

Research on the Correlation between Economic Growth and Inflation—An Empirical Analysis Based on VAR Model

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Abstract. Economic growth and inflation are two important issues that the government needs to consider when making macro policies. Therefore, it is necessary to clarify the relationship and interaction mechanism between the two. This paper uses the data of Xinjiang and Xinjiang from 1978 to 2020, and conducts an empirical study on the relationship between the two by establishing a VAR model. Through a series of analysis, it is found that the relationship between economic growth and inflation in Xinjiang has shown differences in the past 42 years. In the case of Xinjiang, there are alternating positive and negative effects of economic growth on inflation, but there is no significant effect of inflation on economic growth. Combining the empirical findings with the theoretical analysis, this paper argues that the Xinjiang government can help maintain market stability and good macroeconomic operation by strengthening the monitoring of economic development and improving the predictability and effectiveness of price level regulation.

Keywords: VAR model, inflation, economic growth, influence relationship.

1. Introduction

At present, the outbreak of the new crown epidemic and the Russian and Ukraine crisis has forced the global economy to be pressed for a suspension, which exacerbates inflation. The research on the relationship between economic growth and inflation has a long history. For the relationship between the two, different scholars hold different views. Some views believe that economic growth is caused by actual factors and has nothing to do with monetary factors, that is, fluctuations in inflation will not affect economic growth [1,2]. Some views believe that the interest rate will decline when the government adopts an expansion monetary policy, which will stimulate investment. The investment multiplication effect will cause the expansion of production scale, thereby increasing employment, and ultimately bringing the increase in total social output level, thereby achieving economic growth [3-5]. There are also opinions that in countries that implement a fixed exchange rate, inflation will not be conducive to the export of their own country, and speculative capital will often flow to foreign countries. If the government has strengthened the control of foreign exchange at this time, it will greatly discount economic operation efficiency due to excessive intervention, which hinders economic growth [6]. This article takes the macroeconomic growth as the starting point. Through empirical analysis, the dynamic relationship between inflation and economic growth in the background of different research in the past 42 years has effectively answered the correlation between the two macro variables. Proposal on the economic development of Xinjiang based on the empirical results [7].

2. Establishment of model

2.1 VAR model

The vector autoregressive model (ie VAR model) is an unstructured model presented in the form of simultaneous multi-equations, which is an extension of the AR model. The VAR model treats all variables as a vector, and then does its own regression of the lag term [8]. When the lag order is p , the mathematical expression of the model is:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{kt} \end{pmatrix} = \phi_1 \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \\ \vdots \\ y_{kt-1} \end{pmatrix} + \dots + \phi_p \begin{pmatrix} y_{1t-p} \\ y_{2t-p} \\ \vdots \\ y_{kt-p} \end{pmatrix} + H \begin{pmatrix} X_{1t} \\ X_{2t} \\ \vdots \\ X_{kt} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{kt} \end{pmatrix} \quad t = 1, 2, \dots, T \quad (1)$$

2.2 ADF unit root test

Time series stationary means that the statistical values of a set of series are independent of time and do not change with the passage of time. Therefore, if the time series y_t is tested to be a group of stationary series, its mean $E(y_t)$ and variance $\text{Var}(y_t)$ will not be affected by time, which is usually used as the assumption of mathematical models based on causality.

When using the VAR model, the time series must be smooth as a prerequisite, otherwise, the results are prone to invalid or pseudo-regression problems. Therefore, in this paper, the necessary unit root tests are performed on the time series when constructing the VAR model.

2.3 Granger causal test

In order to effectively avoid the occurrence of false correlation problems in the process of time series analysis, the Granger causality test is born. Its main function is to test whether there is a correlation between time series, which is the premise of whether the impulse function can be established.

At the same time, we must also be clear that the causal relationship of the Granger test is essentially a "prediction" relationship, rather than a literal cause and effect relationship, mainly used to judge whether a variable helps to better predict other related variables.

2.4 Impulse response

In the VAR model, the impulse response analysis is the impact effect of a variable on all other variables. It can be clearly seen from the figure that the response time and degree of the impacted variable to the change.

If the shock variable is tested as a stationary time series in the early stage, its response image to the change of the disturbance term should show fluctuations in the initial period, and then gradually return to stability as the number of time periods increases.

2.5 Variance decomposition

The variance decomposition process mainly analyzes the degree of explanation occupied by another variable to its fluctuation during the change of one variable. In the VAR model, according to the results of variance decomposition, we can analyze the contribution ratio of the changes of all variables to the impact of the target variable, and then obtain the importance of each variable relative to the target variable. Therefore, the application of variance decomposition is very important in VAR model.

2.6 Data interpretation and variable introduction

The main objective of this paper is to analyze the interrelationship between economic growth and inflation in Xinjiang region. According to the research theme, we mainly design two variables of economic growth rate and inflation rate in the VAR model. Among them, the GDP growth rate is used to reflect the economic growth rate, and (CPI-100)% is used to represent the inflation rate. The data is processed with the help of EViews 10 econometric analysis software.

In this paper, since we study the relationship between GDP growth rate (RGDP) and inflation rate (RCPI), that is, the binary relationship. Therefore, combined with the VAR model expansion mentioned above, we can construct a binary VAR model of RGDP and RCPI. Taking the VAR model with two variables lagging one period as an example, the general form of the VAR model is as follows:

$$\begin{pmatrix} RCPI_t \\ RGDP_t \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix} + \begin{pmatrix} a_{11}(L) & a_{12}(L) \\ a_{21}(L) & a_{22}(L) \end{pmatrix} \begin{pmatrix} RCPI_{t-1} \\ RGDP_{t-1} \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix} \tag{2}$$

It can also be expressed in two single equation form:

$$RCPI_t = c_1 + a_{11}(L) RCPI_{t-1} + a_{12}(L)RGDP_{t-1} + e_{1t} \tag{3}$$

$$RGDP_t = c_2 + a_{21}(L)RCPI_{t-1} + a_{22}(L)RGDP_{t-1} + e_{2t} \tag{4}$$

The equation form of the VAR model is obtained by combining the two equations.

3. Model Solving and Analysis.

3.1 Data stationarity test

We first perform a unit root test on the Xinjiang data from 1978 to 2020. From the test results, $RGDP_t$ is a stationary series, and $RCPI_t$ is a unit root process with an intercept term. Therefore, the first-order difference processing is performed on $RCPI_t$, and the differential postscript variable is $DRCPI$, and then the unit root test is performed on the new variable after difference, and it is found that it is a stationary sequence when there is no intercept term and no time trend term, that is, $RCPI_t$ obeys the I(1) process is a first-order difference stationary process, and the results are summarized in Table 1.

Table 1 Unit root test results

variable	t- statistic	1% threshold	5% threshold	10% threshold	P	result
RGDP	-3.594716	-4.205004	-3.526609	-3.194611	0.0430	smooth
RCPI	-2.505800	-3.605593	-2.936942	-2.606857	0.1217	Non-stationary
DRCPI	-6.012507	-2.625606	-1.949609	-1.611593	0.0000	smooth

3.2 Establish VAR model

Since $RGDP_t$ and $DRCPI_t$ are stationary time series, in order to meet the requirements of establishing a VAR model, this paper establishes a VAR model between the two variables of Xinjiang $RGDP$ and $DRCPI$. The content is as follows.

$$\begin{pmatrix} DRCPI_t \\ RGDP_t \end{pmatrix} = \begin{pmatrix} 0.035838 \\ 0.031929 \end{pmatrix} + \begin{pmatrix} -0.090609 & -0.198646 & -0.030040 & -0.228989 & 0.143485 & 0.065808 & -0.160497 & 0.863513 & 0.199509 & -1.317075 \\ -0.080822 & -0.070207 & 0.165217 & -0.037890 & -0.079518 & 0.587617 & 0.298598 & -0.094047 & -0.260675 & 0.126832 \end{pmatrix} \begin{pmatrix} DRCPI_{t-1} \\ DRCPI_{t-2} \\ DRCPI_{t-3} \\ DRCPI_{t-4} \\ DRCPI_{t-5} \\ RGDP_{t-1} \\ RGDP_{t-2} \\ RGDP_{t-3} \\ RGDP_{t-4} \\ RGDP_{t-5} \end{pmatrix} \tag{5}$$

3.3 Check the lag order of the model

The lag order of the model is tested, and the results are shown in Table 2. The AIC criterion confirms that the appropriate lag order of the VAR model is 5th order, and the SC criterion confirms that the best lag order of the VAR model is 1st order, and the judgment results of the two are inconsistent. Therefore, according to the judgment result of the LR criterion, that is, the optimal lag order is 5, the subsequent analysis will also be carried out based on VAR (5).

Table 2 Model lag order test results

Lag	L	LogL	LR	FPE	AIC	SC	HQ
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0	130.60 46	NA	1.41e- 06	-	-7.703522	-
1	137.87 07	13.21 109	1.16e- 06	7.794219	7.720072*	7.763702
2	139.23 69	2.318 310	1.37e- 06	7.992164	-7.379050	7.900614
3	145.11 41	9.261 041	1.23e- 06	7.832537	-7.311425	7.679952
4	153.40 80	12.06 392	9.62e- 07	7.946307	-7.390269	7.732688
5	160.81 65	9.877 949*	8.02e- 07*	8.206546	-7.415447	7.931893
6	163.44 14	3.181 768	9.05e- 07	8.413119*	-7.150717	8.077433*
7	164.08 94	0.706 936	1.17e- 06	8.329783	-6.766172	7.933063
8	166.80 71	2.635 333	1.36e- 06	8.126633	-6.507061	7.668879
				8.048917		7.530129

3.4 Stable test

The results of the stationarity test in the VAR (5) model are as follows in Figure 1:

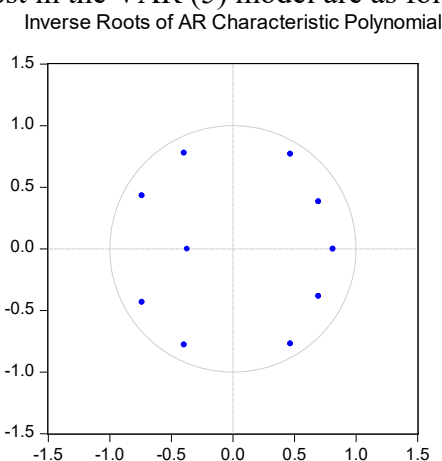


Figure 1 VAR (5) model stationarity test results

In this figure, a point that falls on the horizontal line indicates that it is a real number; a point that falls outside the horizontal line indicates that it is a complex number. It can be seen from the figure that the points all fall within the unit circle, indicating that the model is stable.

3.5 Granger causal test

According to the principle of Granger causality test, whether there is a Granger causality between CPI and GDPR is verified, and the test results are shown in Table 3.

Table 3 Granger causal test

Dependent variable: DRCPI			
Excluded	Chi-sq	df	Prob.
RGDP	23.60551	5	0.0003
All	23.60551	5	0.0003
Dependent variable: RGDP			
Excluded	Chi-sq	df	Prob.
DRCPI	6.271477	5	0.2807
All	6.271477	5	0.2807

It can be seen from Table 3 that at the 0.05 significance level, for the null hypothesis that RGDP cannot cause DRCPI by Granger, the P value is less than the significance level, and the null hypothesis is rejected. It is believed that for Xinjiang, the inflation after the first-order difference is affected by the previous economic growth. Even if the conditions are relaxed to the significance level of 0.1, for the null hypothesis that DRCPI cannot be caused by Granger to cause RGDP, the P value is always greater than the significance level, and the null hypothesis is accepted, and it is believed that Xinjiang's economic growth is not affected by one period of inflation lag.

3.6 Impulse response

As shown in Table 3, based on the results of the Granger causality test, it can be seen that only RGDP can significantly cause the Granger causality of DRCPI, so only the response of DRCPI to RGDP disturbance is analyzed in this section.

Response to Cholesky One S.D. (d.f. adjusted) Innovations

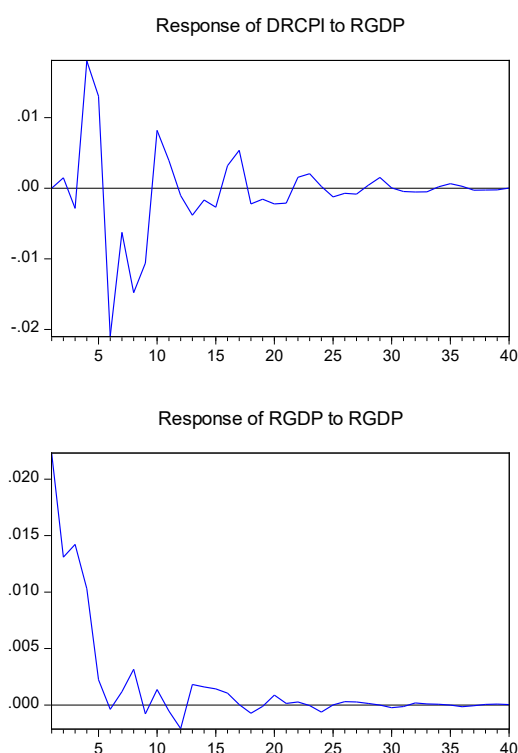


Figure 2 RGDP's pulse response diagram

Analyzing the impulse response plot of RGDP leads to the following conclusions:

(1) The positive shock response of DRCPI to the economic growth rate is almost zero in the current period, while it starts to respond positively to the inflation rate in the lag 2 period, and responds inversely to the inflation rate in the lag period 3. After that, the response of DRCPI to DGDP has been fluctuating between positive and negative, and it has returned to equilibrium in the middle and late stages. Among them, lag 4 and lag 6 have the biggest positive and negative responses to the positive impact of economic growth rate, respectively.

(2) RGDP is a positive shock to itself at the beginning, and the impact of RGDP on itself is occasionally negative at lag 6 and later, and almost always maintains a positive impact.

(3) It can be seen from the figure that the impulse response function curve of DRCPI to RGDP is constantly fluctuating around 0, which shows that Xinjiang's economic growth also has a positive and negative influence on inflation.

3.7 variance decomposition

Like the pulse response analysis, because only RGDP can significantly cause DRCPI, only the DRCPI variables need to be decomposed by the DRCPI variable. The result is shown in Figure 3.

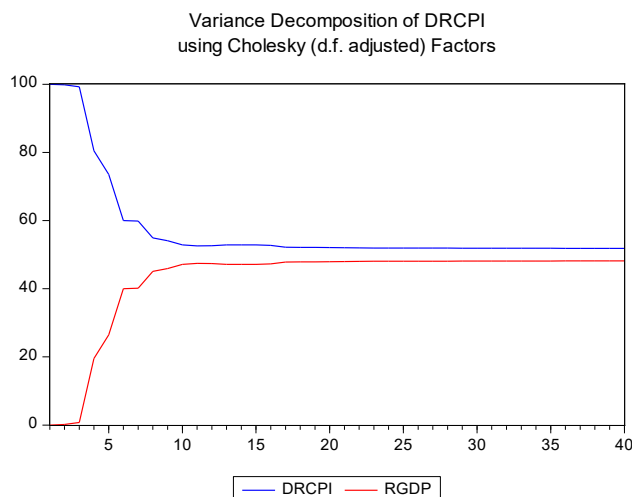


Figure 3 DRCPI variance decomposition diagram

The blue curve shows the proportion of its own reasons among the factors that cause the changes in DRCPI; similarly, the red curve explains the proportion of RGDP in the reasons for the changes in DRCPI. The following conclusions can be drawn from the variance decomposition of the DRCPI variables:

(1) The main reason for the change of price level comes from itself. Overall, the contribution of DRCPI itself is always greater than that of economic growth, and inflation reflects its own strong attributes.

(2) After comparing with Figure 5, it is found that compared with China, the contribution of economic growth to inflation fluctuations is more obvious in Xinjiang.

4. Conclusion

According to the previous analysis, it can be found that during the period from 1978 to 2020, as far as Xinjiang is concerned, the local economic growth did not significantly promote or promote inflation. The impact of inflation on economic growth is not significant.

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