Empirical Analysis on Effect of Agricultural Financial Investment on Increase of Farmers' Income

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Abstract On the basis of economic data from 1978 to 2006, the co-integration theory is applied to discuss the relation between agricultural financial investment and farmers' income. The statistic AR model is obtained. Then, it makes pulse response analysis in combination with principle of pulse response analysis. The regression results show that support in agricultural production, various agricultural operating expenses and three types of costs for agricultural science and technology are favorable to farmers' income, while expenditure in agricultural capital construction and rural relief costs hinder increase of farmers' income. The results of pulse response analysis indicate that the change in support of agricultural production and various agricultural operating expenses have positive impact on farmers' net income, and the impact is greater and greater from the second year; the response of expenditure in agricultural capital construction and rural relief cost is positive in the beginning and starts to fluctuate from the third year; the pulse response of three types of costs for agricultural science and technology is negative, lasts about five periods, and then turns to positive impact. Finally, combining characteristics of China's financial support for agriculture, it concludes that the scale, proportion and structure of financial support for agriculture are quite improper.

Key words Financial support for agriculture, Farmers' income, Co-integration theory, Pulse response analysis

Agriculture is the lifeline of national economy. China is a large agricultural country and agricultural population still takes up absolute majority. Increase of farmers' income concerns realization of moderately prosperous society, stable development, and building of harmonious society. At present, the key to increasing farmers' income is to keep stable growth of agricultural inputs. Under conditions of market economy, initial distribution of national income lays particular emphasis on the efficiency, and the redistribution should focus on the equity. Therefore, it is required to strengthen the support for agriculture through financial anti-poverty policy, transfer payment and financial subsidy, adjust the benefit relation between producers and consumers, and between farmers and urban residents, so as to narrow the income gap and guarantee stable growth of farmers' income. The agricultural input of the state finance is one of the three pillars of agricultural development. The state financial investment in agriculture is helpful to providing rural public goods and laying material foundation for increase of farmers' income. Besides, it is also able to promote transfer of rural surplus labor force, increase farmers' non-agricultural income. In addition, it is favorable to adjusting relationship of financial allocation and realizing the goal of increasing farmers' income. On the basis of economic data from 1978 to 2006, I take an empirical analysis on the relationship between financial agricultural input and farmers' net income, and study the influence of financial investment on farmers' income.

1 Index selection, data source and research method

1.1 Index selection and data preprocessing The expenditure of state finance in agriculture mainly includes support in agricultural production, various agricultural operating expenses, expenditure in agricultural capital construction, three types of costs for agricultural science and technology, and others (mainly referring to rural relief costs). This research selects financial support for agricultural production and various operating expenses (x_1), expenditure in agricultural capital construction (x_2), three types of costs for agricultural science and technology (x_3) and rural relief costs (x_4) in 1978 to 2006, to analyze the relationship between financial support for agriculture and farmers' net income (y). Among these, the support for agricultural production mainly includes the subsidy for small-sized irrigation and water conservancy, well drilling, irrigation and small hydropower station in rural areas; various agricultural operating expenses mainly refers to operating expenses of rural water conservation and meteorological departments; the expenditure for agricultural capital construction is mainly used for highway construction, water conservancy facility construction, and comprehensive development of agriculture; three types of costs for agricultural science and technology consist of expense for trial manufacture of new products, intermediate experimental expense, and subsidy for important scientific research, *etc.*

To remove influence of heteroscedasticity, firstly calculate the natural logarithm of the above five indexes. Table 1 lists the relevant data of farmers' net income and financial support for agriculture in 1978 to 2006.

1.2 Research method Firstly, process the data and conduct stationarity inspection. On the basis of inspection results, build fitting model to carry out econometric analysis, and analyze features of financial support for agriculture in China.

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Table 1 Relevant data of farmers' net income and financial support for agriculture

Year	Farmers' net income (y) //yuan	Support for agricultural production and various operating expenditure (x_1) //10^8 yuan	Expenditure for agricultural capital construction (x_2) //10^8 yuan	Three types of costs for agricultural science and technology (x_3) //10^8 yuan	Rural relief costs (x_4) //10^8 yuan	ln$y$	lnx_1	lnx_2	lnx_3	lnx_4
1978	133.57	76.95	51.14	1.06	6.88	4.895	4.343	3.935	0.058	1.929
1979	160.17	90.11	62.41	1.52	9.80	5.076	4.501	4.134	0.419	2.282
1980	191.33	82.12	48.59	1.31	7.26	5.254	4.408	3.883	0.270	1.982
1981	223.44	73.68	24.15	1.18	9.08	5.409	4.300	3.184	0.166	2.206
1982	270.11	79.88	28.81	1.13	8.60	5.599	4.381	3.361	0.122	2.152
1983	309.77	86.66	34.25	1.81	9.38	5.736	4.462	3.534	0.593	2.239
1984	355.33	95.93	33.63	2.18	9.55	5.873	4.564	3.515	0.779	2.257
1985	397.60	101.04	37.73	1.95	12.90	4.616	3.630	0.668	2.557	5.985
1986	423.80	124.30	43.87	2.70	13.33	4.823	3.781	0.993	2.590	6.049
1987	462.60	134.16	46.81	2.28	12.47	4.899	3.846	0.824	2.523	6.137
1988	544.90	158.74	39.67	2.39	13.27	5.067	3.681	0.871	2.586	6.301
1989	601.50	197.12	50.64	2.48	15.70	5.284	3.925	0.908	2.754	6.399
1990	686.30	221.76	66.71	3.11	16.26	5.402	4.200	1.135	2.789	6.531
1991	708.60	243.55	75.49	2.93	25.60	5.495	4.324	1.075	3.243	6.563
1992	784.00	269.04	85.00	3.00	18.98	5.595	4.443	1.099	2.943	6.664
1993	921.60	323.42	95.00	3.00	19.03	5.779	4.554	1.099	2.946	6.826
1994	1 221.00	399.70	107.00	3.00	23.28	5.991	4.673	1.099	3.148	7.107
1995	1 577.70	430.22	110.00	3.00	31.71	6.064	4.700	1.099	3.457	7.364
1996	1 926.10	510.07	141.51	4.94	43.91	6.235	4.952	1.597	3.782	7.563
1997	2 090.10	560.77	159.78	5.48	40.36	6.329	5.074	1.701	3.698	7.645
1998	2 162.00	626.02	460.70	9.14	58.90	6.439	6.133	2.213	4.076	7.679
1999	2 210.30	677.46	357.00	9.13	42.17	6.518	5.878	2.212	3.742	7.701
2000	2 253.40	766.89	414.46	9.78	40.41	6.642	6.027	2.280	3.699	7.720
2001	2 366.40	917.96	480.81	10.28	47.68	6.822	6.175	2.330	3.865	7.769
2002	2 475.60	1 102.70	423.80	9.88	44.380	7.006	6.049	2.291	3.793	7.814
2003	2 622.20	1 134.86	527.36	12.43	79.80	7.034	6.268	2.52	4.38	7.872
2004	2 936.40	1 693.79	565.01	13.22	85.87	7.435	6.337	2.582	4.453	7.985
2005	3 254.90	1 792.40	512.63	19.90	125.38	7.491	6.240	2.991	4.831	8.088
2006	3 587.00	2 161.35	504.28	21.42	182.04	7.678	6.223	3.064	5.204	8.185

Note: Data is selected from *China Statistical Yearbook* 2008.

2 Results and analyses

2.1 Econometric model analysis

2.1.1 Inspection of stationarity and co-integration relation. Since we use time series data, most time series are nonstationary, it is impossible to directly build econometric model. It is required to inspect the stationarity and check whether it has root of unity. If the variable is nonstationary, check whether there is co-integration relation. If there is such relation, it can directly conduct co-integration regression; if no such relation, it is necessary to conduct differential conversion, and carry out regression after it changes to stationary sequence. This research conducts inspection using ADF method[1], and inspection results are listed in Table 2.

From Table 2, it is known that all variables have root of unity and are nonstationary; the integrated exponent number is equal to 1, but after first order difference, all sequences have no root of unity and are stationary. Therefore, all variables are first order integrated sequence, namely I(1). This indicates that co-integration relation may exist between variables, so it is required to conduct co-integration inspection.

On the basis of the co-integration theory, these nonstationary time series are first order integration, and their linear combination may be stationary. If so, there is long term stationarity relation between these variables, namely, the co-integration relation. The inspection adopts EG two-step method. Firstly, use OLS to estimate long term static regression equation, and inspect the stationarity of residual estimation by ADF. The statistical value of residual ADF is −2.061 659. The critical values of 1%, 5% and 10% are −2.660 3, −1.955 2 and −1.622 8 respectively. The inspection results show that at the significant level of 5%, the statistical value of ADF is −2.061 659, which is lower than the critical value of root of unity −1.955 2. Thus,

Table 2 Inspection results of stationarity of variables

Variable	ADF value	Critical value (5%)	Inspection form (c,t,n)	Integrated exponent number	p value
ln$y$	−1.55	−3.59	(c,t,1)	1	0.31
dln$y$	−3.50	−2.98	(c,0,1)	0	0.00
lnx_1	−1.96	−3.59	(c,t,1)	1	0.13
dlnx_1	−3.55	−2.98	(c,0,1)	0	0.00
lnx_2	−1.54	−3.58	(c,t,1)	1	0.11
dlnx_2	−3.50	−2.98	(c,0,1)	0	0.00
lnx_3	−1.98	−3.59	(c,t,1)	1	0.27
dlnx_3	−3.30	−2.98	(c,0,1)	0	0.00
lnx_4	−1.56	−3.59	(c,t,1)	1	0.14
dlnx_4	−3.13	−2.98	(c,0,1)	0	0.00

Note: d refers to first order difference; c signifies constant; t stands for time trend; and n represents exponent number of lag period.

the original assumption H_0 is rejected, indicating that there is no root of unity in residual, and it is stationary sequence, so it can be deemed that it is co-integrated between ln$y$ and ln$x$, and there exists a long term stationary relation.

2.1.2 Estimation and analysis of model. Use the multiple regression model to analyze static relation between variables, and determine the influence of lnx_1, lnx_2, lnx_3 and lnx_4 on ln$y$ through inspecting their partial coefficients of correlation. Then, conduct co-integration regression analysis on them, and get the following regression equation:

$$\ln y = 1.95 + 1.09\ln x_1 - 0.31\ln x_2 + 0.23\ln x_3 - 0.09\ln x_4$$

$R^2 = 0.9475$; *F-statistic* $= 10^8.22$; $p = 0.00$

Regression analysis indicates that:

Firstly, support for agricultural production and various operating expenditure (x_1) and three types of costs for agricultural science and technology (x_3) are favorable to increase of farmers' income. This is mainly because the support for agricultural production and various operating expenditure reduces farmers' production costs, arouse their enthusiasm for production, and increase agricultural output; three types of costs for agricultural science and technology are favorable for providing new crops, increasing agricultural output and farmers' income.

Secondly, the expenditure for agricultural capital construction (x_2) and rural relief costs (x_4) hinder the increase of farmers' income. In current political system and administrative appointment system, the assessment of performance of local government mainly depends on GDP and development speed. Due to low agricultural benefits, local government often makes investment in non-agricultural fields and urban areas. Although the central government has take measures, they fail to produce an effect because of information asymmetry. As to rural relief costs, they are just embezzled or wasted by local government. Besides, relief itself is not favorable to raising farmers' enthusiasm for production. When farmers know there are reliefs but fail to obtain such reliefs, their enthusiasm for production will be greatly dampened. Thus, the relief is not favorable to increasing farmers' income. Indeed the influence of rural relief costs on farmers' income is small.

2.2 Pulse response analysis The co-integration analysis only shows whether causal relationship and long term relation are balanced between variables, not reflects the disturbance of unit change of variables on the entire system, as well as comprehensive response of dependent variables to these disturbances. For this reason, use VAR function to make further pulse response analysis on relations between variables, and find out dynamic influence of other variables on farmers' net income. To ensure stationarity of the system, here use the first order difference to form the pulse function. d1y refers to the first order difference to y, while d1xi stands for the first order difference to x_i (i = 1, 2, 3, 4). Use Eviews software to conduct pulse response analysis[2], and the results are shown in Fig. 1 through Fig. 4.

From Fig. 1 through Fig. 4, it is known that:

Firstly, the pulse response of d1y to d1x_1 is positive, but in the first year, response does not occur, in the second year, positive response happens, and the influence period is long. These indicate that the change in support of agricultural production and various agricultural operating expenditures have positive impact on farmers' net income, and the impact is greater

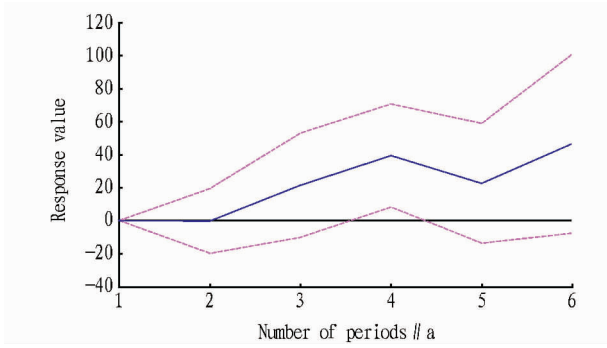

Fig. 1 Response of d1y to a standard deviation innovation of d1x_1

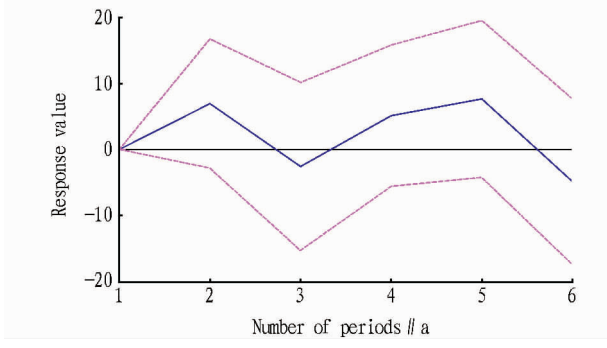

Fig. 2 Response of d1y to a standard deviation innovation of d1x_2

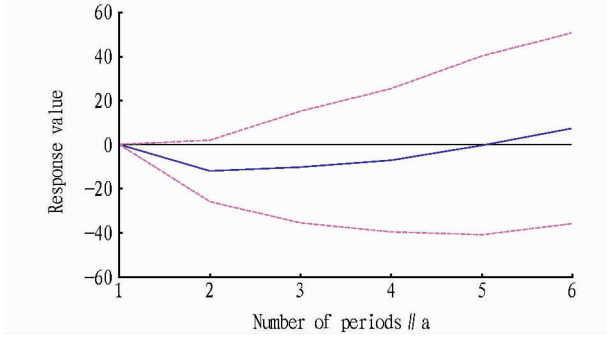

Fig. 3 Response of d1y to a standard deviation innovation of d1x_3

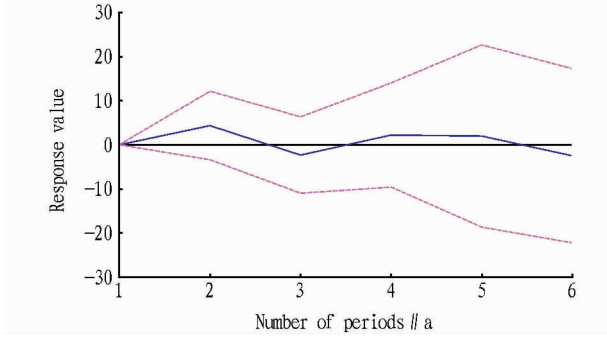

Fig. 4 Response of d1y to a standard deviation innovation of d1x_4

and greater from the second year and lasts for long time, which matches the regression results.

Secondly, the response of d1y to changes of d1x_2 and d1x_2 is positive at the beginning and starts to fluctuate from the third year, which is not consistent with results of regression analysis. Reasons for this include the change in expenditure of agricultural capital construction may exert positive impact on farmers' income at the beginning, which is consistent with the effect of rural relief costs. However, in China, local government does not put financial support for agriculture into agricultural fund, but put into other sectors that may show its political achievements[3]. In addition to serious waste and corruption, such problem becomes worse and influences farmers' income.

Thirdly, the pulse response of three types of costs for agricultural science and technology (x_3) to farmers' income is negative at the beginning. It lasts for about 5 periods and change to positive impact. Three types of costs for agricultural science and technology consist of expense for trial manufacture of new products, intermediate experimental expense, and subsidy for important scientific research. So the initial inputs will not directly increase farmers' income, and it may exert positive impact on farmers' income after a long time.

2.3 Analysis of features of financial support for agriculture

2.3.1 Total amount of financial support for agriculture takes on a rising trend, but the total amount is insufficient and subject to policies. The total amount of financial support and the proportion of financial support for agriculture to total financial expenditure is respectively shown in Fig.5 and Fig.6.

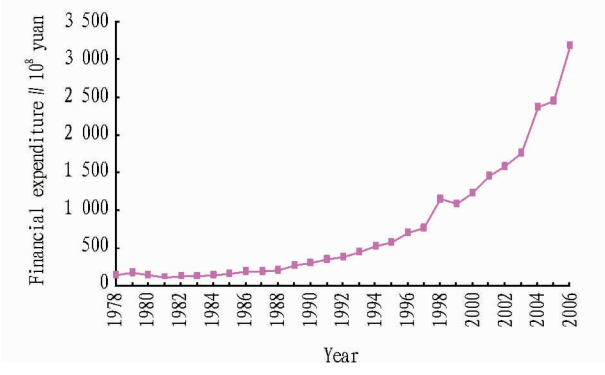

Fig.5 Total amount of financial support in 1978 to 2006

From Fig.5, it is known that the financial expenditure has a reduction in 1999 compared with 1998, but in other years, it continuously increases. The Fig.6 shows that the proportion of financial support for agriculture to total financial expenditure takes on a declining trend. The proportion is very small and not consistent with actual conditions of large agricultural country and large agricultural population. From the comparison between the proportion of agricultural investment to total social investment and the proportion of agricultural output value to total social output value, according to development rules of world agriculture[4], in the middle period of industrialization, if the proportion of agricultural investment (comparative rate of investment) is 1, the actual conditions of China in 1978 to 2006 is lower than

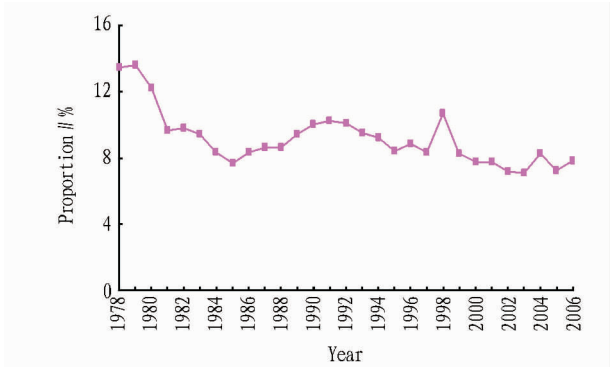

Fig.6 The proportion of financial support for agriculture to total financial expenditure in 1978 to 2006

0.2, and there is a trend of decline. It can be deduced that agricultural investment is inadequate in China, while most part of agricultural investment comes from financial expenditure, so the total amount of financial support for agriculture is seriously insufficient.

Fig.6 indicates that the proportion of financial support for agriculture is small, not stable and takes on a trend of decline. This is related with China's economic development strategy. At early days of reform, China gives priority to the development of heavy industry. The heavy industry belongs to capital-intensive industry. When the capital is rare and much investment is put to cities, both the total amount and proportion of financial support for agriculture are small. Even by now, such situations are not considerably changed. The total amount is increased, but local government does not put financial support for agriculture into farming funds, and they just put capital to sectors that can show their political achievements. In addition to serious waste and corruption, there is serious shortage of fund for agriculture. The financial support for agriculture is greatly influenced by policies, and will have great changes in the macro-economic fluctuation period.

2.3.2 The structure of financial support for agriculture is unreasonable. The financial support for agriculture mainly includes the support for agricultural production and various operating expenditure, expenditure in agricultural capital construction, three types of costs for agricultural science and technology, and rural relief costs. Among these, farmers can be directly benefited more from the support for agricultural production, three types of costs for agricultural science and technology, and rural relief costs. From the above regression analysis and data, it is shown that the proportion of these three types of expenses is low, while the proportion of those hindering increase of farmers' income is greater, up to 70% in 2001. A survey made by the Development Research Centre of the State Council shows that much of financial support for agriculture is used for operation of agricultural administration (some are squandered and wasted)[5]. The operating expenses for supporting agricultural production and agriculture, forestry, water and gas departments take up a larger part in financial support for agriculture (about 70% in recent years).

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tive input and expanding the scale of productive capital input scale, the following rational recommendations are put forward, on the basis of the facts of the research area: promoting the rice growers to increase fixed productive investment; promoting the rice growers to increase productive capital input.

First, raising the minimum purchase price of rice. We should constantly improve the policies and measures for supporting agriculture, to enhance the confidence of rice growers in planting; accelerate the cultivation of "core grain growers". In terms of grain growing cost accounting, we should fully take into account the opportunity cost of labor of the peasant households, scientifically set the minimum grain purchase prices, give full consideration to commodity price and other factors, and gradually raise the minimum grain purchase price.

Second, scaling up rice growing. On the premise of respecting the wishes of farmers, we should encourage rice growers to transfer land, and achieve the optimal allocation of land resources, forming moderate scale cultivation.

Third, making every effort to promote the educational level of rice growers. We should popularize compulsory education in rural areas; strengthen adult literacy education in rural areas; run the evening classes for farmers, to gradually reduce the proportion of illiterate and semi-literate farmers; focus on the promotion of high school education in rural areas; extend free compulsory education to rural vocational education as soon as possible; through short-term training, science and technology seminars, correspondence, *etc.*, use various media to improve farmers' agricultural production skills and transfer employment skills; make great efforts to train all kinds of skilled personnel to adapt to modern agricultural requirements.

Fourth, ensuring that the rice growers obtain productive capital input loans timely. We should improve the rural financial service system to promote the modernization of rice production; accelerate the development of new rural financial institutions, and vigorously develop micro-credit and micro-finance services; explore the establishment rural credit guarantee mechanism supported by the government, involving many parties, and simplify multi-household joint guarantee application procedure.

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3 Conclusions

To begin with, financial support for agriculture can help to establish rural public goods, effectively solve the problem of market failure, and form effective public goods system, to promote increase of farmers' income. Government constantly increasing investment in rural public goods can bring farmers' individual capital investment match the high-efficient agricultural production system and effectively increase farmers' income.

Next, the regression results show that support in agricultural production, various agricultural operating expenditure and three types of costs for agricultural science and technology are favorable to farmers' income, while expenditure in agricultural capital construction and rural relief costs hinder increase of farmers' income. This seems being in violation of general understanding, but it is determined by actual conditions of agriculture in China, so currently the structure of financial support for agriculture is unreasonable.

Besides, financial support for agriculture is a basic tool of the state adjusting and controlling agricultural production and influencing farmers' income. Rural financial funds are reliable guarantee for increasing farmers' income. Amount and structure of rural financial funds become restraining factors of farmers' income. The insufficient total amount greatly restricts growth speed of farmers' income.

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