Foreign Direct Investment, Import and Export Trade and Economic Growth-Based on Vector Autoregression Model[*]

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ARTICLE INFO	ABSTRACT
Publication Online: 10 February 2021 Corresponding Author: **Lulu Xu**	Fostering the new development pattern will promote the level of China's opening-up. Which means that the scale of China's foreign trade, foreign capital use will continue to expand. By establishing a vector autoregression model, this paper conducts an empirical study on the relationship between foreign direct investment, import and export trade and economic growth in China from 1987 to 2018. The results show that there is a long-term equilibrium relationship among foreign direct investment, import and export trade and economic growth in China. China's economic growth has a strong self-promoting effect. China's import and export trade are the Granger cause of economic growth, and in the long term, the contribution of export to the economy is obviously greater than that of import. China's import is a strong Granger reason for export. The contribution of foreign direct investment to import, export and economic growth is relatively low.

KEYWORDS: The New Development Pattern; Foreign Direct Investment; Import and Export; Economic Growth; VAR Model

1. INTRODUCTION

1.1 Background

Since 1987, China's import and export trade has developed rapidly. Figure 1 shows the development trend of China's GDP, import and export trade since 1987.
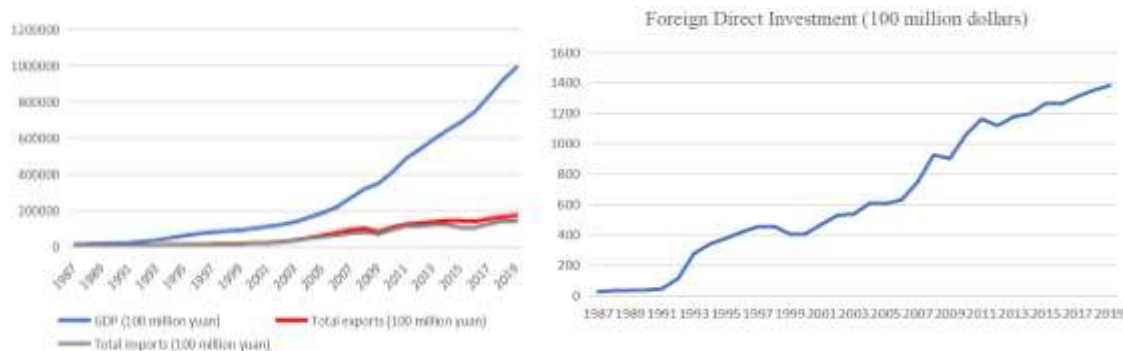

Figure 1: GDP, import and export trade and foreign direct investment trends chart

As can be seen from Figure 1, the GDP, import and export trade and foreign direct investment show an overall upward trend, and the GDP has increased significantly and faster since 1999. However, it is not clear which of these variables affects whom and to what extent they contribute to economic growth. With the proposed strategy of constructing the new

development pattern, the relationship between foreign trade and China's economic growth in the new situation is intriguing. Therefore, based on the above background, examining the relationship between foreign direct investment, import and export trade and economic growth in China is of great significance to how to give full play to the driving effect of foreign investment and import and export trade on economic development in China at present, and can also provide reference for the formulation of China's foreign trade strategy.

1.2 Literature review

At present, domestic and foreign scholars have mainly focused on the analysis of the relationship between pairings. In terms of foreign direct investment and economic growth, Xing Gan et al. (2016)[5] used relevant data modeling analysis from 1990 to 2013 to find out that the promoting effect of foreign direct investment on China's economic growth has a time lag. However, Guoyun Shen (2017)[6] found that foreign direct investment inhibited the quality of economic growth. Lianbo Li (2017)[7] also found through research that competition for foreign direct investment would inhibit the increase of per capita GDP.

In terms of import and export trade and economic growth, Jordanshan et al. (1998)[1] found that there is a two-way causal relationship between China's export trade and economic growth based on monthly data in 10 years. However, Jiang Du   et al. (2004)[8] found that economic growth had little impact on export. Based on the analysis of annual data from 1980 to 2010, Zhangliang Ma (2012)[9] found that both China's import and export activities had positive effects on economic growth. However, Bingbing Zhang (2013)[10] found that only export has a positive effect on China's economic growth in foreign trade. Chuang Deng et al. (2016)[11] found that the import and export trade of medium and low industries had a decreasing positive effect on China's economic growth, while that of high technology industries was the opposite.

In terms of import and export trade and foreign direct investment, Kamal(2000)[2] and Easterly(2001)[3] are both believe that the depreciation of the exchange rate is not conducive to economic growth. And Mills(2008)[4] believed that the effect of exchange rate on economic growth is not the same in different countries. Jiyong Chen et al. (2008)[12] found that foreign direct investment and China's import and export trade are mainly complementary, and substitution and complementarity overlap. Qixin He et al. (2013)[13] made use of relevant data from 1999 to 2011 and found that foreign direct

investment had a positive promoting effect on China's total import and export trade. Xiaoling Liu et al.(2016)[14] found that the driving effect of foreign direct investment on Hunan's export trade was greater than that of import trade. Hengsong Hu(2016)[15] found, based on the analysis of time series data, that foreign direct investment has an increasing promoting role in promoting the development of China's import and export trade, and vice versa. Zhengliang Ding et al.(2014) [16] conducted an empirical study by establishing a vector autoregression model and showed that real exchange rate depreciation has a sustained effect on China's economic growth, and the Balassa-Samuelson effect is not suitable for China.

To sum up, many current studies on the relationship between FDI, import, export and economic growth have different conclusions, and some are even diametrically opposite. In addition, in the past, scholars mostly studied the relationship between pair and pair, but few studied the four factors in a comprehensive way. Many studies built models from different perspectives, and some conclusions were relatively simple, lacking an overall view. Therefore, this study attempts to integrate these four factors based on the vector autoregression (VAR) model to explore the contribution of import and export and foreign direct investment to China's economic growth and the interaction mechanism between them.

2. THEORETICAL MODEL, DATA AND VARIABLE DESCRIPTION

2.1 VAR model

Vector autoregression model (VAR) is a method used to analyze multivariable data. It was first proposed by Sims in 1980. It is one of the effective prediction models. The general form of VAR model is as follows[15]:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + ... + A_N y_{t-N} + Bx_t + \varepsilon_t$$

Where, y_t is an endogenous variable column vector, x_t is an exogenous variable vector, $A_N ... A_N$ and B are coefficient matrices to be estimated, and ε_t is an error vector, satisfying $E(\varepsilon_t) = 0$, $E(\varepsilon_t, y_{t-i}) = 0$, i =1,2,…,N, $E(\varepsilon_t, x_t) = 0$.

2.2 Data and variable description

2.2.1 Variable setting

A total of 32 annual time series data from 1987 to 2018 were selected. GDP as a measure of economic growth; The level of foreign direct investment (FDI) is measured by the

national FDI over the years. China's import trade and export trade are measured by the total amount of national import and export over the years.

The data are processed as follows: In order to reduce data differences and fluctuations, natural logarithms of all variables are taken.

2.2.2 Data sources and descriptive analysis

The data are mainly derived from China Statistical Yearbook, China Financial Yearbook and the national annual data of EPS data platform. Table 1 below presents the results of descriptive statistical analysis of the data:

Table 1: Descriptive statistical analysis of variables

Variable	Variable	Mean	Median	Max	Min	Std. Dev.
Economic Growth	LNGDP	11.594	11.731	13.710	9.133	1.434
FDI	LNFDI	5.996	6.275	7.208	3.142	1.229
Import Trade	LNI	10.106	10.272	11.856	7.387	1.437
Export Trade	LNE	10.223	10.350	12.009	7.293	1.512

3. RESULTS AND DISCUSSION

3.1 Model construction and verification

3.1.1 Unit root test

In order to avoid false regression, ADF method is used to conduct unit root test on the data first. Table 2 below shows the ADF test results of variables LNGDP, LNFDI, LNI and LNE carried out by Eviews10.0 software. According to the P value, all variables are unstable. After the first-order difference, the four sequences of DLNGDP, DLNFDI, DLNI and DLNE are all stable, therefore, they meet the conditions of co-integration test.

Table 2: Unit root test results

Variable	t statistics	P value	stationarity
LNGDP	5.089	1.000	unstable
DLNGDP	5.089	0.000	stable
LNFDI	2.438	0.995	unstable
DLNFDI	2.438	0.021	stable
LNI	4.880	1.000	unstable
DLNI	4.880	0.000	stable
LNE	4.670	1.000	unstable
DLNE	4.670	0.000	stable

3.1.2 The construction of VAR model

A 4-dimensional vector autoregression model was built based on the variables selected in the study, LNGDP, LNFDI, LNI and LNE. The optimal lag order of the VAR model was determined according to the lag length test index. The results are shown in Table 3 below.

Table 3: Optimal lag period of vector autoregression model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-18.226	NA	5.75e-05	1.588	1.778	1.646
1	97.089	189.445*	4.85e-08	-5.506	-4.555*	-5.215
2	116.029	25.705	4.25e-08	-5.716	-4.004	-5.193
3	129.374	14.297	6.36e-08	-5.527	-3.053	-4.770
4	161.508	25.248	3.22e-08*	-6.679*	-3.444	-5.690*

As can be seen intuitively from Table 3, 3 of the 5 test indicators all choose lag period 4 as the optimal lag period.

Therefore, VAR (4) is established. After the establishment of the VAR model, the stability of AR root should be verified first, so as to determine whether the model can further carry out impulse response function and variance decomposition. The

test results are shown in Figure 2 below. Figure 2 shows that the reciprocal values of all characteristic roots are inside the unit circle, so the VAR(4) model is stable.
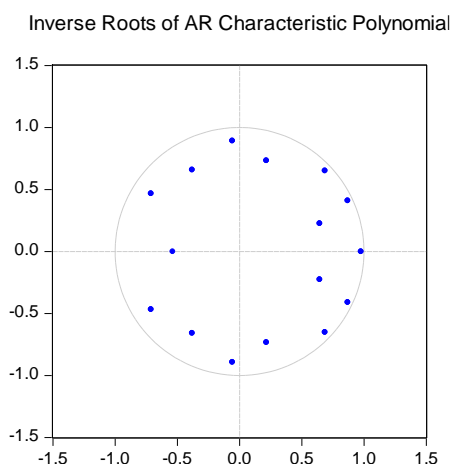

Figure 2: AR root

3.1.3 Johansen cointegration test

In order to determine whether the long-term stationary relationship between the original sequences exists, the

Johansen co-integration test can be conducted based on VAR(1) combined with the unit root test results. The specific test results are shown in Table 4 below.

Table 4: Test results of characteristic Trace

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.647	53.270	47.856	0.014
At most 1	0.358	22.026	29.797	0.297
At most 2	0.168	8.744	15.495	0.390
At most 3	0.102	3.212	3.841	0.073

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

According to the results of characteristic root test, there was only one cointegrating relationship between sequence LNGDP, LNFDI, LNI and LNE at the significance level of 0.05, that is, there was a long-term equilibrium relationship among the four variables LNGDP, LNFDI, LNI and LNE.

3.2 Granger causality test

In order to further investigate the dynamic correlation between variables, Granger causality test was performed on the variables. As can be seen from the test results, at the significance level of 5% with a lag of 5 periods:

1. China's import and export are both Granger causes of economic growth, but foreign direct investment is not. This shows that with the success of the reform and opening-up policy, the contribution of China's foreign trade to economic growth is increasingly prominent.

2. China's import, export and economic growth are all strong Granger causes of FDI, which may be due to the continuous development of China's import and export trade driving the flow of foreign investment in China, which in turn promotes the level of FDI, which in turn further increases with the improvement of economic level.

3. China's import is a strong Granger cause of export, which indicates that import has a greater stimulus effect on export. But China's export trade is not the Granger cause of import trade.

3.3 Impulse response analysis

Based on the stable VAR(4) model, impulse response function analysis is conducted to investigate the interaction among foreign direct investment, import, export and economic growth. The results are shown in Figure 3-6. Wherein, the

horizontal axis represents the lag period length of the impact effect (in years), and the lag period is set as 32 years. The solid line represents the impulse response function, and the dotted line represents the deviation band of plus or minus two times standard deviation.
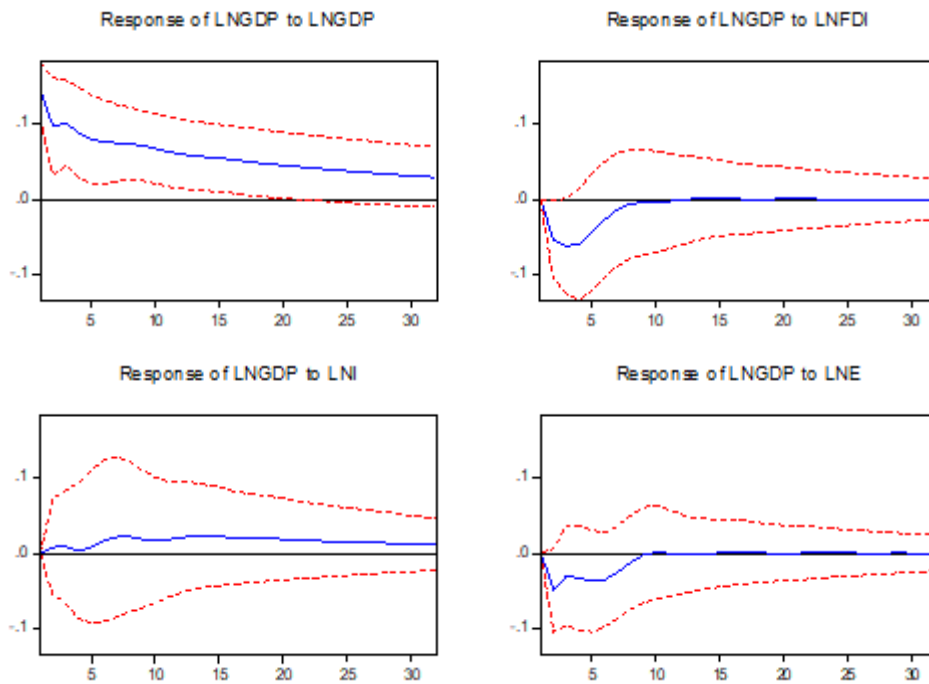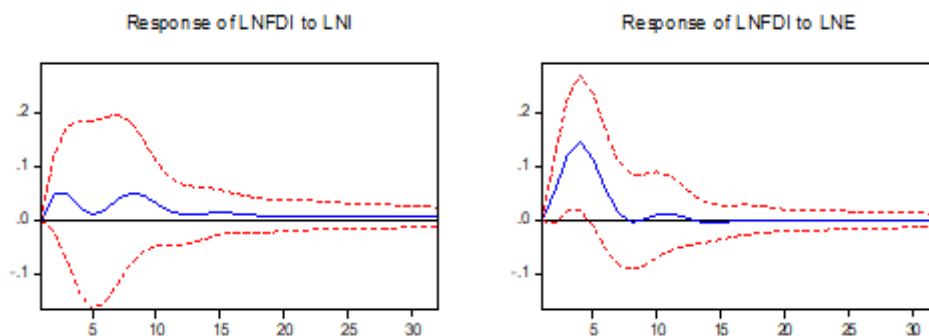

Figure 3: Impulse response of LNGDP to LNGDP, LNFDI, LNI, LNE respectively

Figure 3 examines the shock response of economic growth to itself, foreign direct investment, import and export. The impact of economic growth on itself shows a positive response in the current period. In the first two periods, the impact effect gradually declined, and after a slight rise in the third period, it began to decline slowly from the fourth period and gradually leveled off, and was close to 0 in the 32nd period. The impact of economic growth on foreign direct investment of one standard deviation shows significant negative effect, and this negative effect will last for 12 years, and from the 13th year, it tends to be stable, converging to 0. The import shock of one standard deviation has a weak positive effect on economic growth with a gradual upward trend. The impact effect of export shock of one standard deviation on economic growth is negative from period 1 to 9, and converges to 0 from period 10 to period 32. This shows that in the long run, the self-cumulative promotion effect of economic growth is not obvious; The positive effect of foreign direct investment on economic growth lags behind and has a inhibiting effect on economic growth in the early stage. Compared with export, import trade has a more obvious promoting effect on economic growth, and the promoting effect of export on economic growth can only be shown in the long run, that is, the positive effect of export on economic growth has a certain degree of lag. From the reform and opening up in 1978 to China's accession to the WTO in 2001, and then to "the Belt And the Road" project construction, China has been increasingly connected with the world, and the contribution rate of export to economic growth has slowed down over time.
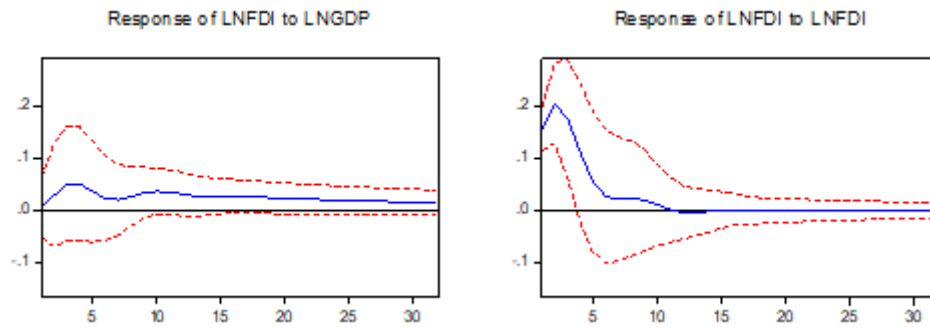
Figure 4: Impulse response of LNFDI to LNGDP, LNFDI, LNI, LNE respectively

Figure 4 summarizes the impact of FDI on itself, economic growth, import and export. The impact of foreign direct investment on itself has a significant positive response in the current period, and this positive effect starts to rise from the first period, reaches the peak in the second period, and begins to fluctuate and decline. The continuous positive effect remains until the 11th period, and then presents a short negative fluctuation and finally tends to 0. After a shock to GDP in this period, it has a significant positive effect on foreign direct investment, and the effect gradually increases. After reaching the peak in the third period, it begins to decline slowly, and after reaching the lowest in the seventh period, it slowly picks up and gradually becomes stable. After a shock to import in this period, it also has a continuous and significant positive effect on

foreign direct investment, and the effect shows a fluctuating trend of increasing first and then decreasing, and it starts to stabilize in the 12th period until it converges to 0. After a shock to export in this period, the positive effect on foreign direct investment was stronger than the impact of import, and continued to rise rapidly in the first to the fourth period, reached the peak in the fourth period and then fell rapidly, and gradually converged to 0 after experiencing small fluctuations in the ninth to 12th period.

This shows that, on the whole, foreign direct investment itself has obvious self-promotion effect. Economic growth, import and export all have significant promoting effects on FDI, and the short-term promoting effect is more obvious, which is consistent with the results of Granger causality test.
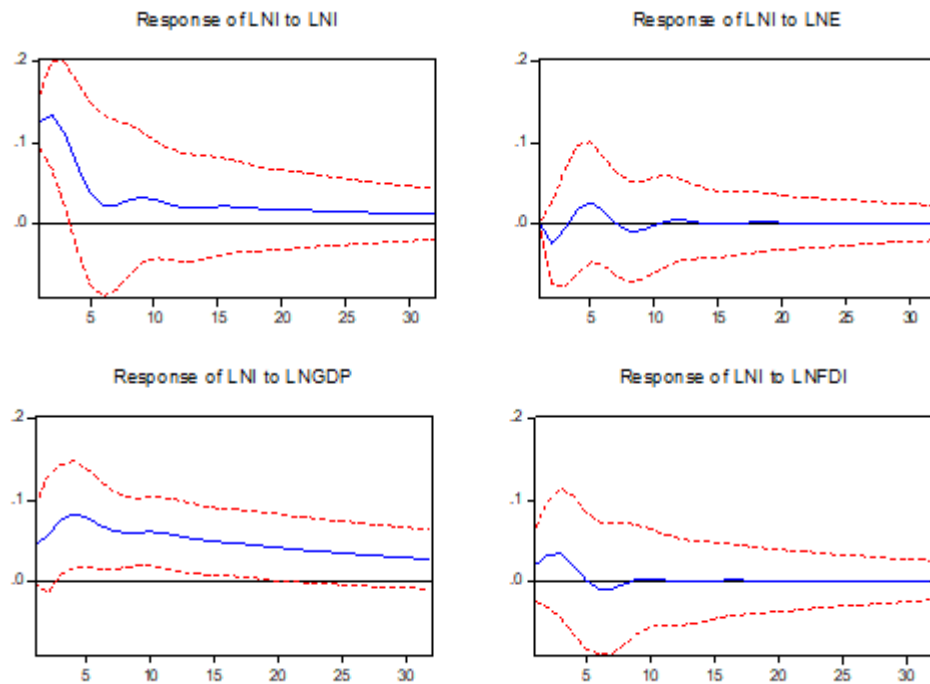

Figure 5: Impulse response of LNI to LNGDP, LNFDI, LNI, LNE respectively

Figure 5 summarizes the impact of import on itself, economic growth, foreign direct investment, and export. The impact of import on itself has a significant positive response in

the current period, and this positive effect continues to show in the next 30 years. This positive effect reaches the peak in the second period, then slowly drops down, and tends to be stable

in the 12th period. After a shock to GDP in the current period, it will have a sustained and strong significant positive effect on imports, which will gradually flatten out after reaching the peak in the fourth period. After a shock to FDI in the current period, there was a significant positive effect on import, and this effect increased first, and then decreased after reaching the peak in the third period. In the sixth period, it showed a negative effect. This negative effect lasted until the ninth period, and then gradually stabilized and tended to 0.After this period to export a shock, has a negative effect on imports, and the negative effect in the second stage after the peak slowly began to abate, in 4 ~ 6 period into short sustained positive effect and then continue to present a weak negative effect, and the negative

effects lasted until the 10th, then gradually converge to zero. This suggests that, on the whole, imports themselves have a self-promoting effect. Economic growth has a significant and continuous promoting effect on import trade, which is mainly because with the economic growth, people's "money bag" becomes bigger, and there is a greater effective demand for foreign goods, thus stimulating the import trade. In the short term, foreign direct investment has a certain degree of promoting effect on import trade, but with the passage of time, this promoting effect is gradually weakened. In general, exports have little influence on imports, and there is no significant dynamic correlation with imports, which is consistent with the results of Granger causality test.
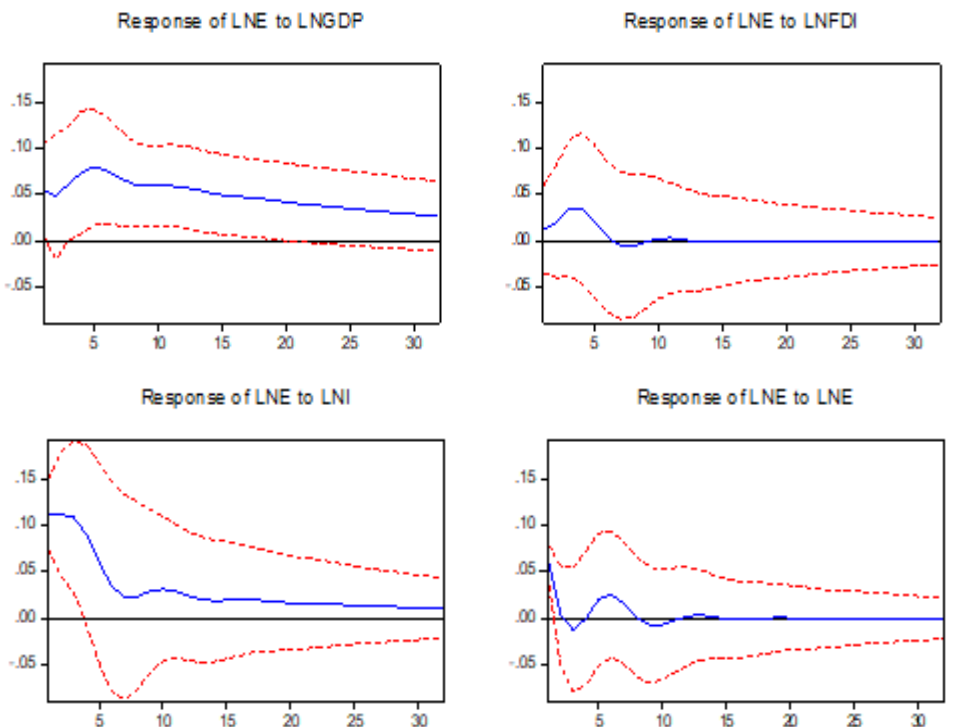

Figure 6: Impulse response of LNE to LNGDP, LNFDI, LNI, LNE respectively

Figure 6 examines the shock response of export to itself, economic growth, foreign direct investment, and import. The impact of export on itself has a significant positive effect in the current period, which weakens rapidly in the first two periods, turns into a temporary negative effect in the third period, continues to present a positive effect in the fourth to eighth period, and then gradually reaches 0 after experiencing a small fluctuation. After a shock to GDP in the current period, it will have a sustained and significant positive effect on export, and this positive effect is strong on the whole, and gradually becomes stable after reaching the peak in the fifth period. After a shock to FDI in the current period, the positive effect on export had a lag. The first two periods had no significant impact, but gradually increased in the third to fifth period, and gradually weakened after reaching the peak in the fifth period, and tended to be stable from the 10th period. After a shock to import in this period, it has a continuous and significant positive effect on export, and this positive effect gradually

weakened from the second period and leveled off from the 16th period. This shows that, on the whole, economic growth has a significant and sustained promoting effect on export; The effect of foreign direct investment on export promotion is only obvious in the short term. In the long run, foreign direct investment has little impact on exports; China's import has a strong promoting effect on export, and the two show a strong dynamic correlation, which is also consistent with the results of Granger causality test.

4. VARIANCE DECOMPOSITION ANALYSIS

Based on the established VAR (4) model, 32-period lag variance decomposition analysis was performed. Before variance decomposition, Cholesky orthogonalization was performed on the variables [17] . The results are shown in figure 7 to figure 10.
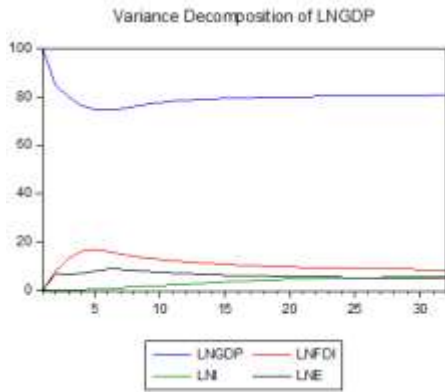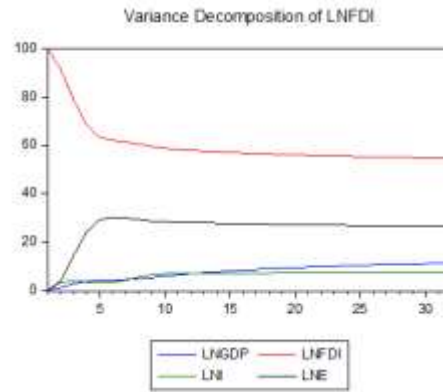
Figure 7: Variance decomposition of LNGDP

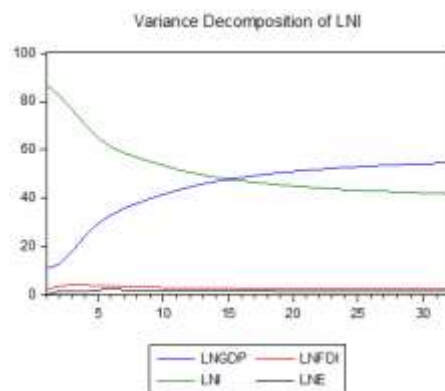**Figure 8:** Variance decomposition of LNFDI

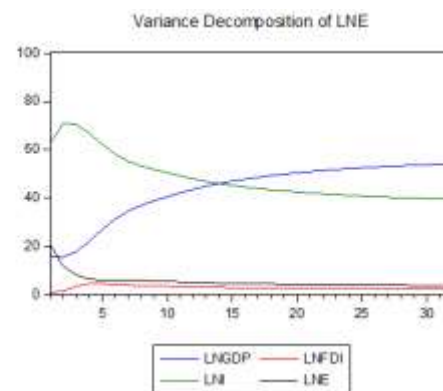**Figure 9:** Variance decomposition of LNI

Figure 10: Variance decomposition of LNE

Figure 7 shows the variance decomposition results of LNGDP. In combination with variance decomposition table, it can be seen that the contribution of GDP to its own forecast standard deviation decreases gradually at first and tends to be stable from the 14th period as the forecast period goes on.The contribution of FDI, import and export to GDP forecast standard deviation increases slowly at first, and then tends to be stable.In the long run, 80% of the fluctuations in economic growth can be explained by itself, 0-16.86% by foreign direct investment, 0-5.72% by imports, and 0-8.76% by exports. Compared with other variables, the contribution of import and export to GDP forecast standard deviation is smaller, and the contribution of export is slightly greater than that of import. On the whole, although the contribution of foreign direct investment to GDP shows a stable state, its contribution is not large. This is mainly because competition for foreign direct investment has a negative effect on economic growth. Therefore, on the one hand, we should further optimize and adjust the structure of import and export trade, in order to explore the potential pull effect of import and export trade on the economy. On the other hand, measures such as strengthening human capital cultivation and encouraging innovation should be taken to make good use of FDI's demonstration effect and spillover effect [18], so as to give full play to FDI's promoting role in China's economic growth.

Figure 8 shows the variance decomposition results of LNFDI. In combination with the variance decomposition table, it can be seen that the contribution of FDI to its own forecast standard deviation decreases gradually with the advance of the forecast period, and then gradually becomes stable from the 12th period. The contribution of GDP and import to FDI forecast standard deviation increases slowly at first and then tends to be stable. In contrast, the contribution of exports to FDI forecast standard deviation increased rapidly from period 1 to 6, and gradually stabilized after reaching the peak in period 6, and the contribution in the last period was 26.55%.In the long run, China's foreign direct investment fluctuations 55% of its own explanation, GDP, import and export impact accounted for 11%, 7.5% and 26.55% respectively. Compared with other variables, the contribution of import is small, while the contribution of export is much larger, which is mainly related to China's export-oriented economic policy. The contribution of economic growth to foreign direct investment is relatively high. This is consistent with the Granger causality test and the impulse response path of the impact of FDI in Figure 4.

Figure 9 shows the variance decomposition results of LNI. In combination with the variance decomposition table, it can be seen that the contribution of import trade to its own forecast standard deviation decreases gradually with the passage of the forecast period, and then gradually becomes stable from the 20th period. The contribution of GDP to the forecast standard deviation of import trade increases slowly at first and then tends

to be stable. The contribution of FDI and export trade is always low and stable. In the long run, 41.86% of the fluctuation of import trade is explained by its own fluctuation, and the influence of GDP, FDI and export accounts for 54.59%, 41.86% and 1.42% respectively. Export is not the cause of import, which is consistent with the Granger causality test and the impulse response path of import shock in Figure 5.

Figure 10 shows the variance decomposition results of LNE. In combination with the variance decomposition table, it can be seen that the contribution of exports to its own forecast standard deviation decreases gradually in the short term and then gradually becomes stable from the fifth period. The contribution of GDP to the forecast standard deviation of export increases slowly at first and then tends to be stable. The contribution degree of FDI is always low and stable. The contribution of import to export was relatively high in the current period, then decreased slowly, and gradually stabilized from the 15th period. In the long run, 3.84% of export fluctuations are explained by their own fluctuations, and the influences of GDP, FDI and import account for 54.21%, 2.42% and 39.51%, respectively. This indicates that the import is a strong Granger cause of the export, which is consistent with the Granger causality test and the impulse response path of the export impacted in Figure 6. In general, economic growth and import are the main factors affecting exports, while the change of foreign direct investment has little impact on exports.

5. CONCLUSIONS

5.1 Main Conclusions

This paper builds the VAR model based on the time series data from 1987 to 2018, and draws the following conclusions:

1. China's economic growth has a strong self-promoting effect.

2. China's import and export are the Granger causes of economic growth, and in the long term, the contribution of export to the economy is obviously greater than that of import.

3. China's import has a sustained and significant positive effect on export. Import is a strong Granger cause of export, but export is not the Granger cause of import.

4. The overall contribution of FDI to import, export and economic growth is relatively low.

5.2 Suggestions

1. Sound interaction among factors of economic development should be formed. The country should continue to focus on economic construction, take the new development concept as the guidance, further improve the level of national economic development through deepening reform, industrial transformation and upgrading and other measures, and finally achieve sound and sustainable economic development.

2. Further optimize the structure of foreign trade. Under the "open economy", foreign trade still plays a strong role in promoting economic growth, and the optimization of foreign trade structure will have a great role in promoting the development of China's economy. Therefore, it is necessary to increase the proportion of high-tech industry in China's import and export trade and expand the scale of import of productive services, so as to promote export through import and give full play to the effect of import on export. At the same time, policies should be adopted to encourage and support the import of products with obvious technology spillover effect and the export of products of domestic own-brand enterprises, so as to create an economic and trade environment conducive to technological innovation.

3. Develop differentiated trade policies and give full play to the positive effect of foreign direct investment on the economy. Since 1983, the scale of the use of foreign capital in China is more and more big, the influence of foreign direct investment to our country economy in the early days is very significant, however, in recent years due to the foreign company dedicated to prevent their know-how, the influence of FDI to our country economy weakened obviously, therefore, in order to better play to the potential role of foreign capital of our country economy, FDI should be encouraged to set up headquarters economy, speed up the production of FDI spillover effect and the demonstration effect, to give play to the role of FDI to our country economic growth to promote. At the same time, we should prevent over-reliance on the spillover effect of foreign direct investment, so we should comprehensively enhance our human capital, increase the cultivation of scientific and technological innovation talents, and then improve the scientific and technological content of our economy and trade. So that we can foster the new development pattern successfully.

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