



An Empirical Analysis of Relationship between Export and Energy Consumption in Shandong Province

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Abstract

In this paper, the relation between the energy consumption and the export of Shandong is analyzed by co-integration and Granger causality test. The research result as follows: there is a positive relationship between the export and energy consumption. On the other hand, the growth of the export is cause of increase of the energy consumption. Therefore the increase of Shandong's export promotes energy consumption and also is restricted by its energy consumption.

Keywords: Energy consumption, Export, Co-integration test, Granger causality test

1. Introduction

Since beginning of opening up policy, the economic development of China has been increasing rapidly, but energy consumption has been growing fast rapidly. Currently, China's energy consumption becomes the second largest one in the world. Shortage of energy is taking more and more side effects on China's economic development. More and more people are paying attention to the problem. Meantime, China's export developed so rapidly that its ratio of dependence on export has arrived at 33 percent by 2006 which account for 33 percent China's GDP. Obviously, both energy and export have paid very important role in China's economic development. On the one hand, the export is a great power to drive its economic development. On the other hand, smoothly developing of export of China depends on the energy supply. In this paper, we will take Shandong province of China for example, to analyze the relationship between the export and energy consumption.

2. Econometric Analysis of Relationship between the Export and Discharge of Industrial Pollutants

2.1 Methodology

Due to most of time series not being stationary, if they are simply regressed, spurious regression may take place to reduce the reliability of research result. To solve the problem, Granger (1967) introduced time series analysis that is called co-integration test. Granger causality test (Granger & Sims, 1972) used in time series analysis to examine the direction of causality between two economic series has been employed in many econometric studies for the past three decades. In this paper, co-integration test and Granger causality test are used to analyze the relationship between the export and energy consumption.

2.2 Unit root test

Before conducting co-integrating and Granger causality test, unit roots of a time series should be examined. Campbell and Perron (1991) provided rules for investigating whether a time series contains unit roots. The formation is as follows.

$$\Delta y_t = \alpha + \delta t + \omega y_{t-1} + \sum_{i=1}^p r_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

Where Δ is the first difference operator, y_t is random variable, α is constant, t is a time, p is lagged difference, and the null hypothesis of no co-integration amongst the variable is ($H_0: \omega=0$) against the alternative hypothesis ($H_1: \omega<0$). If ($H_0: \omega=0$) is accepted, but ($H_1: \omega<0$) is rejected, the unit root of variable $\{y_t\}$ is existent, i.e., y_t is non stationary series and vice versa.

2.3 Cointegrating test

If series x_t and y_t are non stationary and both of them are integrated with same order, we can use OLS to estimate equation (2) and then test whether the residual of regression equation (2) is stationary. If the residual is stationary, there exists a co-integrating relationship between x_t and y_t , and vice versa.

$$x_t = c + \beta y_t + \mu_t \quad (2)$$

2.4 Granger causality test

Within a bi-variant context, the type of Granger causality test states that if a variable X Granger causes Y, the mean square error (MSE) of a forecast of Y based on the past value of both of X and Y is lower than that of a forecast that we use only past value of Y. This Granger test is implemented by running the following regression equation (3). Similarly, by testing equation (4), we can find that whether a variable Y is Granger causes of X.

$$y_t = \alpha_0 + \sum_{i=1}^m \alpha_i y_{t-i} + \sum_{i=1}^m \beta_i x_{t-i} + \varepsilon_t \quad (3)$$

$$x_t = \alpha_0 + \sum_{j=1}^m \alpha_j x_{t-j} + \sum_{j=1}^m \beta_j y_{t-j} + \varepsilon_t \quad (4)$$

2.5 Data

Shandong's export from 1980 to 2006 is from China Foreign Trade Statistical Yearbook and its energy consumption is from Shandong Statistical Yearbook. Table 1 shows the changes of the export and energy consumption of Shandong. In order to remove the error of autocorrelation, the variables in the model will be in logarithm.

3 Empirical Results

3.1 Results of ADF test

By using Augmented Dickey-Fuller (ADF) to tests unit roots of these series, we get results of ADF test (See Table 2). The results indicate that unit roots testing values of the level series are greater than the critical values. Therefore the null hypothesis of non-stationary could not be rejected, but after first differencing of these variables, the T-bar test statistics are well less than the corresponding critical values at either 5% or 1% signification level, which indicate that the null of hypothesis of non-stationary should be rejected and the alternative hypothesis of stationary be accepted. In other words, the variables (lnEC, lnEX) are integrated of order two or I(2).i.e., these two variables become stationary after being first differenced.

3.2 Results of co-integration test

By using OLS, the equation (5) is obtained. Results of ADF testing on unit roots of the residues in the equations show that the residue is stationary series (See Table2). So there is a long and dynamic relationship between the export and energy consumption. The coefficient in the equation which are elastic of export to energy consumption shows that the energy consumption will increase to 0.1539% when the export of Shandong grows 1%

$$\ln EC = 7.0873 + 0.1539 \ln EXP + (AR(1) = 0.7717) \quad (5)$$

(16.947***) (5.2152**) (3.1210*)

$$R^2=0.8935 \quad \text{adjusted, } R^2=0.8722 \quad DW=1.9469$$

Note: (1) values in the brackets are t-statistic.

(2)*, **, *** represent significant at level of 10%, 5% and 1% respectively.

3.3 Result of Granger causality test

The result of Granger causality test as follows: The null hypothesis that "Changes of energy consumption does not Granger cause the change of the export" is accepted at the least of 10%, but the null hypothesis that "the change of the export does not Granger cause the changes of energy consumption is rejected at the least of 5% signification level. Therefore, the growth of the export is cause of increase of the energy consumption.

4. Conclusions and Suggestion

Through studying on the relationship between the relationship between Shandong's export and its energy consumption, we find that on the one hand, there is a positive relationship between the export and energy consumption, on the other hand, that the growth of the export is cause of increase of the energy consumption. So the increase of Shandong's export promotes energy consumption s its energy consumption.

Under the short supply of energy in Shandong, some countermeasure should be taken. On the one hand, the export product structure should be adjusted and the export products which cost more energy should be decreased, On the other hand, enterprises producing export products should update their technology level in order to reduce the energy

consumption of export products.

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Table 1. Results of ADF test

Variable	ADF statistic	Lags	1% Critical Value	5% Critical Value	Stationary or not
lnEC	-0.6375	1	-3.0294	-3.8304	No*
lnEX	1.4286	1	-3.0294	-3.8304	No*
d ² lnEC	-4.3948	1	-3.0521	-3.8877	Yes
d ² lnEX	-5.5404	1	-3.0521	-3.8877	Yes

Notes: (1) The optimal lags for conduction ADF test were decided by AIC(Akaike information criteria)

(2) EC and EX represent energy consumption and export respectively.

* Represents signification at 1% level.

Table 2. Result of unit root testing residues in equation (5)

ADF statistic	ADF statistic	ADF(5%)	ADF(1%)	Conclusion
None	-3.4257	-1.9583	-2.6819	Stationary
Intercept	-4.0187	-3.0114	-3.7856	Stationary
Trend and intercept	-6.3124	-3.6454	-4.4691	Stationary

Table 3. Results of Granger causality test

Null Hypothesis	Lags	F-statistic	Probability
lnEC does not Granger Cause lnEXP	1	3.8999	0.0647
	2	13.3235	0.0000
lnEXP does not Granger Cause lnEC	1	0.1455	0.1455
	2	0.1777	0.1777

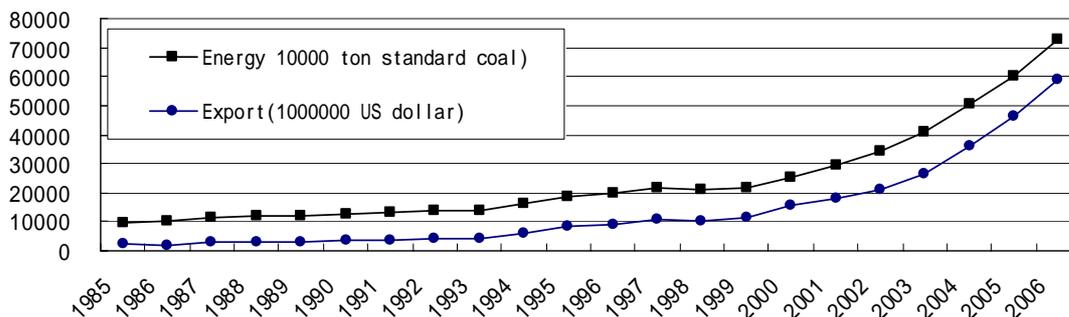


Figure 1. Changes of the export and energy consumption of Shandong from 1985 to 2006