Empirical Analysis of Chinese Natural Gas Importing Power Effect

Lingzhi Li*, Liyun Zhao*
School of Economics and Management, Nanjing University of Science and Technology, Nanjing, Jiangsu, China

*Corresponding author e-mail: 1310821947@qq.com, liyunzhao3526@163.com

Abstract. Through the monthly data from 2016 to 2018, this paper studies the Chinese import volume of natural gas and international gas prices, and finds that the change of Chinese natural gas import volume has a great impact on the change of international gas price, and the increase of Chinese natural gas import will promote the growth of international gas price, there is a negative import "big country effect".

1. Introduction
Natural gas, as a highly efficient and relatively clean fuel, is an important means and starting point for China to effectively control air pollution and promote the revolution in energy consumption, and has been widely used in China. According to relevant reports of the natural gas industry, since domestic natural gas production is lower than domestic natural gas demand, China has become the largest importer of international natural gas markets since 2018. Therefore, this article studies the import of natural gas in China.

2. Data selection
In 2015 and before, the government regulated the direct or indirect “guarantee, pressure, support, and control” of the natural gas industry, and adopted industrial policies that directly interfere with the market and restrict competition in the natural gas industry. National intervention forces have played an important role in the natural gas industry. Position, the power of market regulation is relatively weak. Since 2015, Chinese policy on the natural gas industry has shifted to a functional industrial policy that enhances market competitiveness, and gradually abandoned the selective industrial policy of direct intervention and restricting competition, and set the role of market regulation in the short-term and long-term goals of price reform is gradually being realized. And according to statistical data analysis, since 2016, Chinese natural gas imports accounted for more than 6% of the world's total imports for the first time, so 2016-2018 was selected as the sample interval.

In order to study the dynamic relationship between Chinese natural gas import prices and international natural gas prices, a vector autoregressive (VAR) model is constructed for empirical analysis. Because Chinese natural gas import prices are mainly based on the long-term association, natural gas suppliers and importing companies negotiate benchmark agreement prices. Therefore, this article uses Chinese natural gas import prices to represent international natural gas prices. This article selects the monthly data of Chinese natural gas imports (IM) and natural gas import prices (IP) from January 2016 to June 2018 to analyze the effects of Chinese natural gas importing countries.
2.1. Empirical Analysis Based on Granger Causality Test

2.1.1. Stationarity test. The Granger causality test requires a stationary sequence for the variable, so it is necessary to perform a stationary test on the time-series variable to transform the non-stationary sequence into a stationary sequence. In this paper, the ADF unit root test is performed on the stationarity test of the IM and IP time series. The test results are shown in the table below.

| Variable | ADF Statistics | 1% threshold | 5% threshold | 10% threshold | test results |
|----------|----------------|--------------|--------------|---------------|--------------|
| IM       | 0.086473       | -2.644302    | -1.952473    | -1.610211     | unstable     |
| IP       | 0.385861       | -2.647120    | -1.952910    | -1.610011     | unstable     |

Table 2. ADF Unit Root Test Results for First Order Difference Sequences.

| Variable | ADF Statistics | 1% threshold | 5% threshold | 10% threshold | test results |
|----------|----------------|--------------|--------------|---------------|--------------|
| D(IM)    | -6.903530      | -2.647120    | -1.952910    | -1.610011     | stable       |
| D(IP)    | -8.025372      | -2.647120    | -1.952910    | -1.610011     | stable       |

Note: D (IM) and D (IP) respectively represent the first order difference of the variables. It can be seen from the results in the table that at a significance level of 1%, the natural gas import volume and natural gas import price are non-stationary in the horizontal series. Therefore, a first-order difference is taken from the sample data. After testing, the first-order difference both of the variables are stable time series, so the natural gas import volume and natural gas import price are first-order single-integrated stationary time series, so a co-integration test is performed.

2.1.2. Johansen cointegration test. Statistically judging whether the variables are co-integrated can be judged by the existence of a long-term equilibrium relationship between the variables. Combined with sample data and using the Johansen cointegration test, Eviews is used to test whether there is a long-term stable equilibrium relationship between Chinese natural gas imports and natural gas import prices. The test results are as follows:

| Null hypothesis                        | Eigenvalues | Trace statistics | 10% threshold | Adjoint probability |
|----------------------------------------|-------------|-----------------|---------------|--------------------|
| No co-integration relationship exists * | 0.349342    | 14.42127        | 13.42878      | 0.0721             |
| There is at most one cointegration relationship | 0.065286    | 1.957922        | 2.705545      | 0.1617             |

Note: The maximum eigenvalue test indicates that there is only one cointegration relationship at the 10% significance level; * indicates that the null hypothesis was rejected at the 10% significance level. According to the statistics of the Johansen cointegration test and its concomitant probability, it was found that the Chinese natural gas import volume and the international gas price were at a significant level of 10%. The cointegration test rejected the null hypothesis that there was no cointegration relationship between the variables and accepted The null hypothesis that there is at most one cointegration relationship between the variables. Therefore, it can be considered that there is a cointegration relationship between Chinese natural gas imports and international gas prices, that is, a long-term stable equilibrium between Chinese natural gas imports and international gas prices relationship.
Time series data can be used to construct a VAR model when the first-order difference is stable and there is a co-integration relationship (this needs to be ensured as a stable VAR model). This paper uses the original data to establish a VAR model, and performs impulse response analysis and variance decomposition analysis.

2.1.3. VAR model construction. VAR models are often used to analyze the effects of random disturbance terms (especially external shocks) on multivariable economic systems, and can directly examine the internal relationships between economic variables without considering economic theory. The VAR model constructed in this study is expressed by the formula as follows:

\[ Y_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \varepsilon_t \]  

(1)

\[ E(\varepsilon_t) = 0, \quad E(\varepsilon_t, Y_{(t-i)}) = 0, \quad i=1, 2..., p. \]

The final VAR model and the statistical results of the model are as follows:

\[
\begin{pmatrix}
IM_t \\
IP_t \\
\end{pmatrix} = 
\begin{pmatrix}
31.93630 \\
1.198481 \\
\end{pmatrix} + 
\begin{pmatrix}
0.618504 & 21.35030 \\
0.000951 & 0.321711 \\
\end{pmatrix} \begin{pmatrix}
IM_{t-1} \\
IP_{t-1} \\
\end{pmatrix} + 
\begin{pmatrix}
0.170381 & 12.07872 \\
-0.001771 & 0.424110 \\
\end{pmatrix} \begin{pmatrix}
IM_{t-2} \\
IP_{t-2} \\
\end{pmatrix} 
\]

(2)

Table 4. Various statistical values of the VAR model.

| Variable | R2 | Sum of squared residuals | S.E. equation | F | Log-likelihood function value | AIC | SC | Dependent variable mean | Standard deviation of the dependent variable |
|----------|----|--------------------------|---------------|---|-------------------------------|-----|----|------------------------|----------------------------------|
| IM      | -6.90 | -2.65                     | -1.95        | 9.08 | -168                        | 11.97 | 12.2 | 558                  | 130                               |
| IP      | -8.03 | -2.65                     | -1.95        | 10.56 | 1.21                         | 0.26 | 0.50 | 2.86                  | 0.39                              |

Based on the VAR model, a Granger causality test was performed on Chinese natural gas imports and international natural gas prices at a significance level of 10%:

Table 5. Granger causality test results.

| Null hypothesis | Lag | F     | Prob   |
|-----------------|-----|-------|--------|
| Why IM is not IP| 2   | 0.26318 | 0.7708 |
| Why IP is not IM| 2   | 4.25376 | 0.0262 |

It can be seen from the results of the Granger causality test that when the lag time is 2, observing the probability, it can be found that the probability value of the international gas price is not the cause of Chinese natural gas imports is greater than 77%. Accept the original hypothesis, indicating that the international gas price Changes in Chinese natural gas imports will not affect Chinese natural gas imports; the probability that Chinese natural gas imports are not the cause of international natural gas prices is less than 5%. The original hypothesis is rejected, indicating that Chinese natural gas imports are the reason for the changes in international natural gas prices. Changes will affect changes in international natural gas prices.

According to the analysis results of Eviews, the modulus of the inverse of the VAR characteristic root is all in the unit circle, so the VAR model established in this study is a stable model.

Because VAR models are non-theoretical models, this study does not explain and explain the correlation coefficient matrix in the model in depth. In addition, each coefficient in the VAR model only reflects the local dynamic relationship, and cannot represent the overall and global complex dynamic relationship. Therefore, the VAR model cannot be analyzed by analyzing the estimated coefficients of
the model. Usually, the impulse response function and variance decomposition technology are needed for further analysis.

Figure 1. Illustration of the unit circle of the modulus of the inverse of the VAR characteristic root.

2.1.4. Impulse response analysis.

According to the first graph in Figure 2, the international natural gas price has an alternating positive and negative response to the impact of Chinese natural gas imports. In the short term, the natural gas price responds positively and negatively. 0.15, from the positive effect to the negative effect in the second period, that is, the increase in the price of international natural gas will have an inhibitory effect on Chinese natural gas imports, but the inhibitory effect is not significant; in the long run, the response level will turn positive after the 22nd period. Effect, the degree of response tends to be zero, that is, the increase in international natural gas prices has a promotion effect on natural gas imports from China, but the promotion effect is not significant

According to the second graph in Figure 2, the impact of Chinese natural gas imports on international natural gas prices is dominated by positive effects, and reached its maximum value in the sixth period, which is 9.954172. After the sixth period, the degree of response shows a downward trend. The lowest value of positive effect was 0.252914 in the 19th period, and it turned into a negative effect shock in the 19th period, but the effect was not obvious. This shows that in terms of the correlation between Chinese natural gas imports and international natural gas prices, in the short term, an increase in Chinese natural gas imports can significantly increase international natural gas prices. In the long term, with the increase in the number of periods, Chinese natural gas imports The increase in volume has a certain restraining
effect on international natural gas prices, that is, there is a great power effect on Chinese natural gas imports.

2.1.5. Analysis of variance. Use the variance decomposition technique to explore the degree and contribution of Chinese natural gas imports and international natural gas price variables to current variables and external shocks:

Table 6. Analysis results of variance.

| Date | Variance analysis of IM | Variance analysis of IP |
|------|------------------------|------------------------|
|      | IM                     | IP                     |
| 1    | 100.0000               | 0.0000                 |
| 2    | 99.78692              | 0.213082               |
| 3    | 99.45182              | 0.548179               |
| 4    | 99.03005              | 0.969951               |
| 5    | 98.56749              | 1.432507               |
| 6    | 98.10897              | 1.891030               |
| 7    | 97.68015              | 2.319849               |
| 8    | 97.30413              | 2.695869               |
| 9    | 96.99152              | 3.008483               |
| 10   | 96.74621              | 3.253794               |
| ...  | ...                   | ...                    |
| 28   | 96.27617              | 3.723830               |
| 29   | 96.27541              | 3.724590               |
| 30   | 96.27484              | 3.725159               |

It can be seen from the results of the variance decomposition that international natural gas prices have been affected by Chinese natural gas imports since the current period: in the first period, the degree of interpretation of Chinese natural gas imports to international natural gas prices exceeded 19%, and in the second period, it was 31.95%, there was a slight decrease in the third period, and it gradually increased from the fifth period. In the long term, the impact is close to the international gas price itself. Therefore, Chinese natural gas imports have a greater influence on international natural gas prices, indicating that Chinese natural gas imports have a large importing country effect, which is consistent with the results of the Granger causality test.

3. Conclusion
Through the empirical test of the "big country effect" of Chinese natural gas imports, it was found that changes in Chinese natural gas imports have a greater impact on changes in international natural gas prices, and that the increase in Chinese natural gas imports will promote the increase in international natural gas prices. Importing country effect.

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