An Empirical Analysis of the Relationship Between Fiscal Expenditure on Agriculture and Agricultural Economic Growth

Yan Zhang
School of Leisure Management, Xi’an Eurasia University, Xi’an 710065, Shaanxi, China

Abstract
This author makes an empirical analysis of the relationship between fiscal expenditure on agriculture and agricultural economic growth. The results show that there is not only a long-term stable equilibrium relationship between the expenditure of financial support for agriculture, the employment of the first industry, the investment of agricultural fixed assets and the total output value of agriculture, but also the financial support for agriculture is the Granger reason for the growth of the total output value of agricultural output, and the financial support expenditure has a positive impact on the total agricultural output.

Key words: Fiscal Expenditure on Agriculture, Agricultural Economic Growth, VAR Model

1. Introduction
Agriculture is the basic industry of the national economy, with long production cycle, high risk and low return on investment. Its characteristics determine that the development of agriculture needs the investment of multi-channel funds. Governments usually regard public expenditure policy as the main means of regulation to protect agriculture and protect farmers’ interests. In recent years, with the development of China’s industrialization, the economic development has entered a new stage. The Chinese government attaches great importance to the “three rural issues (namely, agriculture, rural areas and farmers)” and gradually increases its investment in agriculture. Therefore, it is of great significance to study the relationship between agricultural expenditure on agricultural support and agricultural economic growth, realize the coordinated development between the two, and maximize the government’s financial support for agricultural development.

Whether fiscal policy has achieved the expected goal, the contribution of fiscal expenditure to economic growth has always been a concern of governments and academia. Many scholars have done a lot of research on the relationship between fiscal expenditure and economic growth. As early as 1970, Arrow and Kurz applied endogenous growth model to make a theoretical study on the relationship between fiscal expenditure and economic growth. Some scholars used the Keynes growth model to analyze the impact of fiscal policy on the macro economy [1]. Others adopted different methods to do empirical research on the relationship between fiscal expenditure and economic growth in different regions. Some used the extended Solow model to study the role of government expenditure and fiscal policy on economic growth in 13 Asian countries [2]. Others utilized the generalized moment estimation method to study the influence of government expenditure on the sample of developing countries [3]. Still Others used the panel vector auto regression (PVAR) to study the effect of tax and expenditure on the growth of national income [4]. And some used regression analysis to analyze the impact of democracy on fiscal and monetary policies in Nigeria [5]. Based on the Greek economy from 1960 to 2014, others explored the effect of the government expenditure multiplier on economic growth by using autoregressive distribution lag method (ARDL) [6]. Still others adopted the error correction model (ECM) to analyze the effect of fiscal policy on economic growth from 1970 to 2014 in Nigeria [7]. Some scholars used multiple regression method and bootstrap mediating effect test analysis to explore the mechanism of influence of relationship learning on channel assets [8]. Some scholars applied the newly developed bootstrap ARDL method and found that there exist cointegration relationships among economic growth, income inequality and life insurance consumption [9]. The conclusions are different because of the research methods, the samples and the selection periods, and the interaction between fiscal expenditure and economic growth is the mainstream view. In addition, a considerable number of scholars studied the impact of the scale and structure of fiscal expenditure on economic growth. Through a long term study on the relationship between agricultural economic growth and financial investment, some scholars found that financial investment into the field of agriculture is more competitive in other fields. Others introduced the gradient method to adjust the component portion of the Japanese local government financial expenditure to achieve the highest economic growth rate [10]. Still others used vector error correction model to test the causality of production and protection expenditure and real GDP in Nigeria from 1979 to 2012 [11]. And some scholars used the ARDL method to assess the long-term and short-term dynamics of the public expenditure composition and economic growth in Pakistan [12].
Through combing the relevant literature, it can be seen that the existing research focuses on the relationship between fiscal expenditure and economic growth. There are few studies on agricultural expenditure and agricultural economic growth. Most of the research focuses on the economic performance of financial support for agriculture, which is based on theoretical analysis. The innovation of this paper lies in the reference of research method for financial expenditure and economic growth to study the relationship between the expenditure of financial support and the growth of agricultural economy, and taking an example of an area as an example. Based on the improved Cobb Douglas production function (C-D production function) as the basic framework, this author used Johansen cointegration test to study the relationship between financial support expenditure and agricultural economic growth, and applied such dynamic econometric methods as impulse response function and Granger causality test to respectively study the interaction between different factors, in order to provide theoretical basis and practical reference for the government and relevant departments to formulate agricultural support policies.

2. The Construction Model and The Econometric Method

2.1. The Construction Model

The existing research shows that the economic growth in China is more in line with the AK type growth theory since the reform and opening up. Cobb Douglas production function is used to calculate the impact of input factors on economic growth. Barro (1990) took the government public capital stock as explanatory variable into the model, and regarded it as one of the factors that affect economic growth. Based on the Barro model, this author introduced the fiscal expenditure on agriculture into the production function and constructed the expanded C-D production function. The details are as follows.

\[ Y = AK^\alpha L^\beta G^\gamma \]  

(1)

In order to reduce the fluctuation and eliminate the heteroscedasticity of the data, the logarithm of the upper two sides is obtained.

\[ \ln Y = \ln A + \alpha \ln K + \beta \ln L + \gamma \ln G \]  

(2)

In which, \( Y \) stands for the total agricultural output value; \( K \) is for the investment in agricultural fixed assets; \( L \) for the input of agricultural labor; \( G \) for the fund of financial support for agriculture; and \( \alpha, \beta \) and \( \gamma \) for the contribution of agricultural capital, agricultural labor force and financial support to agricultural output value.

2.2. The Econometric Method

VAR econometric models are often used to analyze the relationship between economic variables. In VAR model, each endogenous variable in the system is regarded as the function of the lagging value of all endogenous variables in the system to construct the model, which is usually used to predict the interrelated time series system and to analyze the dynamic impact of random disturbance on the variable system, thus to explain the effects of various economic shocks on the formation of the economic variables. VAR model avoids the single equation econometric model which cannot describe the interaction between variables, and promotes the dynamic analysis of the economic system. The analysis method of VAR model includes a series of steps, such as the stability test of the data, the Johansen cointegration test, the selection of the optimal stagnation, the impulse response analysis and the Granger causality test.

Most of the time series take on random trend, that is, the data may be a non-stationary time series data. If it is not tested by mathematical methods and stationed smoothly, it will be directly returned by non-stationary variables, the results of the analysis are “pseudo regression” to a large extent, and the economic conclusion with deviations is obtained. In order to avoid “pseudo regression”, it is necessary to test the stability of the time series variables, the ADF unit root test is usually used before estimating the model.

The economic significance of cointegration lies in the fact that there is a long-term stable equilibrium relationship among variables. The purpose of cointegration test is to determine whether a linear combination of a series of non-stationary sequences has a stable equilibrium relationship. Cointegration test can be divided into two categories: one is the cointegration test based on regression coefficient, such as Johansen cointegration test. The other is the cointegration test based on regression residuals, such as the E-G two step method. In this paper, Johansen cointegration test is used because it is a multivariate cointegration analysis. The Johansen cointegration test was proposed by Johansenhe and Juselius in 1990. The basic idea is that if two or more variables are not stationary, but their same order difference is stationary, then these nonstationary time series have a long-term cointegration relationship.

Impulse response function describes the response of an endogenous variable to a unit change impact from another endogenous variable, reflecting the influence of a standard difference impact on the current and future
values of the endogenous variable from the random perturbation and the path change of its influence, which can be used as the time domain description of the system characteristics.

Cointegration test only checks whether there is a long-term equilibrium relationship between variables, but whether there is a causal relationship between variables, the Granger causality test also needs to be carried out. The idea of Granger causality test is that if the past value of variable $x$ is helpful to the current value of predictive variable $y$, that is, when the past values of $y$ are returned to the current value of $y$, if the past values of $x$ are added together, the regression equation can be significantly enhanced, which is called $x$ is the reason for Granger of $y$, otherwise $x$ is not the reason for Granger of $y$.

3. Results

This author takes area A as an example to study the relationship between fiscal expenditure on agriculture and agricultural economic growth. Area A is an important province in Western China. Its total value added in agriculture accounts for about 2% of China’s total. In recent years, its total expenditure on agriculture has been on the rise with the significant increasing of economic strength in area A. The area is a typical representative of the backward economy. It is chosen as the object of analysis because it is a good representation for the study of how to develop agriculture by optimizing the expenditure of financial support for agriculture in the backward areas.

3.1. The Sample Data

The gross output value of agriculture in area A reflects the development level ($Y$) of agricultural economy in A area. The labor input of the first industry labor force in area A is expressed as labor input ($L$); the capital input is expressed by the fixed assets investment ($K$) of the farmers in area A; the expenditure for agriculture is expressed by the government supporting the agricultural expenditure ($G$) in area A. In order to reduce the phenomenon of heteroscedasticity, the trend of variables can be linearized as far as possible. The logarithms of $Y$, $L$, $K$ and $G$ are taken, they are expressed as $\ln Y$, $\ln L$, $\ln K$ and $\ln G$.

In this paper, such data are selected as the total output value of agricultural output, the number of labor force of the first industry, the investment of fixed assets of farmers and the expenditure of agricultural and forestry water from 1997 to 2016 in area A, which are derived from The Statistical Yearbook of the Area A. All of the analysis is done with Eviews7.0 in this paper.

3.2. The Test of Stability

The stationarity of four variables of the time series $\ln Y$, $\ln L$, $\ln K$ and $\ln G$ are tested, that is, ADF test, and the results are shown in the following table.

<p>| Table 1. The results of adf unit root test |
|-------------------------------|---------------------|---------------------|-------------------|---------------------|---------------------|</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>Test form(c, t, n)</th>
<th>ADF statistic</th>
<th>Critical value(5%)</th>
<th>P value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln Y$</td>
<td>(c, 0, 0)</td>
<td>-2.21</td>
<td>-3.67</td>
<td>0.46</td>
<td>Unstable</td>
</tr>
<tr>
<td>$\Delta(\ln Y)$</td>
<td>(c, 0, 0)</td>
<td>-3.04</td>
<td>-2.88</td>
<td>0.04</td>
<td>Stable</td>
</tr>
<tr>
<td>$\ln L$</td>
<td>(c, 0, 1)</td>
<td>-2.11</td>
<td>-3.69</td>
<td>0.50</td>
<td>Unstable</td>
</tr>
<tr>
<td>$\Delta(\ln L)$</td>
<td>(c, 0, 0)</td>
<td>-3.04</td>
<td>-2.73</td>
<td>0.02</td>
<td>Stable</td>
</tr>
<tr>
<td>$\ln K$</td>
<td>(c, 0, 0)</td>
<td>-1.94</td>
<td>-3.67</td>
<td>0.59</td>
<td>Unstable</td>
</tr>
<tr>
<td>$\Delta(\ln K)$</td>
<td>(c, 0, 0)</td>
<td>-3.97</td>
<td>-3.04</td>
<td>0.01</td>
<td>Stable</td>
</tr>
<tr>
<td>$\ln G$</td>
<td>(c, 0, 0)</td>
<td>-3.08</td>
<td>-3.67</td>
<td>0.14</td>
<td>Unstable</td>
</tr>
<tr>
<td>$\Delta(\ln G)$</td>
<td>(c, 0, 0)</td>
<td>-6.76</td>
<td>-3.04</td>
<td>0.00</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Notes: $D$ represents first order difference; $C$ is constant; $t$ is trend; $n$ is lagging order; critical value is 5% significant level; lag period is determined by AIC and SC criterion.

It can be seen from Table 1 that the ADF statistics of variables $\ln Y$, $\ln L$, $\ln K$ and $\ln G$ are all larger than the critical values and are unstable, and their ADF statistics of the first order difference sequence are all smaller than the critical values, all of which are stable, that is, they are all first order and consistent with the precondition of subsequent inspection.
3.3. Johansen Cointegration Test

In order to analyze whether there is a long-term stable relationship between fiscal expenditure on agriculture and agricultural economic growth, Johansen cointegration test is needed. According to AIC and SC information criterion, the best lag period is 1. In the Johansen cointegration test, the form is selected which has linear trend and the cointegration equation with only intercept. The results are as follows.

Table 2. The results of Johansen cointegration test

<table>
<thead>
<tr>
<th>Original hypothesis</th>
<th>Eigenvalue</th>
<th>Trace statistics</th>
<th>5% critical value</th>
<th>P value</th>
<th>Maximal eigenvalue statistic</th>
<th>5% critical value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No one</td>
<td>0.77</td>
<td>57.65</td>
<td>47.86</td>
<td>0.00</td>
<td>27.58</td>
<td>26.88</td>
<td>0.04</td>
</tr>
<tr>
<td>Up to 1</td>
<td>0.61</td>
<td>29.80</td>
<td>30.76</td>
<td>0.06</td>
<td>10.03</td>
<td>21.13</td>
<td>0.07</td>
</tr>
<tr>
<td>Up to 2</td>
<td>0.52</td>
<td>13.73</td>
<td>15.49</td>
<td>0.09</td>
<td>13.34</td>
<td>14.26</td>
<td>0.07</td>
</tr>
<tr>
<td>Up to 3</td>
<td>0.02</td>
<td>0.39</td>
<td>3.84</td>
<td>0.53</td>
<td>0.39</td>
<td>3.84</td>
<td>0.53</td>
</tr>
</tbody>
</table>

It can be seen from Table 2 that, regardless of the eigenvalue trace test or the maximum eigenvalue test, the results show that there is a cointegration equation between the variables \( Y \), \( L \), \( K \), and \( G \), at a significant level of 5%, that is, there is a stable equilibrium relationship between the total agricultural output value, the employment of the first industry, the investment in agricultural fixed assets and the expenditure on the financial support for agriculture from 1997 to 2016 in area A. Its standardized cointegration equation is as follows:

\[
\ln Y = 9.22 \ln L + 2.13 \ln K + 0.34 \ln G
\]  

(3)

From the cointegration equation, it can be seen that the regression coefficient 9.22 is the elastic coefficient of the gross agricultural product to the employment of the first industry, that is, the number of workers employed in the first industry increases by 1 percentage points, the gross agricultural product rises by 9.22 percentage points. The regression coefficient 2.13 is the elastic coefficient of agricultural fixed assets investment, that is, the investment of agricultural fixed assets increases by 1 percentage points, and the gross agricultural product rises by 2.13 percentage points. The regression coefficient 0.34 is the elastic coefficient of the gross agricultural product to the expenditure of financial support for agriculture, that is, the expenditure of financial support to agriculture increases by 1 percentage points, and the gross agricultural product rises by 0.34 percentage points.

3.4. Impulse Response Analysis

According to the optimal lag criterion, the optimal lag order of VAR model is 1. In the case of the lag order is 1, the residual of VAR(1) model is tested. The results show that the residual error satisfies the no autocorrelation and normal distribution, and the reciprocal of all the units in VAR model is less than 1, which indicates that VAR(1) model is stable, so the impulse response analysis of VAR(1) model can be used.

On the basis of VAR(1), the impulse response function is used to analyze the response form of gross agricultural product to the impact of fiscal expenditure on agriculture and the impact degree and the time lag. The impulse response function of gross agricultural product can be obtained from the impact of fiscal expenditure on agriculture (see Figure 1). In which, the transverse axis indicates the number of lag periods of the impact, the longitudinal axis indicates the response size of variable \( \ln Y \) to variable \( \ln Y \), the solid line represents the curve of the impulse response function, and the two dotted lines represent the confidence band of the two times the standard deviation.

Figure 1 shows the impulse response function of gross agricultural product after the impact of fiscal expenditure on agriculture. From Figure 1, it can be seen that fiscal expenditure on agriculture has a positive impact on gross agricultural product, but the degree of impact varies from time to time. In the beginning, the impact is smaller, the impulse response value of the first stage is almost 0, that is, the positive impact of the first year financial support to agriculture 1%, the increase in agricultural output value is small, until there is a large increase in the second year. With the passage of time, this positive trend gradually increases to the maximum in the fifth period, then basically maintains at this level. It can be seen that the impact of fiscal expenditure on agriculture is smaller in the short run, but it will produce significant results in the long run.
3.5. Granger Causality Test

From the results of Johansen cointegration test, it can be seen that there is a long-term equilibrium relationship between the gross agricultural product and the employment personnel of the first industry, the investment in fixed assets of agriculture and the expenditure of financial support for agriculture, but the short-term causality of this long-term equilibrium needs further verification. Granger causality test is used to test the causal direction of the two variables to examine whether the variables are leading or lagging in time. The application of Granger causality test is that the tested variables are stationary or cointegration. From the previous analysis, it can be seen that the first order difference sequence of variables is stable, which satisfies the condition of Granger causality test. The test result of Granger causality test is related to the choice of lag length. According to the AIC and SC information criteria, the optimal lag time is determined by 1, and the result of Granger causality test is shown in Table 3.

<table>
<thead>
<tr>
<th>Zero hypothesis</th>
<th>F value</th>
<th>P value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnL is not the Granger cause of lnY</td>
<td>6.99</td>
<td>0.03</td>
<td>Rejection</td>
</tr>
<tr>
<td>lnK is not the Granger cause of lnY</td>
<td>2.07</td>
<td>0.35</td>
<td>Reception</td>
</tr>
<tr>
<td>lnG is not the Granger cause of lnY</td>
<td>11.26</td>
<td>0.00</td>
<td>Rejection</td>
</tr>
<tr>
<td>lnY is not the Granger cause of lnL</td>
<td>0.10</td>
<td>0.95</td>
<td>Reception</td>
</tr>
<tr>
<td>lnY is not the Granger cause of lnK</td>
<td>7.32</td>
<td>0.02</td>
<td>Rejection</td>
</tr>
<tr>
<td>lnY is not the Granger cause of lnG</td>
<td>1.36</td>
<td>0.51</td>
<td>Reception</td>
</tr>
</tbody>
</table>

From table 3, it can be seen that in the confidence level of 5% and the optimal lag period, lnL and lnG are the Granger causes of lnY, and lnK is not the Granger cause of lnY, that is, the number of employment in the first industry and the expenditure of financial support to agriculture are the causes of the change in the gross agricultural product. lnY is not the Granger cause of lnL and lnG, but the Granger cause of lnK, that is, the gross agricultural product is not the cause of the change in the number of employment in the first industry and the change of the expenditure of the financial supporting agriculture.

4. Conclusions

Based on the statistical data from 1997 to 2016 in area A, the dynamic relationship between financial support expenditure and agricultural economic growth is empirically studied by cointegration test, impulse response analysis and Granger causality test. The following conclusions are drawn. Firstly, from the cointegration relationship, there is only a cointegration relationship between the gross agricultural product and the employment personnel of the first industry, the investment in fixed assets of agriculture and the expenditure of financial support for agriculture, that is, the long-term role of the financial support for agriculture, the employment of the first industry and the investment in agricultural fixed assets to the development of agriculture. From the cointegration equation, it can be drawn that every one percentage point of fiscal expenditure on agricultural support will increase the gross agricultural product by 0.34 percentage points. This shows that fiscal expenditure on agriculture in area A has a positive effect on the development of agriculture, but this effect is not significant.

Secondly, from the impulse response analysis, the positive impact of the financial support to agriculture in the current period has a small impact on the gross agricultural product. From the beginning of the second period, there is a significant increase, to the maximum in the fifth period, and then basically maintains at this level. This
shows that although fiscal expenditure on agriculture has a positive effect on gross agricultural product, it has a weaker effect and a longer impact. Impulse response analysis reflects the internal circulation transmission mechanism between agricultural economic growth and fiscal expenditure on agriculture from a dynamic perspective.

Thirdly, from the Granger causality test, there is a one-way causality between the expenditure of financial support for agriculture and the gross agricultural product, that is, the expenditure of financial support for agriculture is the Granger cause of the change in the gross agricultural product, and the gross agricultural product is not the Granger cause of the changes in the expenditure of financial support to agriculture. This means that fiscal expenditure on agriculture can effectively promote agricultural economic growth in the short term, but the long-term effect is not significant. On the contrary, the growth of agricultural economy often does not cause the increase of financial support for agriculture.

Therefore, based on the above conclusions, it can be obtained: first, the government should increase the investment in agriculture, establish and improve the stable growth mechanism of financial support for agriculture, and provide long-term stable fund support for agricultural development. Second, on the basis of ensuring the investment of agricultural finance, the government should strive to improve its wealth. The efficiency of the use of the funds of the government and supporting agriculture should be used to improve the output efficiency of the financial support for agriculture. Third, in the formulation of agricultural support policies, the government should fully consider the relationship between the expenditure of financial support for agriculture and the development of agriculture, so as to achieve a benign cycle of interaction between the two. Fourth, the government should pay attention to the implementation of the long-term policy and short-term policy to support the development of agricultural economy, while perfecting the long-term policy and supplementing the short-term policy to stimulate the development of agricultural economy.

Acknowledgements

This work was supported by 2018 special scientific research project of Shaanxi province department of education “Research on the Way of Shaanxi Economic Growth from the Perspective of Supply-side Structure Reform”(Number: 18JK1060).

References