	2460.0	822.70	9.52	8009.57	2.953	−167.6	0.5183	2036.17
2012	1638.9	7.469	2.654	8923.73	2661.59	2600.0	965.66	109.49	8105.69	2.452	−1545.1	0.5350	2017.88
2013	1582.0	7.336	2.583	9477.33	2972.59	2580.0	1050.24	347.75	8106.19	2.520	−1786.0	0.5451	2101.15
2014	1487.0	7.254	2.281	16775.27	4036.12	2670.0	1078.27	744.15	8112.26	3.164	−2063.0	0.5567	2143.95

2.3 Methods Influences of independent variables on dependent variable Y are often studied by regression analysis, but common linear regression can not solve the problem of independent variables containing qualitative variables (like x_{13}), and generalized linear regression is often used to solve this problem. However, correlations between independent variables also influence generalized linear regression equations greatly, especially when there are linear or strong correlations between independent variables. In this paper, the principal components of the quantitative variables ($x_1 - x_{12}$) were extracted by Principal Component Analysis (PCA) to form new independent variables. To discuss effects of the minimum purchase price policy for rice on the planting area of rice, the minimum purchase

price policy was used as the fixed effect and other factors were as the random effect to establish a mixed linear model as follows:

$$Y = X\beta + Z\gamma + \varepsilon$$

where Y is an observed value, namely the data vector of the planting area; X is a dummy variable generated by using x_{13} data; β is an unknown vector composed of fixed effect parameters of known design matrix X; Z is a new variable obtained after PCA of $x_1 - x_{12}$; γ is an unknown vector composed of random effect parameters of known design matrix Y; ε is an unknown random error vector. A mixed linear model is a statistical method that is used to process hierarchical structure data in medicine field, and it is often used to fit clustering or non-independent hierarchical data or repeated measured data in various periods. At the same time, impacts of fixed and random effect produced by different clustering or hierarchical data are brought into the model. In substance, it decomposes the residual term of a multiple linear regression model further and then lead to random effect[10]. In comparison with common linear models, good fitting results and accurate prediction effect can be obtained by a mixed linear model.

3 Results and analysis

3.1 Principal component analysis In this paper, the observed data of planting area of rice in Hubei Province during 1995 – 2014 constituted dependent variable Y. Meanwhile, due to the existence of lagged variables, there were 19 effective observation samples. The minimum purchase price policy for rice x_{13} was as the fixed effect X, and it is a qualitative variable and have two observation levels. The principal components of factors $x_1 - x_{12}$ were extracted to construct Z matrix. The contribution rate of each principal component obtained by Princomp module of SAS 9.2 is shown in Table 3. The contribution rate of principal components 1 – 5 decreased gradually, and the accumulated contribution rate of principal components 1 – 5 increased from 54.52% to 96.60%, and the accumulated contribution rate of principal component 5 met the requirements. That is, the first five principal components included 96.60% of information about the 12 variables, so the first five principal components $z_1 - z_5$ were chosen to construct random effect matrix Z of mixed linear equations.

Table 3 Contribution rate of each principal component

Principal component	Eigenvalue	Variance	Contribution rate	Accumulated contribution rate
1	6.54276705	3.79002808	0.5452	0.5452
2	2.75273897	1.72530529	0.2294	0.7746
3	1.02743368	0.34608499	0.0856	0.8602
4	0.68134869	0.08861613	0.0568	0.9170
5	0.59273256	0.38466046	0.0494	0.9660

Table 4 Scores of the five principal components during 1995 – 2014

Year	The first principal component z_1	The second principal component z_2	The third principal component z_3	The fourth principal component z_4	The fifth principal component z_5
1995	-2.05692	-0.26352	-2.10722	-1.59619	-0.02166
1996	-1.27968	-1.61375	-1.99480	-0.08164	0.47365
1997	-1.71631	-2.02255	-0.99629	-0.73888	-0.62076
1998	-1.65208	-2.82003	-0.11995	1.21468	0.28836
1999	-1.77408	-2.59105	0.84164	0.59520	0.15927
2000	-2.06483	-1.41719	1.42915	0.26730	-0.59211
2001	-1.81764	-0.81776	0.98981	-0.44432	-0.27792
2002	-1.91466	0.32401	0.72295	0.19661	0.37850
2003	-2.37542	1.15851	1.26512	0.21739	-0.28741
2004	-1.22606	1.14512	0.36577	-0.00256	0.29438
2005	-0.68497	1.52353	-0.19317	-0.22813	0.21093
2006	-1.03559	2.13151	0.57090	-1.00671	0.23391
2007	-0.43114	2.02365	0.00024	0.44078	0.90679
2008	0.25445	1.82126	0.71031	-1.05204	0.65166
2009	1.16135	1.52776	-1.23051	1.85747	1.20866
2010	0.83671	1.67204	-0.43745	0.92461	-2.35701
2011	2.85359	0.59806	-0.69617	0.65382	-0.38509
2012	3.69707	0.37809	-0.28773	-0.19443	-0.75114
2013	4.47826	-0.44970	0.20621	-0.49567	-0.30846
2014	6.74799	-2.30798	0.96119	-0.52730	0.79547

Afterwards, the scores of the five principal components during 1995 – 2014 were calculated by using the software SAS, and these scores constituted Z in mixed linear models (Table 4).

3.2 Mixed linear models The minimum purchase price policy for rice (x_{13}) as the fixed effect and the five principal components $z_1 - z_5$ as the random effect were substituted into the mixed linear model of rice planting area in Hubei Province Y firstly. Afterwards, Mixed module of SAS 9.2 was used to solve

the model, and the test results of covariance parameter γ are shown in Table 5. According to Table 5, the test values of $Pr > Z$ of all principal components were smaller than 0.01, showing that the covariance parameter passed through the test. That is, the random factor had significant effects on the dependent variable.

Table 5 Test results of the covariance parameter

Principal component	Estimate	Standard error	Z value	$Pr > Z$
z_1	1381.26	2075.24	0.67	0.0003
z_2	11471	16480	0.70	<0.0001
z_3	3251.17	4796.3	0.68	<0.0001
z_4	1604.29	2557	0.63	0.0047
z_5	13373	19258	0.69	<0.0001
Residual	2513.51	954.5	2.63	0.0042

Test results of fixed effect parameter x_{13} are shown in Table 6. According to Table 6, the test values of $Pr > |t|$ were smaller than 0.01, so the null hypothesis was rejected, and x_{13} was significantly effective.

Table 6 Test results of the fixed effect parameter

Effect	x_{13}	Estimate	Standard error	DF	t value	$Pr > \|t\|$
Intercept		2190.32	26.8352	12	81.62	<0.0001
x_{13}	A	−245.27	57.5827	12	−4.26	0.0011
x_{13}	B	0	–	–	–	–

Finally, the regression equation of the minimum purchase price policy for rice and the planting area of rice was obtained as follows:

$$y_{|x_{13}=1} = 2190.32 \times x_{13} + 1381.26 \times z_1 + 11471 \times z_2 + 3251.17 \times z_3 + 1604.29 \times z_4 + 13373 \times z_5 + 2513.51$$

where $x_{13} = 1$ mean the regression equation reflects impacts of the minimum purchase price policy for rice on the planting area of rice in Hubei Province during 2004 – 2014. In Table 7, the probability of F test was smaller than 0.01, indicating that the regression equation was significant and had statistical significance.

Table 7 Results of F test

Effect	Num DF	Den DF	F value	$Pr > F$
x_{13}	1	12	18.14	0.0011

According to Table 7, the regression equation was valid. Meanwhile, the fixed effect x_{13} passed through its parameter test, showing that the minimum purchase price policy for rice had impacts on the planting area of rice in Hubei Province. Its coefficient was positive, so the impacts were positive. In comparison with other regression parameters, the effects of the minimum purchase price policy for rice on the planting area of rice in Hubei Province was extremely significant. The planting behavior of farmers as the study subject is based on their judgment about market situation and national policies to a great extent. With China's constant attention and investment in agriculture since the reform and open, the influence of national agricultural insurance policies on their planting behavior is more obvious than that of market. Under the current policies of supporting grain production, farmers' reaction to prices of agricultural products is more sensitive. The minimum purchase price policy for grain can decrease the risk of investment in agriculture greatly, protect farmers' benefit in continuously changing market of agricultural products, bring confidence and guarantee to farmers engaged in agricultural activities, improve farmers' enthusiasm for planting grain, and then affect the planting area of grain in a peasant household.

4 Conclusions and discussion

In this paper, the results show that the minimum purchase price policy for rice had significantly positive effects on the planting area of rice in Hubei Province. That is, it improved farmers' enthusiasm for planting rice, increased the planting area of rice, and then ensured the production and supply of rice in Hubei Province.

In fact, the crop planting behavior of farmers depends on the expected income from crops which can be divided into the expected yield and expected prices of crops. The expected prices of crops are mainly the expected market and policy prices (the minimum purchase price), while the expected yield of crops will be affected by initial planting area, disasters, fruiting rate, quantity of applied fertilizer, but farmers mainly determine initial planting area, and it can be controlled more easily by farmers than other factors. Here it is assumed that the minimum purchase price is the expected price of grain, and farmers will obtain their initial expected income to meet their agricultural production and family goal if the minimum purchase price is higher than the actual market price, otherwise farmers will obtain additional revenue to realize increase of family income, thereby improving farmers' trust and support for the national agricultural protection policy and their enthusiasm for agricultural production. However, it is assumed that the past market price is as the expected price, farmers can realize the expected income if the expected market price is lower than the actual market price; if the expected market price is higher than the actual market price, agricultural income planning of a family can not finished, and farmers' enthusiasm for agricultural or crop production will be affected. Therefore, the minimum purchase price is as the expected price, and any market prices can ensure the realization of the expected income. Moreover, it has certain resistance to the abrupt change of actual market prices. That is, if

the minimum purchase price is as the expected price, farmers' actual price must be equal to or higher than the expected price, and farmers can obtain the expected income and additional income. Based on the price protection, the expected income is the product of the expected price and yield, so the expected price is the expected market price in years when the minimum purchase price policy was not implemented, which may bring negative effects and affect farmers' enthusiasm for agricultural production. In years when the minimum purchase price policy has been implemented, price protection and realization of the expected income will improve farmers' enthusiasm for planting crops whose prices are protected and their planting area. That is, the implementation of the minimum purchase price policy will promote the sowing area of rice.

Since the implementation of the minimum purchase price policy for rice in Hubei Province in 2004, the planting area of rice in Hubei Province fluctuated but tended to increase on the whole. The regression results of factors influencing the planting area of rice show that the minimum purchase price policy for rice had positive effects on the planting area of rice in Hubei Province, so the agricultural protection policy was an effective measure to increase the planting area of rice. To ensure future food security, the sowing area of rice should be stabilized during the establishment of production input decisions; if farmers' level of education is low, it is needed to guild and protect agricultural production effectively to improve farmers' enthusiasm for agricultural production, insist on optimizing resource environment and policy environment of rice production, and establish more policies to protect farmers' benefit in market. Meanwhile, it is needed to use the price protection policy to popularize and sow high-quality rice varieties and provide effective technical support for farmers, strengthen drought monitoring and early warning capability, improve drought resistant security system, consolidate water conservancy infrastructure construction in paddy field, and enhance rice comprehensive production, drought resistance and disaster reduction capacity. At the present stage, the government should insist on using the minimum purchase price policy to conduct macro-control of market price to realize organic combination of market regulation and macro-control. At the same time, disadvantages of the minimum purchase price policy should be improved.

References

[1] LI W. Peasants' willingness to rice planting and its influential factors: Based on data of Zixing, Hunan [J]. Journal of Hunan Agricultural University(Social Science), 2010,11(5):7 – 13. (in Chinese).

[2] XIAO SX, LIU XH. Analysis on the impact factors for cotton planting area——Based on the investigation at Xinjiang, Henan, Jiangsu and Shandong [J]. Journal of Agrotechnical Economics, 2008(4):79 – 84. (in Chinese).

[3] ZHANG SP. Economic effects of China' s grain price fluctuation [J]. Finance and Economics, 2011(8): 93 – 102. (in Chinese).

[4] ZHONG J, QIN F. Effect of price support policies on grain production in China [J]. Modern Economic Science, 2012,34(3): 119 – 128. (in Chinese).

[5] GRDEN B. The economies of agricultural policies [M]. 2003.

[6] ANDREW PB. Wheat price policy in Pakistan: A welfare economics approach [M]. 1992.

[7] LI W. Peasants' willingness to rice planting and its influential factors: Based on data of Zixing, Hunan [J]. Journal of Hunan Agricultural University(Social Science), 2010, 11(5): 7 – 13. (in Chinese).

[8] ZHANG JS, WANG YP. Empirical study of factors influencing the yield increase of grain in China [J]. Hubei Agricultural Sciences, 2008, 47(4): 482 – 485. (in Chinese).

[9] WANG W, GUO XY. An econometric analysis of farmers' education level and rural economic growth [J]. Farm Economic Management, 2007(2): 43 – 45. (in Chinese).

[10] LIU XL, ZOU GH, LI Y, et al. Assessment of paddy soil productivity by using the multiple linear mixed-effect regression model [J]. Research of Agricultural Modernization, 2014, 35(5): 603 – 609. (in Chinese).

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[2] NOTTHAM RAY M. Urban geography[M]. New York: John Wiley & Sons, 1979

[3] FEI XT. Small towns and big issues[M]. Nanjing: Jiangsu People's Publishing Ltd., 1984. (in Chinese).

[4] FAN G. Discussion on equilibrium, disequilibrium and sustainability issues in structures[J]. Economic Research Journal, 1991(7): 13 – 20. (in Chinese).

[5] NIU WY, LI QQ. An understanding of China's new urbanization strategy[J]. Impact of Science on Society, 2010 (1): 14 – 20. (in Chinese).

[6] MILLS ES. Studies in the structure of the urban economy[J]. Baltimore, The Johns Hopkins Press,1972.

[7] GLAESER EL, KALLAL HD, *et al*. Growth in cities, National Bureau of Economic Research[J]. 1992.

[8] ROSENTHAL SS, STRANGE WC. Geography, industrial organization, and agglomeration[J]. Review of Economics and Statistics, 2003, 85(2): 377 – 393.

[9] BAI CE, DU YJ, TAO ZG, *et al*. Local protectionism and industrial concentration in China: Overall trend and important factors[J]. Economic Research Journal, 2004, 11(4): 29 – 40. (in Chinese).

[10] JIANG L, JI MH. Urbanization, regional innovation cluster, and spatial knowledge spillover——Empirical study based on spatial econometric model[J]. Soft Science, 2011(12):86 – 90. (in Chinese).

[11] LIU XY, SHAO J, XUE YL. Agglomeration and region economic growth: An empirical review based on panel data of Chinese prefecture cities[J]. Nankai Economic Studies, 2012, 3: 52 – 64. (in Chinese).

[12] LIAO XL. Dynamic analysis of the mechanism of fiscal expenditure and urbanization on urban-rural income gap[J]. Soft Science, 2012(4):33 – 38. (in Chinese).

[13] NIE HL, HAN Y, QIAN L. The dynamic comparison between the level of urbanization and the economic growth based on panel data[J]. Soft Science, 2012(5):27 – 31. (in Chinese).

[14] HENDERSON JV. The urbanization process and economic growth: The so-what question[J]. Journal of Economic Growth, 2003(8):47 – 71.

[15] LU M, GAO H, ZUO TH. Urban size and inclusive of employment [J]. Social Sciences in China, 2012(10): 47 – 66. (in Chinese).

[16] CHEN GL, CHEN JJ. Industrial relationship, geo-spatial database and the secondary and tertiary industries gathered together[J]. Management World, 2012 (4):82 – 100. (in Chinese).

[17] REN XH, ZHANG ZY. Transportation infrastructure, factor mobility and urban-rural income gap[J]. Management Review, 2013, 25(2): 51 – 59. (in Chinese).

[18] ROODMAN D. How to do xtabond2: An introduction to difference and system GMM in Stata[J]. Stata Journal, 2009, 9(1): 86.