The Impact of Private Investment in Public Expenditure on Economic Growth in Jiangxi Province—Empirical Analysis Based on State Space Model and SVAR Model

Yong-bing YANG* and Meng-shi DING
School of Economics and Management, East China Jiaotong University
*Corresponding author

**Keywords**: Public spending, Private investment, Economic growth.

**Abstract.** In order to study the impact of public spending on private investment and its role in economic growth in Jiangxi Province, the article first analyzes the relationship between them theoretically, then analyzes the effect of public expenditure on private investment in Jiangxi Province by constructing state space model, and then tests the dynamic of public expenditure through private investment on economic growth by constructing SVAR model. Finally, according to the above research results and the situation of Jiangxi province, it is suggested to improve the public expenditure in Jiangxi Province from three aspects: innovating investment and financing mode, introducing competition mechanism and lowering the threshold of state-owned monopoly industries.

**Introduction**

Economic growth is the theme of economics. One of the most important functions of our government functions is to promote the socialist economic construction. Therefore, our government’s public service and economic growth are inextricably linked. Since the reform and opening up, China has vigorously built a socialist market economy with Chinese characteristics and the drawbacks of a market economy have required the government to play a macro-regulatory role of "visible hand". And government spending is the government's most important tool for macro-control. In particular, public investment spending, both for the main micro-economy and the macro-economy as a whole are of great significance.

The academic community has always been debated about the relationship between public spending and private investment. One view is that public spending is squeezed into private investment (Chen Langnan and Yang Zihui, 2007[1]; Wei Xiangjie, 2015). Another view is that public spending squeezes out private investment (Fang Yingfeng, Tong Guangrong, Zou Wei, 2015[2] and Lu Jiafei, 2010[3]).

In addition, many scholars also discussed the relationship between public expenditure and economic growth. One view is that public spending is an impediment to economic growth (Zhuangzi Yin and Zou Wei, 2003[4]). Another view is that public spending has a significant positive effect (Liu Jin, 2004[5]).

**Theoretical Analysis**

It is assumed that the economic society is a generational overlapping and composed of innumerable homogenous people, while each is rational and has only two periods, young and old. Therefore, we can obtain the individual's consumption constraint in the young period (t) and the old period (t + 1), respectively:

\[ t \text{ period: } c_t = w_t - s_t - tax_t \]  
\[ t + 1 \text{ period: } c_{t+1} = s_t(1 + r_{t+1}) \]
Suppose the personal utility function is:

$$U = a(e_1, e_2, \ldots, e_t) \ln e_\mu + \sum_{j=1}^{p} \ln e_\mu + \frac{1}{1+p} (\ln c_{t+1} + \sum_{j=1}^{p} \ln e_{\mu+1})$$

(3)

$$e_j \geq 0 \quad (j = 1, 2, \ldots, i)$$

$$\frac{\partial U}{\partial e_i} \leq 0 \text{ or } e_i \geq 0, \quad j = 1, 2, \ldots, i$$

Suppose the current production element is the current investment, then the production function can be expressed as:

$$y_t = f(i_t, r_t, y_{t-1}) = i_t^\alpha i_{r_t}^\beta, \quad \alpha, \beta > 0, \alpha + \beta < 1$$

(4)

Assuming that government spending on public services is maintained by taxes, its financial constraints are:

$$tax_t = i_{r_t} + \sum_{j=1}^{p} e_{\gamma}$$

(5)

we can derive from (1)(2)(3):

$$\frac{\partial y_t}{\partial i_t} = \frac{\delta}{1 - \delta \alpha (1 - \beta)} i_t^{\alpha - 1} i_{r_t}^\beta + \frac{\delta (1 - \alpha - \beta)}{\alpha} i_t^{\alpha - 1} i_{r_t}^\beta$$

(6)

From (6) we can see that public investment comes from people's tax revenue, thus reducing private investment, resulting in "crowding-out effect". If public investment increases the operational efficiency of private investment, it will produce "crowding-in effect".

From the above analysis we can see that the theory can not exactly know the kind of affection applied to the situation in Jiangxi Province, so the article will empirically verify the actual situation in Jiangxi Province.

The Dynamic Impact of Public Expenditure on Private Investment in Jiangxi Provinces

Data Description

In order to study the contribution of the scale of public service expenditures in Jiangxi Province to economic growth, empirical studies have selected the historical GDP, public expenditures and private investment of Jiangxi Province from the Statistical Yearbook of Jiangxi Province from 1978 to 2015 as the research data.

In addition, in order to eliminate the impact of price changes, we calculate the annual GDP deflator based on 1978, and then divide each data item by the year's GDP deflator to convert it into base period actual data. Empirical tests used in the article are using Eviews8.0 software.

Model Settings

In fact, with the impact of the economic environment and policy environment, the economic structure of our country is gradually changing, and the usual fixed parameter model can not reflect this change. Therefore, we need to consider adopting a variable parameter model. The use of state space model can be constructed variable parameter model:

$$y_t = \mathbf{x}_t' \beta_t + \mathbf{w}_t' \gamma + \mu_t, \quad t = 1, 2, \ldots, T$$

(7)
Which is changing over time, reflecting the explanatory variables on the dependent variable changes in the relationship, assuming variable parameters AR (1) Description:

$$\beta_t = \psi \beta_{t-1} + \epsilon_t$$  \hspace{1cm} (8)

It can also be extended to the AR (p) model, and it is assumed that:

$$(\mu_t, \epsilon_t) \sim N \begin{bmatrix} 0 \\ \begin{bmatrix} \sigma^2 \\ \mathbf{g} \\ \mathbf{Q} \end{bmatrix} \end{bmatrix}, t = 1, 2, ..., T$$  \hspace{1cm} (9)

The variable parameter model is obviously a form of state space model. Among them, $\beta_t$ are unobservable variables and must be estimated using observable variables $x_t, y_t$. The measurement matrix $Z_t = x_t$ is an explanatory variable matrix with variable parameters. $w_t$ is a vector of explanatory variables with fixed parameters and $Y$ is a fixed parameter vector. $\mu_t, \epsilon_t$ is not necessary to be independent of each other, Which obeys the mean of 0 and the covariance matrix of variance is $\sigma^2$, and $\text{cov}(\mu_t, \epsilon_t) = \mathbf{g}$.

Since the impact of government public expenditure on private investment is a dynamic process, the regression coefficient of the variable of public expenditure scale is a variable parameter. Therefore, referring to the variable parameter model, the effect of public expenditure on private investment can be expressed as:

Measurement equation : $PV_t = \beta_0 + \beta_1 G_t + \mu_t$

State equation : $\beta_t = \psi \beta_{t-1} + \epsilon_t$  \hspace{1cm} (10)

| Year | Parameter estimation | Year | Parameter estimation | Year | Parameter estimation |
|------|----------------------|------|----------------------|------|----------------------|
| 1978 | 4.313648212          | 1991 | 3.970109986          | 2004 | 3.832500903          |
| 1979 | 4.209645602          | 1992 | 3.9074622           | 2005 | 3.928438453          |
| 1980 | 4.522783663          | 1993 | 3.89894594          | 2006 | 3.99348822          |
| 1981 | 4.78852036           | 1994 | 3.941495213         | 2007 | 3.978254799          |
| 1982 | 4.995420838          | 1995 | 3.970637839         | 2008 | 3.931583084          |
| 1983 | 5.095468471          | 1996 | 3.994666336         | 2009 | 3.891876906          |
| 1984 | 5.033459271          | 1997 | 3.970736007         | 2010 | 3.886992147          |
| 1985 | 4.773796025          | 1998 | 3.93391331          | 2011 | 3.791329815          |
| 1986 | 4.463912749          | 1999 | 3.827233248         | 2012 | 3.755690089          |
| 1987 | 4.316427477          | 2000 | 3.745922606         | 2013 | 3.766909355          |
| 1988 | 4.2638501            | 2001 | 3.592978477         | 2014 | 3.81926196          |
| 1989 | 4.150150943          | 2002 | 3.525672662         | 2015 | 3.869761274          |
| 1990 | 4.071477922          | 2003 | 3.660350072         |

In the model, private investment $PV$ is the explanatory variable, public expenditure $G$ is an explanatory variable matrix of observable time-varying parameters, and $\beta_t$ is unobservable
variable. \( \mu_t, \epsilon_t \) is independent random perturbation term and follows the normal distribution with mean 0 and variance \( \sigma_{\mu}^2, \sigma_{\epsilon}^2 \).

**Model Estimation**

Table 1 shows the result of model estimation:

From Table 1, it can be seen that public expenditure in Jiangxi province promoted private investment during 1978-2015. In 1978-1990, the promotion effect of public expenditure on private investment fluctuated greatly, with the highest point reaching 5.095468471 in 1983. After 1983, the effect of government public expenditure on private investment has not changed much. At 3.75-4.0 between.

The Dynamic Impacts of Private Investment on Public Expenditure on Economic Growth in Four Jiangxi Provinces

**Data Stationarity Test**

When using SVAR models to analyze variables, the precondition is that the data must be stable. Therefore, the unit root test data first.

|                | 1% level | 5% level | 10% level | ADF test statistic | Prob.* | Is it steady? |
|----------------|----------|----------|-----------|-------------------|--------|--------------|
| lnGDP          | -3.639407| -2.951125| -2.6143   | 1.018754          | 0.9959 | no           |
| I(1)           | -3.639407| -2.951125| -2.6143   | -2.592158         | 0.1044 | yes          |
| lnG            | -3.621023| -2.943427| -2.610263 | 3.030071          | 1      | no           |
| I(1)           | -3.626784| -2.945842| -2.611531 | -3.230356         | 0.0263 | yes          |
| lnPC           | -3.621023| -2.943427| -2.610263 | 2.330998          | 0.9999 | no           |
| I(1)           | -3.626784| -2.945842| -2.611531 | -4.741173         | 0.0005 | yes          |

As can be seen from the table 2, lnGDP, lnG, lnPV are all non-stationary, but there are first-order single integrations under the first-order difference of the sequences, i.e. lnGDP ~ I (1), lnG ~ I (1). So reject the null hypothesis that lnGDP, lnG, lnPV are all stationary sequences.

**SVAR Model Settings**

The SVAR model is set as follows:

\[
\begin{align*}
\text{x}_t &= b_{10} + b_{11} y_{t-1} + b_{12} z_{t-1} + \gamma_{11} x_{t-1} + \gamma_{12} y_{t-1} + \gamma_{13} z_{t-1} + \lambda_{11} x_{t-2} + \lambda_{12} y_{t-2} + \lambda_{13} z_{t-2} + \mu_{t-1} \\
\text{y}_t &= b_{20} + b_{21} x_{t-1} + b_{22} z_{t-1} + \gamma_{21} x_{t-1} + \gamma_{22} y_{t-1} + \gamma_{23} z_{t-1} + \lambda_{21} x_{t-2} + \lambda_{22} y_{t-2} + \lambda_{23} z_{t-2} + \mu_{t-1} \\
\text{z}_t &= b_{30} + b_{31} x_{t-1} + b_{32} y_{t-1} + \gamma_{31} x_{t-1} + \gamma_{32} y_{t-1} + \gamma_{33} z_{t-1} + \lambda_{31} x_{t-2} + \lambda_{32} y_{t-2} + \lambda_{33} z_{t-2} + \mu_{t-1} \\
t &= 1, 2, \ldots, T
\end{align*}
\]

(11)

It can be seen from the SVAR model that although the SVAR model shows that although \( \mu_{t-1}, \mu_{t-2}, \mu_{t-3} \) is only a random shock acting on \( x_t, y_t, z_t \), if \((b_{21}, b_{31}), (b_{12}, b_{32}), (b_{13}, b_{33})\) all are (0,0), random shocks \( \mu_{t-1}, \mu_{t-2}, \mu_{t-3} \) acting on \( x_t, y_t, z_t \) can be passed the impact on these variables is transmitted immediately to the other two variables, resulting in indirect immediate effects. The interactive effect of this impact reflects the bi-directional and feedback relationship of the role of variables.
SVAR Model Recognition Conditions

The identification conditions set in this paper according to the economic theory in this empirical study are as follows: The expenditure on public services is not affected by the current real GDP; that is, the public expenditure is not affected by the current private investment, that is, the consumption of residents is not affected by the current private investment, which is. In this case, the estimated model after all the unknown parameters obtained is as follows:

\[
\tilde{B}_t e_t = \begin{bmatrix} 1 & 8.933273 & -6.818879 \\ -41.36955 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} e_{1t} = \begin{bmatrix} \mu_1(t) \\ e_{2t} \\ e_{3t} \end{bmatrix} \mu_{2t} \\
\mu_{3t} 
\]

Impulse Response and Variance Decomposition

The results of impulse response analysis show that: the positive impact of private investment in Jiangxi Province has a negative impact on economic growth; public service expenditure in Jiangxi Province has a long-term role in promoting private investment; and public service expenditure is mainly affected by its own policy factors.

Variance decomposition results show that: Public service expenditure can promote economic growth in the long run; Public service expenditure through influencing private investment and thus affecting the economic growth path exists; The scale of public service expenditure is basically only affected by its own policy factors.

\[\text{Figure 1. Impulse response analysis results.} \]

\[\text{Figure 2. Variance decomposition results.} \]

Recommendations

First, innovating investment and financing model. Break the existing monopoly of state-owned finance, innovate financing tools and financing products. For example: Jiangxi Province can learn from "Yu E Bao" financing model for Internet financing. Not only can private capital be brought together for economic development, but it also benefits savers.

Second, the introduction of competition mechanism. The Jiangxi provincial government can adopt a bidding approach to encourage state-owned enterprises and private enterprises to compete in many public utilities. Making efficiency the best way to determine the whereabouts of capital can
not only give full play to the productivity and creativity of private enterprises, but also be an incentive for state-owned enterprises.

Third, reducing the threshold of state-owned monopoly industries so that idle private capital can be converted into investment. For example, the construction of Nanchang Metro Line 1 and Line 2 has a total investment of about 27.424 billion yuan, of which 11.25 billion yuan is government-led investment while the remaining funds are mainly raised through finance, bonds and social funds. It can be seen that the mode of investment and financing is very single. As an improvement, Nanchang municipal government, on the one hand, identified investors through competitive bidding and bid-winning investors also chose builders, operators and maintainers through competitive tendering. This will maximize the efficiency of capital operation. On the other hand, due to the significant real estate appreciation brought by subway construction, the problem of shortage of funds can be solved by transforming the external benefits of rail transit into the benefits of rail transit enterprises and attracting the private sector investment both at home and abroad. This will not only reduce the burden on the government, but also make full use of private capital to promote economic growth.

References

[1] Lang-nan Chen, Zi-Hui Yang. Empirical Study on the Effect of Chinese Government Expenditure and Financing on Private Investment Crowding[J]. World Economy, 2007(1):49-59.

[2] Ying-feng Fang, Guang-Rong Tong, Wei Zou. Public Capital, Private Investment and Regional Poverty Trap[J]. Economic Review, 2015(5):70-83.

[3] Jia-fei Lu. Research on the Effect of Government Expenditure and Non-tax Financing on Private Investment—Based on China's Empirical Test (1981-2008)[J]. World Economic Review, 2010(11):55-62.

[4] Zi-yin Zhuang, Wei Zou. Can Public Expenditure Promote Economic Growth: An Empirical Analysis of China[J]. Management World, 2003(7):4-12.

[5] Jin Liu, Wei Ding, Liu Junmin. Analysis and empirical research on the relationship between public expenditure and economic growth[J]. Fiscal Studies, 2004(3):50-52.