Research Article **IJESE (2020) 1:5**

International Journal of Economics, Sociology and Education

(ISSN:2692-1359)

The Impact of China's Prohibition of Importing Solid Waste on the World Economy Based on Autoregressive Model

Yishuai Tian[1]*, Qian Cao[2], Siguang Zheng[3], Boying Lv[1]

[1]College of Hydraulic & Environmental Engineering, China Three Gorges University, Yichang 443002, China. [2]College of Foreign Languages, China Three Gorges University, Yichang, 443002, China. [3]College of Electrical Engineering & New Energy, China Three Gorges University, Yichang, 443002, China.

ABSTRACT

To explore the impact of China's ban on the import of solid waste on the world economy and the environment. In this paper, a VR autoregressive model based on time series was established. India, Malaysia, the United States, and Japan were selected as countries affected by China's ban on waste imports to replace the impact on the world. The GDP and CO2 emissions of various countries are used as indicators to measure the economy and the environment. By predicting the data that China has not implemented the ban on the collection of imported waste and comparing it with the data after the actual implementation, it was found that: after the promulgation of the policy, the environmental quality of the major importing countries declined and the economy increased. The economic impact of the significant solid waste exporting countries is not apparent, and environmental pollution increases slightly.

Keywords: Time series; Solid waste; GDP; CO2;

***Correspondence to Author:**
Yishuai Tian
College of Hydraulic & Environmental Engineering, China Three Gorges University, Yichang 443002, China.

How to cite this article:
Yishuai Tian, Qian Cao, Siguang Zheng, Boying Lv. The Impact of China's Prohibition of Importing Solid Waste on the World Economy Based on Autoregressive Model. International Journal of Economics, Sociology and Education, 2020; 1:5

eSciPub LLC, Houston, TX USA.
Website: https://escipub.com/

1. Introduction

In April 2018, the Ministry of Ecology and Environment of China issued a notice on the adjustment of the catalog of imported wastes [1], which decided to adjust 32 varieties of solid wastes, such as waste hardware, scrap ships and scrap automobile pressing parts, to "prohibited entry." At the end of 2018, 16 types of solid waste, such as scrap metal, scrap ship, scrap automobile parts, smelting slag and waste plastic from the industrial origin, were banned. After part of the ban came into effect, a large-scale restructuring of the waste industry chain was opened around the world, and 32 varieties were prohibited at the end of 2019. Although solid waste brings environmental pollution, its low cost may be a lack of resources in other countries [2].

Therefore, it is of considerable significance to explore the impact of China's ban on the import of solid waste on the world economy and environment [3]. At present, there are not a few articles to explore its impact. For example, Chen et al [4] used the life cycle of plastic waste to calculate the environmental and economic impact of incineration. It is found that plastic waste will cause a lot of pollution from 13 aspects. Brooks et al [3] estimated that by 2030, China's new policy will replace the import of 111 million tons of plastic waste and indirectly reduce the amount of plastic waste produced worldwide.

Although there are many studies on the impact of China's ban on the import of solid waste on the world economy, most of them are general and have not been combined with the actual data. Therefore, this paper first selects several typical affected countries and related indicators and uses the VR autoregressive model of time series to predict the impact of relevant indicators on the world economy, to provide a consistent basis for studying the economic impact of China's ban on substantial waste imports.

2. Research objects and indicators

2.1 Research objects

According to the literature data, before the implementation of "China's ban on the import of waste," China is far ahead in the amount of garbage import and is the main garbage exporter of the United States, Japan, Britain, and other countries. After the implementation of "China's ban on imported waste," garbage importing countries moved to the main battlefield. China has dramatically reduced its garbage imports, while small garbage importing countries in the past have significantly increased their imports. For this reason, we select the United States and Japan as the countries most affected by China's policy of banning the import of solid waste, while India and Malaysia are the countries most affected by China's policy of prohibiting.

2.2 Indicators

The change in the number of garbage imports leads to the shortage of raw materials in garbage importing countries, and the reduction of garbage exports will increase the cost of waste disposal in garbage exporting countries. And one of the three most intuitive indicators of the economy is GDP[5], so GDP is chosen as the index that affects the economy.

As the garbage importing countries will dispose of the recycled imported garbage, solid waste will be incinerated, which will inevitably produce greenhouse gases, harmful gases, and other environmental pollutants. Because CO2 emissions can measure the average greenhouse gas emissions generated during production, transportation, use, and recycling of a product, and CO2 data are easy to collect, CO2 is selected as the main environmental measurement index [5].

3. Establishment of VR autoregressive model

A VR autoregressive model based on time series is established to predict the economic and ecological index data in 2018 and compared with the corresponding 2018 actual index data, to get the impact of "China's ban on import waste" on the world economy and environment.

3.1 Daniel test for stationarity of data

Spearman correlation coefficient is a rank correlation coefficient [8]. For the observed data of two-dimensional population samples (the number is n), the unitary sample data of each component can be obtained. Let the first-dimensional rank statistic be $R_1, R_2, \mathrm{L}\ R_n$. The second-dimensional statistic is $S_1, S_2 \mathrm{L}\ S_n$. When they are

closely related, the two groups of rank statistics are also closely related, and the Spearman correlation coefficient is:

$$q_{XY}=\frac{\sum_{i=1}^{n}(R_i-\bar{R})(S_i-\bar{S})}{\sqrt{\sum_{i=1}^{n}(R_i-\bar{R})^2}\sqrt{\sum_{i=1}^{n}\left(S_i-\bar{S}\right)^2}}$$

For the Spearman correlation coefficient, a hypothetical test can be done:

$$H_0:\rho_{XY}=0, H_1:\rho\neq 0$$

For the samples of time series, the order is that R_t, considers the Spearman correlation coefficient q of variables to (t,R_t), which has the following formula:

$$q=1-\frac{6}{n(n^2-1)}\sum_{1}^{n}(t-R_t)^2$$

Construction statistics:

$$T=\frac{q\sqrt{n-2}}{\sqrt{1-q^2}}$$

Hypothetical： H_0: Sequence y_t stationary， H_1: Sequence y_t non-stationary. For a given level of significance α， Calculating $(t,\ R_t)$ from time series a_t Spearman Rank correlation coefficient q_s of t=1,2,⋯,n .If $|T|\le t_{\alpha/2}(n-2)$， reject H_0， When $q_s>0$ believes that there is an upward trend when believes that there is a downward trend. The stationarity of the original time series is tested according to the above method and after correlation calculation. Obtain $|T|>t_{\alpha/2}(n-2)$. Therefore, it can be considered that the sequence is non-stationary, and because of the $q>0$ curve of this question, the sequence has an upward trend.

3.2 Establishment of Model

R model is a kind of linear prediction [6], that is, N known data can be derived from the model before or after the Nth point. As an important index of national economic operation, the emissions of GDP and environmental index CO2 have certain stability and growth, and the historical data of GDP and CO2 has a positive impact on the future trend, so the time series method is selected to establish a prediction model for the changes of GDP and CO2. Fixed sequence. To construct a stationary sequence, the sequence $a_t(t=1,2,\cdots,n)$ can be obtained by doing the first-order difference operation $\mathrm{b_t=a_{t+1}-a_t}$ on the sequence $\mathrm{b_t}\left(t=1,2,\cdots,n\right)$. According to the data of each index series, each time series array is stable. The following AR model can be established to predict $\mathrm{b_t}$, c_1, c_2 is the undetermined coefficient, ε_t is a random disturbance term, and the formula is as follows:

$$y_t=c_1y_{t-1}+c_2y_{t-2}+\varepsilon_t$$

The solution of the undetermined coefficient. Using the least square method to solve the values of c_1, c_2 and ε_t. The formula of the solution is as follows:

$$c_i=\frac{\sum_{t=1}^{n}\left(y_t-\bar{y}\right)\left(c_i-\bar{c}\right)}{\sum_{t=1}^{n}\left(c_i-\bar{c}\right)^2}\qquad (i=1,2)$$

$$\varepsilon_t=\bar{y}_t-c_1\bar{y}_{t-1}-c_2\bar{y}_{t-2}$$

4. Results and analysis

By substituting the data of each index into the final equation, through the operation of MATLAB software, the changes of economic and environ-

mental indicators of each country in 2018 can be obtained, respectively, as shown in Table 1.

Table 1: forecast results (unit GDP: billion yuan; CO2 emissions: tons)

State		Index	Actual value	Predicted value	Difference value
Prohibit the import of solid waste	China	CO_2 emissions	1008472	1026100	-17628
		GDP	90090	89965	125
Major exporters of solid waste	America	CO_2 emissions	541706	554360	-12654
		GDP	90090	90012	78
	Japan	CO_2 emissions	122890	121760	1130
		GDP	34483	34099	384
Major importers of solid waste	India	CO_2 emissions	260736	275540	-14804
		GDP	18942	20578	-1635
	Malaysia	CO_2 emissions	27542	26129	1413
		GDP	2458	2366	92

From the above table, we can find out:

Due to China's ban on solid waste importers, environmental pollution has greatly improved, and the economy has shown a steady or upward trend. According to the analysis data, due to the promulgation of the policy of banning the import of solid waste, the emissions of environmental polluters, that is, CO2, have decreased by 176828 tons, and economically, the GNP increased by 125.1 billion yuan in 2018. Banning the import of solid waste will promote both the environment and the economy.

For the major exporting countries affected by the policy of banning the import of solid waste-- the United States and Japan, the environmental pollution has intensified, and the economy has shown a steady trend of change. According to the analysis data, Japan's real CO2 emissions have increased by 1130 tons, due to environmental pollution caused by the extra disposal of garbage. The economic impact on the United States and Japan is small.

For India and Malaysia, the major waste importing countries affected by the policy of banning the import of solid waste, the economy is multiplying, but environmental pollution is increasing. The analysis of the data shows that due to the impact of some policies in India in 2018, its information is opposite to that of Malaysia, so it is not of reference significance. In Malaysia, due to the import of solid waste to make up for the gap in raw material sources, GDP increased by 92.4 billion yuan, but due to the environmental pollution caused by waste disposal, the actual emissions of CO2 increased by 1413 tons.

To further discuss the impact of China's policy on the import of solid waste on the environment and economy of countries around the world [7], calculates the ratio of the predicted value to the actual cost of garbage import and export countries, as shown in Fig.1.

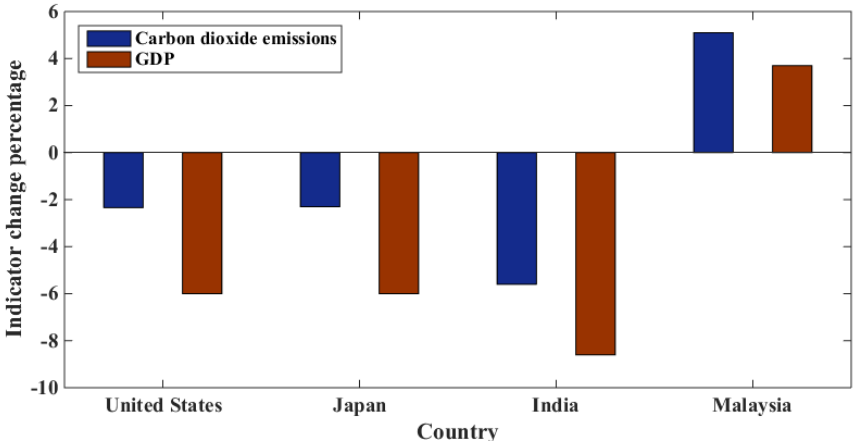

Fig.1 percentage of countries affected

As can be seen from Fig.1. For China before and after the implementation of "China's policy of banning the import of solid waste," the amount of garbage import mainly affected the change of the environment. It shows that the main benefit after China's implementation is in the improvement of the environment, and the economy has not been significantly affected. China banned the import of solid waste garbage exporting country before and after the policy, environmental impact "is not very clear, the overall trend of decline. As the first transport line break will lead to the increased cost of the new line of links, so GDP will drop slightly. For the garbage importing countries before and after the impact of "China's policy of banning the import of solid waste," GDP is overgrowing, but environmental pollution is aggravating, and the effect on the environment even exceeds the growth of GDP.

5. Conclusion

To explore the impact of China's ban on the import of solid waste on the world economy and the environment. In this paper, a VR autoregressive model based on time series is established. India, Malaysia, the United States, and Japan are selected as countries affected by China's ban on imported waste to replace the influence of the world. The GDP and CO2 emissions of various countries are used as indicators to measure the economy and the environment. Through the prediction of the data that China has not implemented the ban on the collection of imported waste and compares it with the data after the actual implementation.

The results show that: after the promulgation of the policy, the environmental quality of the major waste importing countries decreased and the economy increased, among which Indonesia's GDP and environmental pollution increased, while India's GDP decreased slightly due to the reduction of imports, and so did environmental pollution. The environmental pollution in developed countries has increased slightly, but the change in GDP is not obvious.

References

1. The Ministry of Ecology and Environment and other four ministries jointly issued the "Announcement" [EB / OL] to adjust the import waste management catalog. [2020/2/25]. Https://baijiahao.baidu.com/s?id=1621149457966262856&wfr= spider & for = pc.
2. Al-Salem S M, Lettieri P, Baeyens J. Recycling and recovery routes of plastic solid waste (PSW): A review [J]. WASTE MANAGEMENT, 2009,29 (10): 2625-2643.
3. Brooks A L, Wang S, Jambeck J R. The Chinese import ban and its impact on global plastic waste trade [J]. SCIENCE ADVANCES, 2018,4(eaat 01316).
4. Chen Y, Cui Z, Cui X, et al. Life cycle

assessment of end-of-life treatments of waste plastics in China [J]. RESOURCES CONSERVATION AND RECYCLING, 2019,146: 348-357.

5. CO2 emissions (kg/PPP USD GDP) | Data [EB/OL]. [2020/2/25]. Https://data.worldbank.org.cn/indicator/EN.ATM.CO2E.PP .GD.
6. Podobnik B, Stanley H E. Detrended cross-correlation analysis: A new method for ana-lyzing two nonstationary time series[J]. PHYSICAL REVIEW LETTERS, 2008,100(0841028).
7. Qu S, Guo Y, Ma Z, et al. Implications of China's foreign waste ban on the global circular economy[J]. RESOURCES CONSERVATION AND RECYCLING, 2019,144:252-255.