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A Research on GDP Growth, Industrial Goods Export and FDI in Industrial Sector in Shandong Province

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ABSTRACT
This paper is to aim at analysing the relationship of Shandong GDP growth with industrial exports and FDI in industrial sector. Test results show that a 1 per cent increase in Shandong industrial goods export will lead to an increase in GDP growth by 0.84 per cent, and that a 1 per cent increase in FDI in industrial sector will lead to an increase in GDP growth by 0.13 per cent. Impulse responses function analysis shows that the response of GDP by impulse of Cholesky On 1 SD innovation of industrial goods export is much higher than that by FDI in industrial sector. The Granger Causality test results indicate that industrial goods export and FDI in industrial sector both help explain the GDP growth in Shandong province. So it is very important for government of Shandong to encourage the industrial goods export and attract the foreign direct investment in industrial sector to accelerate its GDP growth.
Keywords: *Shandong GDP growth, industrial goods export, FDI in industrial sector, Granger Causality test*

1. INTRODUCTION

Shandong province is the one of the very important economic powers in China with GDP reaching 7647 billion RMB in 2018. In this paper, analysis is conducted to find the forces behind the GDP growth in Shandong by focusing on industrial goods export and foreign investment in industrial sector. By using the VAR model we want to find the possible steady relationship among those variables in the long run.

2. LITERATURE REVIEW

The impact of foreign direct investment (FDI) on GDP growth is often discussed by the researchers. To assess the impact of FDI on GDP growth, panel data regression is used with pooled and fixed effect models. The study confirms that FDI promotes economic growth and policy implication to other Asian economies has been put forward [1]. Some other paper discussed the causation between FDI and economic growth of Russia for year 1995 to 2016. In the long run, the direction of causality between growth and FDI is in the direction from FDI to growth. Therefore, we can conclude that FDI benefits the Russian economy as a whole by boosting the GDP [2].
Studies also are focused on problems related to FDI in the North Central Area and South Central Coast of Vietnam in the period from 2000 to 2010. Both FDI and GDP also contributed significantly and positively in explaining each other in the provinces which was extremely difficult socio-economic conditions [3]. The impact of the factors of production on economic growth in Poland in the years 1992–2012 are studied with particular focus on the impact of FDI, and the results are to verify whether a causality relationship occurred between GDP and FDI [4].
The causal relationship between FDI and GDP in the frame of overall integration impact of CEE countries to EU are discussed by researchers on two homogenous sample groups of EU countries, 10 developed and 8 CEE developing ones. The final studies show that development policy must be focused on increasing the absorptive capabilities of these countries [5]. Some paper uses the bivariate VAR model and applies impulse response and variance decomposition method. The research show that FDI does have positive effect on China's economic growth, and policy recommendations on the introduction of foreign direct investment in the next stage of China are also made [6].
In this paper, the model and data are first explained, then the unit root test and cointegration test are conducted. The impulse response function analysis and Granger causality will be tested to find the relationship among the GDP growth, industrial goods export and FDI in industrial sector in Shandong province.

3. MODEL AND DATA

We know that the vector autoregression (VAR) model is very good at solving problems on the relevant time series prediction system and the dynamic impact of random disturbance on variables system. Here is the VAR model with only one lag as follows:

$$Y_t = \alpha + \Phi Y_{t-1} + \varepsilon_t, \ \varepsilon_t \sim IID(0,\Omega) \quad (1)$$

So Vector Moving Average (VMA) form is as follows:

$$Y_t = (I - \Phi)^{-1}\alpha + \sum_{i=0}^{\infty}\Phi^i\varepsilon_{t-i} \quad (2)$$

or in the matrix form as:

$$\begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \begin{pmatrix} 1-\phi_{22} & \phi_{12} \\ \phi_{21} & 1-\phi_{11} \end{pmatrix}\begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix} + \sum_{i=0}^{\infty}\begin{pmatrix} \varphi_{11}(i) & \varphi_{12}(i) \\ \varphi_{21}(i) & \varphi_{22}(i) \end{pmatrix}\begin{pmatrix} \varepsilon_{xt-i} \\ \varepsilon_{yt-1} \end{pmatrix} \quad (3)$$

The stationarity of the variable series can be tested to determine whether they are stationary sequences or not because the non-stationarity of the sequences might lead to a false causal relationship. If we find that the sequence is not a stationary one, it should be differenced one or more times to become stationary, and only then the following test can be accomplished.

A difference stationary series is said to be integrated and is denoted as I (d) where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. Therefore, it is important to check whether a series is stationary or not before using it in a regression.

In this paper, data are taken from the annual "Shandong Statistical Yearbook" and sample period is selected to include the years of 1995-2018. Model variables are classified into 3 groups including the Gross domestic product (GDP), Industrial goods export (IEX) and FDI in industrial sector (IFDI). Variables are in the form of the natural logarithm, i.e. LNGDP, LNIEX and LNIFDI.

4. TESTS AND DISCUSSION

4.1 Unit Root Test

Group unit root test in this section is used to test the variables' stationarity. The first null hypothesis is to assume there is a common unit root in level and the Levin, Lin & Chu Test shows that the probability is 0.1722 which is higher than the 0.10 statistical significance requirements. The second null hypothesis is to assume variables have individual unit root in level and three methods are all used to test the variables. The left two column of Table 1 indicates that the variables have unit root and they are not stationary in level.

Next the first-degree difference of the variables is tested to check the stationarity. The right two column of Table 1 shows the results by adopting the same methods as in level. As Table 1 indicates that the variables in 1st difference both in group and individual form do not have any unit root and all the variables in 1st difference are stationary because the probabilities are far less than the 0.01 significance requirement.

4.2. Cointegration Test

Since all variable of LNGDP, LNIEX and LNIFID meet the I(1) first-order stationary conditions，we can use the cointegration method to test the possible relationship of the variables. This study is based on the VAR model proposed and developed by Johansen and Juselius [7]. We use the Trace statistics test to do the research and the test results indicates there is one conintegration equation exiting at the 0.05 level. Cointegration test results are as shown in Table 2.

So the representations of the coefficients of VAR model are estimated on EViews with a lag number p = 1 as shown in Equation (4):

$$LNGDP = 0.017*LNGDP(-1) + 0.84*LNIEX(-1) + 0.13*LNIFDI(-1) + 3.14 \quad (4)$$

Table 1 Group Unit Root Test Results for LN*** in Level and 1st difference

	Summary Series: Series: LNGDP, LNIEX, LNIFDI in level		Summary Series: Series: LNGDP, LNIEX, LNIFDI in 1st difference	
Method	Statistic	Prob.**	Statistic	Prob.**
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.94546	0.1722	-8.80216	0.0000
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.52959	0.7018	-7.72230	0.0000
ADF - Fisher Chi-square	2.82632	0.8303	52.0313	0.0000
PP - Fisher Chi-square	2.29977	0.8902	254.458	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

4.3 Impulse Response Function Analysis

Impulse responses function analysis is adopted here to test the responses by impulse of Cholesky one S.D Innovations of variables. We can see from Figure 1 that LNIEX will lead to increased LNGDP response level reaching the maximum in period 2, then gradually decreasing to the lower level. The impulse of LNIFDI will lead to increased LNGDP too but at a lower level compared to that of the LNIEX.

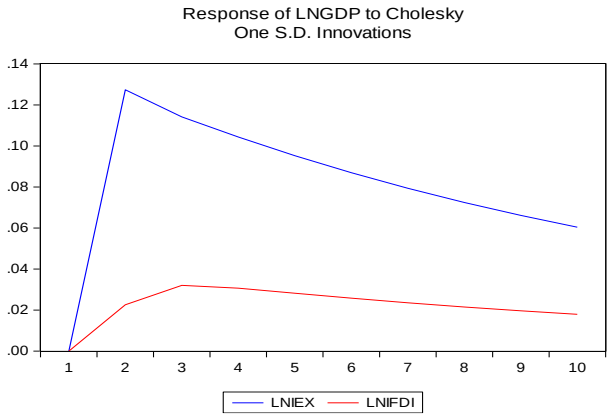

Figure 1 Impulse response function analysis

4.4 Granger Causality Tests

The Granger Causality test results as shown in Table 2, at lagging order of 4 and 10% significant level, indicate that LNIEX does Granger cause LNGDP, but LNGDP does not Granger cause LNIEX. At the same time, results also indicate that LNIFDI does Granger cause LNGDP and LNGDP does not Granger cause LNIFDI. These are all one-way Granger causes of LNGDP and LNIEX, LNGDP and LNIFDI. But the LNIFDI and LNIEX are two-way non Granger causes. This shows that Shandong 's industrial goods export and FDI in industrial sector both help explain the growth of GDP.

5. CONCLUSION

This paper is to aim at analysing the relationship of Shandong GDP growth with industrial exports and FDI in industrial sector. After the unit root tests are done, all the variables in 1st difference are found to be stationary.

Then we estimated the coefficients of VAR model. Coefficients of VAR model estimated in equation 4 show that a 1 per cent increase in IEX in the previous year will lead to an increase in GDP growth by 0.84 per cent, and that a 1 per cent increase in IFDI in the previous year will lead to an increase in GDP growth by 0.13 per cent.

Impulse responses function analysis shows that the response of GDP by impulse of Cholesky On 1 SD innovation of industrial goods export is much higher than that by FDI in industrial sector. And the Granger Causality test results indicates that industrial goods export and FDI in industrial sector both help explain the GDP growth in Shandong province.

Some suggestion could be recommended to the decision makers of the Shandong provinces in making macroeconomic decisions. In order to accelerate the GDP growth it is very important to encourage the industrial goods export and attract the foreign direct investment in industrial sector in Shandong province.

Table 2 Pairwise Granger causality tests

Sample: 1995 2018

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusion
LNIEX does not Granger Cause LNGDP	20	4.67065	0.0190	Reject
LNGDP does not Granger Cause LNIEX		0.83018	0.5332	Accept
LNIFDI does not Granger Cause LNGDP	20	3.03960	0.0648	Reject
LNGDP does not Granger Cause LNIFDI		1.20119	0.3641	Accept
LNIFDI does not Granger Cause LNIEX	20	2.50493	0.1028	Accept
LNIEX does not Granger Cause LNIFDI		0.88917	0.5020	Accept

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