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The Changes of Fiscal Agriculture-Supporting Expenditure and Farmers' Income Based on Grey Correlation Theory

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Abstract According to the relevant data of *China Statistical Yearbook* and *Chinese Rural Statistical Yearbook* in the year of 2009, the changes of grey correlation degree of farmers' net income, various items of incomes, national gross agriculture-supporting expenditure and various items of expenditures, farmers' net income and various items of fiscal agriculture-supporting expenditure in the Eighth Five-Year Plan, Ninth Five-Year Plan and Tenth Five-Year Plan by using grey correlation degree and the by choosing seven indicators covering income from wage and salary, income from household business, transfer income and property income, agricultural production-supporting expenditure, agricultural basic construction expenditure, expenses of three items of agricultural technology and the fee of rural relief. The results show that the grey correlation degree of each time period and household net income shows the downward trend; from overall perspective, the grey correlation degree of national gross agriculture-supporting expenditure, agricultural basic construction expenditure and agricultural production-supporting expenditure shows the descending trend; the grey correlation degree of fiscal agricultural supporting expenditure and the expenditure of three items of agricultural technology and fee of rural relief show the upward trend; the influence of agricultural production-supporting expenditure on farmers' income shows downward trend; the influence of agricultural basic construction on farmers' income shows upward trend; the fee of rural relief play an active role in the promoting the farmers' income increase; the role played by fee of rural relief in promoting farmers' income increase should be further increased; the increase of farmers' income shows great reliance on agricultural science and technology. In the end, the relevant suggestions on establishing stable increase mechanism of fiscal agricultural support and insisting on the dynamic adjustment of the structure of fiscal agricultural supporting capital are put forward.

Key words Fiscal agriculture-supporting expenditure, Farmers' income, Grey correlation degree, Grey correlation analysis, China

Fiscal expenditure, is also called public financial expenditure, refers to the fiscal capital paid by the government for providing public accommodation and services and satisfying social common needs under the status of market economy. Besides directly constituting and affecting the aggregate social needs, fiscal expenditure plays a vital role in the distribution of the total social income. Generally speaking, if the purchase expenditure takes a large proportion in fiscal expenditure, then the total social demand will be increased and then the production can be promoted and job opportunities will be improved. If the transfer expenditure takes a large proportion in fiscal expenditure, the fiscal activities show strong functions on income redistribution and people' income will be increased directly. Public fiscal theory indicates that fiscal agriculture-supporting policies not only have great impact on the agricultural development, but also play a major role in affecting farmers' income increase^[1]. The considerable fiscal capital input by developed countries has pushed forward their agricultural production and also proved the positive effects of agricultural supporting policies on farmers' income increase. In the agriculture-advanced countries including U. S., Canada, U. K. and Australia, the fiscal support provided by the government accounts for above 25% of the GDP of agriculture; in Japan, Israel *et al.*, the agricultural fiscal sup-

port provided by the their governments takes 45% –95% of the agricultural GDP. Japan and Korea have carried out agro-product protection policy and agriculture protection policy in the early 1960s and later 1960s. Even in developing country, such as India, the governmental fiscal support on agriculture is tantamount to 10% of the agricultural GDP^[2]. The experiences of these countries imply that the agricultural protection policy and fiscal agriculture-supporting policy have promoted farmers' income increase effectively.

Since the implementation of reform and opening up to the outside world, Chinese fiscal support on agriculture has increased continuously and the support has played a positive role in promoting the development of agricultural production and farmers' income increase. However, in China, with limited agricultural supporting fund and low farmers' income, the insufficient agricultural input caused by the decrease of relative share of fiscal support has become a major element that restricts agricultural development and farmers' income increase. On the basis of mirroring foreign relevant experiences and the data of Chinese rural households per capita average net income and fiscal agricultural supporting expenditure, the paper analyzes the changes of fiscal agriculture-supporting expenditure and farmers' income since the Eighth Five-Year Plan by using the grey correlation analysis, so as to intensify the research on the relations of fiscal agriculture-supporting and farmers' income and provide reference for making scientific and reasonable fiscal agriculture-supporting policies and optimizing fiscal agricultural supporting structure.

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1 Data source, index selection and research method

1.1 Data source The data come from *China Statistical Yearbook 2009* and *Chinese Rural Statistical Yearbook 2009*.

1.2 Index selection In order to study the correlation between farmers' income and fiscal agriculture-supporting fund, the paper chose the rural households per capita net income as an sample, which can be divided into income from wage and salary, household operation income, transfer and prosperity income according to the nature of the income. The national fiscal agriculture-supporting includes four sub-items: expenditure on supporting rural production, expenditure on rural basic construction, fee of three items of agricultural technology and fee of rural relief.

1.3 Research method The changes of the grey correlation of fiscal expenditure on supporting agriculture and farmers' income are studied by using grey correlation degree.

1.3.1 The fundamental principle of grey correlation degree. Grey theory is a systematic scientific theory first put forward by Professor DENG Ju-long in 1982. The grey correlation degree is a new analysis method to judge the correlation degree of factors according to the similarities of the changes of each factor.

The measurement of the correlation degree of two systems or two elements is called correlation degree. Correlation degree describes the relative changes of elements in the developmental process of system, and it is the relativity of changes, direction, and speed *et al.* If the relative changes of the two are nearly in substantial agreement in the developmental process, the correlation degree of the two is large; or else, the correlation degree will be small^[3]. In essence, grey correlation analysis is the quantitative comparable analysis on developmental momentum and the comparison of the geometrical relationship of the statistics. The analysis method makes up for the disadvantages of regression analysis in terms of a small number of data, less work of calculation, no needs of typical distribution rules and multifactor analysis^[4]. The economic system of fiscal agricultural support, farmers' income *et al.* have the nature of grey, so, the grey correlation theory can be used to discuss the main relations of each element.

1.3.2 Grey correlation analysis method. Grey correlation analysis is the method used to judge the correlation degree of elements according to the similarities of geometrical forms of the changing curve of each element. The specific calculating steps can be seen as follows:

1.3.2.1 Determining the reference sequence and comparison sequence. The data sequence that reflects the system behavior features is called reference sequence. The sequence that affects the behavior of system is called comparison sequence.

Reference sequence is:

$$x_0(k) = [x_0(1), x_0(2), x_0(3), \dots, x_0(k)]$$

Comparison sequence is: $x_i(k) = [x_i(1), x_i(2), x_i(3), \dots, x_i(k)]$

Among the sequences, $k=1, 2, \dots, n; i=1, 2, \dots, m$.

1.3.2.2 Dimensionless process of original data. As a result of the different dimensions of the original data, the data varies hugely in quantity, and it is hard to get the correct results when comparing them. In order to conduct correlation analysis and maintain the unitarily of original data, the original data should

be transformed and the dimensionless process should be conducted. The paper adopts the initial value method to handle the original data.

1.3.2.3 Calculating the difference sequence. Calculating the difference sequence of reference sequence and comparison sequence. Difference sequence $\Delta_{0i}(k) = |x_0(k) - x_i(k)|$, $i=1, 2, \dots, m; k=1, 2, \dots, n$.

1.3.2.4 Calculating the maximum value and minimum value of reference sequence and comparison sequence.

$$\begin{aligned} \Delta_{\max} &= \max \{ \Delta_{0i}(k) \} \\ \Delta_{\min} &= \min \{ \Delta_{0i}(k) \}, \\ i &= 1, 2, \dots, m; k = 1, 2, \dots, n \end{aligned}$$

1.3.2.5 Calculating the correlation coefficient.

$$\xi_{0i}(k) = \frac{\Delta_{\min} + \rho \Delta_{\max}}{\Delta_{0i}(k) + \rho \Delta_{\max}}$$

In the equation, ρ is resolution ratio, $\rho \in (0, 1)$, supposing $\rho = 0.5$. $i=1, 2, \dots, m; k=1, 2, \dots, n$.

1.3.2.6 Calculating correlation degree. There are many correlation coefficient, the information is over scattered, and it is hard to compare the coefficient, so it is necessary to collect the correlation coefficient of each period into a value. That is to say, it can reflect the correlation degree of the whole process by calculating the average value of correlation coefficient at each moment. The general expression of correlation degree is:

$$r_{0i} = \frac{1}{n} \sum_{k=1}^n \xi_{0i}(k)$$

1.3.2.7 Ranking correlation sequence. When measuring the correlation degree of elements, not the degree of the elements, but the ranking of the correlation degree is crucial. Ranking the correlation degree of m subsequences of the same parent sequence, the correlation sequence $\{x\}$ is composed to reflect the relations of each sub sequence of parent sequence. If $r_{0a} > r_{0b}$, then in the same sequence $\{x_0\}$, the sub sequence $\{x_a\}$ is better than $\{x_b\}$. It is described as $\{x_a | x_0\} > \{x_b | x_0\}$; if $r_{0a} < r_{0b}$, then in the same parent sequence $\{x_0\}$, the sub sequence x_a is worse than x_b , it is marked as: $\{x_a | x_0\} < \{x_b | x_0\}$ ^[3].

2 Results and analysis

2.1 The changes of famers' net income and the grey correlation degree of each item of income The research selects farmers' average net income in the time period from 1991 to 1995, from 1996 to 2000 and from 2001 to 2005 as reference sequence; takes the income from wage and salary, rural household operation net income, transfer income and property income as the comparative sequence to calculate the grey correlation degree of reference sequence and comparative sequence, the results can be seen on Table 1.

It can be seen from Table 1 that, in the time period of Eighth Five-Year Plan, Ninth Five-Year Plan and Tenth Five-Year Plan, Chinese farmers' income still has larger correlation degree with household operation net income. It indicates that during the surveyed period, the household operation net income is still the main elements that affects farmers' income, but the correlation degree shows the downward trend. Since the Ninth Five-Year Plan, the correlation degree of farmers' income with the income from wage and salary has increased but the correlation degree with the transfer and property income slowed the descending trend. It implies that with the adjustment

of rural economic structure and the development of rural economy, farmers' income structure has been improving gradually, the impact of farmers' income from the primary industry on net income is weakening and the impact of the income from wage and salary is rising. Farmers' income source has been transferring from the agriculture to non-agriculture, but the non-agricultural income is not so obvious. Continuously and effectively adjusting rural industrial structure and greatly developing non-agricultural industry are conducive to increase farmers' income.

Table 1 Grey correlation degree of farmers, net income and each item of income from the Eighth Five-Year Plan period to the Tenth Five-Year Plan period

| Items | 1991 – 1995 | 1996 – 2000 | 2001 – 2005 |
|-------------------------------------|----------------|----------------|----------------|
| Income from wage and salary | 0.898 213 | 0.621 895 | 0.770 366 |
| Households operation net income | 0.927 828 | 0.818 936 | 0.816 836 |
| Transfer income and property income | 0.660 582 | 0.800 434 | 0.651 713 |

Data source: the data comes from *China Statistical Yearbook*(1992 – 2008).

2.2 Changes of grey correlation degree between national fiscal agriculture-supporting expenditure and various items of agricultural supporting expenditure

The following analysis takes the national fiscal agriculture-supporting expenditure in the time period from 1991 to 1995, from 1996 to 2000 and from 2001 to 2005 as reference sequences; takes various items of agricultural supporting expenditure (expenditure on supporting rural production, expenditure on agricultural basic construction, fee of three items of agricultural technology and fee of rural relief) as comparative sequence to calculate the grey correlation degree of reference sequence and comparative sequence in various time period. The calculation results can be seen on Table 2.

It can be seen from Table 2, the national total fiscal agriculture-supporting expenditure has large correlation degree with the expenditure on supporting agricultural production in the Eighth Five-Year Plan period, followed by agricultural basic construction expenditure and the least correlation degree with fee of rural relief. In the Ninth Five-Year Plan period, the national total fiscal agriculture-supporting expenditure has the largest correlation degree with the expenditure on supporting agricultural production, followed by fee of rural relief and fee of three items of agricultural technology; in Tenth Five-Year Plan period, the national total fiscal agriculture has the largest grey correlation degree with the fee of three items of agricultural technology, followed by expenditure on supporting agricultural production and fee of rural relief. Each period has relatively greater grey correlation degree with the expenditure on supporting agricultural production, which indicates that in various periods, the expenditure on supporting agricultural production is the major factor that affects the national total fiscal agricultural supporting expenditure. But from the overall perspective, the grey correlation degree of national total fiscal agricultural supporting expenditure to the expenditure on supporting agricultural production shows downward trend. At the same time, except for the expenditure on supporting agricultural production, its grey correlation degree to the expenditure on agricultural basic construction shows downward trend as well. However, its grey cor-

relation degree to fee of three items of agricultural technology and fee of rural relief showed upward trend. Especially, in the Tenth Five-Year Plan period, the national total fiscal agricultural expenditure showed the strongest grey correlation degree to the fee of three items of agricultural technology, which indicated that fee of three items of agricultural technology is the major factor that affects the national total agricultural supporting expenditure, and directly relates to the national strategy of "invigorating agriculture by science and technology" and the raised input on agricultural scientific research.

Table 2 Grey correlation degree of the aggregate fiscal agricultural supporting expenditure and various items of expenditure in the time period from the Eighth Five-Year Plan period to the Tenth Five-Year Plan

| Items | 1991 – 1995 | 1996 – 2000 | 2001 – 2005 |
|---|----------------|----------------|----------------|
| Agricultural production expenditure | 0.850 701 | 0.907 823 | 0.807 988 |
| Agricultural basic construction expenditure | 0.839 254 | 0.739 226 | 0.689 509 |
| Fee of three items of agricultural technology | 0.624 873 | 0.502 244 | 0.855 956 |
| Fee of rural relief | 0.524 628 | 0.828 739 | 0.659 415 |

2.3 Changes of the grey correlation degree of farmers' net income and various items of fiscal expenditure

The following analyses take Chinese farmers' net income in the time period from 1991 to 1995, from 1996 to 2000 and from 2001 to 2005 as reference sequences and take expenditure on supporting farmers in each time period as comparative sequence. The calculation results can be seen on Table 2.

Table 3 Grey correlation degree of farmers, net income and the various agricultural supporting expenditure from the Eighth Five-Year Plan period to the Tenth Five-Year Plan

| Items | 1991 – 1995 | 1996 – 2000 | 2001 – 2005 |
|---|----------------|----------------|----------------|
| Expenditure on supporting agricultural production | 0.880 018 | 0.941 802 | 0.732 399 |
| Expenditure on agricultural basic construction | 0.800 903 | 0.712 42 | 0.858 283 |
| Fee of three items of agricultural technology | 0.671 953 | 0.512 537 | 0.792 606 |
| Fee of rural relief | 0.588 923 | 0.923 393 | 0.646 388 |

It can be seen from Table 3 that, in the Eighth Five-Year Plan period and the Ninth Five-Year Plan period, farmers' net income has the greatest grey correlation degree to the expenditure on supporting agricultural production. In the Tenth Five-Year Plan period, farmers' net income has the greatest correlation degree to the agricultural basic construction fee, which indicated that in this period, farmers' income was closely related to the agricultural basic construction. The expenditure on supporting agricultural production and agricultural basic construction has positive impact on farmers' income increase. However, the influence of the expenditure on supporting agricultural production on farmers' income showed downward trend. The influence of the expenditure on agricultural basic construction on farmers' income showed the trend of increase. The grey correlation degree of farmers' income and fee of rural relief

were strong in the Ninth Five-Year Plan period, but weak in the Eighth Five-Year Plan period and the Tenth Five-Year Plan period, which implied that the positive role of the relief fee in promoting farmers' income increase should be well displayed, especially the direct role in increasing the income of poor rural households without the labors. The grey correlation degree of farmers' income and the fee of three items of agricultural science and technology presented upward trend, which indicated that farmers' income increase relied on the science and technology. In the Tenth Five-Year Plan period, the grey correlation degree of farmers' income and the each item of fiscal agriculture-supporting expenditure was almost equal, which explained that for one thing, the structure of national fiscal agriculture-supporting expenditure was improving gradually, for another thing, the overall improvement of fiscal agricultural expenditure led to the increase of farmers' income.

3 Countermeasures and suggestions

3.1 Establishing long-term and stable growth mechanism of fiscal agriculture-supporting fund The *Agricultural Law* stipulates that "the growth range of total agricultural input invested by local finance at national or country level or above should higher than the growth range of financial regular revenues". Amid protecting the continuous and stable increase of the total amount of agriculture-supporting fund and further display the positive functions of fiscal agriculture-supporting, the growth range of fiscal budget for supporting agriculture should surpass the growth range of fiscal expenditure, and then fully display the role of fiscal agriculture-supporting fund in promoting farmers' income increase.

3.2 Insisting on the dynamic adjustment of the capital structure of agriculture-supporting funds and optimizing fiscal agriculture-supporting structure In the first place, the expenditure on assisting agricultural production should be increased, especially the fiscal support on rural cooperatives. The administration expenditure should be controlled and reduced. In the second place, the management on agricultural basic construction should be strengthened and the inner structure if it should be rationalized to direct the capital to invest in facilities and middle and small-size infrastructure construction highly related to farmers' income increase and intensify the input of fund on agricultural comprehensive development. In the third place, the input on the fee of three items of agricultural technology should be increased. The government should invest the fields, which is characterized by long period, high risks, low attraction to other investors, to vigorously support agricultural self innovation, agricultural standardization and rural informatization and to increase the input on the promotion of agricultural science and technology; further perfect the system of agricultural science and technology promotion and enhance farmers' quality, to accelerate the application of agricultural scientific achievements and improve the contribution made by agricultural science and technology to agricultural development, and then increase farmers' income. In the fourth place, the input on fee of agriculture relief should be increased, especially the hardship relief assistance and production support of poverty-stricken households. The urban-rural social security system should be established and perfected^[5].

3.3 Intensifying the supervision on fiscal agriculture-supporting fund and improving the use efficiency of agriculture-supporting fund In the process of fiscal agriculture-supporting, the government should intensify the supervision on various sections and implement the systematized, normalized and transparent management; ensure the safety of capital; improve the use efficiency and interest rate of agriculture-supporting fund to normalize the input of governmental funds, reasonably allocate public fiscal resources, perfect rural infrastructure, alter the backward situation of rural areas and achieve the target of farmers' income increase.

3.4 Intensifying the fiscal transfer payment of rural public accommodation and improving rural living and production environment With the development of rural social economy, governmental support on agriculture has been intensifying, which has greatly pushed forward the development of agricultural production, rural development and farmers' income increase. Since the reform and opening up, the public expenditure provided by Chinese government has played a positive role in rural economic development and farmers' income increase. In order to reduce farmers' burden and accelerate rural economic development, in the supply of public accommodation, the country should try to change the urban-rural dual supply system; adjust the public fiscal expenditure policies according to the demand of urban and rural coordinate development; intensify the fiscal transfer payment and support of rural public accommodation. Therefore, the government should adopt effective measures to absorb private capital; widen new fund supply channels of rural public accommodation and then underpin the fiscal input supply of rural public accommodation^[6]. When conducting public investment, the government should try to adjust the structure of public expenditure; improve the public expenditure on science and technology and rural relief; and attach importance on satisfying the demands of rural compulsory education, agricultural scientific research, agricultural technology promotion, medical care, social security and agricultural information services^[7]. Only by this, farmers' living quality can be continuously improved on the basis of improving rural living conditions so as to lay foundation for facilitating the sustainable development of rural economy; alleviating farmers' burden and increasing farmers' income.

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