

Comparative Study on the Economic Environment of Oil and Gas Resource Countries based on Entropy Weight-TOPSIS Method

Mingyan Ding

Beijing Jiaotong University, Beijing, China

Keywords: Economic Environment, Entropy Weight-Topsis Method, Research and Prediction, Oil and Gas Resources Cooperation Countries.

Abstract: This paper evaluates the economic environment of oil and gas resource cooperation countries of China through data evaluation. This paper selects 9 evaluation indicator variables, constructs the evaluation system, and uses the entropy weight and TOPSIS method to calculate the economic environment of these countries. According to the assessment results, population, per capita GDP and total GDP have the greatest impact on the economic environment. India, Qatar, UAE, Indonesia and Russia have the best economic environment and have good investment prospects for Chinese companies; Uzbekistan, Iran and Azerbaijan have relatively backward economic environment and high investment risk, so a risk response system should be established before business corporation.

1 INTRODUCTION

Since the "one belt, one road" initiative was proposed, China's cooperation with oil and gas resources countries along the route has become increasingly close. However, most countries along the line belong to developing countries, and there are great differences in soft environment such as economic development, political situation, legal environment and social environment. These factors may be potential investment risks. Economic environment is one of the most important components of soft environment. At present, the backward economic development of some countries increases the risk of Chinese enterprises investing abroad. In order to promote cooperation with countries rich in oil and gas resources and reduce investment risks, China must study and predict the economic environment of countries along the line. By understanding the economic development of various countries, enterprises choose appropriate investment cooperation countries.

Economic environment is a non-material condition and an important benchmark to measure the investment environment of a country or region. Investment in various countries, regions or industries is increasingly inseparable from economic soft environment evaluation. The development of big data

economy provides scholars from all walks of life with a new method to study the economic environment. Since the one belt and road initiative, many scholars have evaluated and analyzed the economic environment of different countries based on different data methods to guide China's enterprises to invest overseas.

Most domestic scholars generally start with the hard environment and soft environment when studying the investment environment of China's oil and gas resources cooperation countries. There is little literature devoted to the economic environmental conditions of countries along the line. Moreover, the index system and research methods constructed by domestic scholars are not exactly the same. Therefore, combined with relevant data, this paper studies the economic environment of China's oil and gas resources cooperation countries, constructs an evaluation system and makes mathematical analysis, so as to deeply understand and predict the economic environment of countries along the line.

The investment environment can reflect a country's ability to attract investment. The theory of "investment environment" appeared only around 1970. With the development of mathematical model and information technology, foreign scholars began to carry out quantitative research, and the research results are more objective. Gliberman (2002) studies

the impact of national governance capacity on foreign capital inflow and outflow, which is divided into three aspects: economy, politics, system and legal environment (Globerman, 2002) Raj (2016) established a comprehensive evaluation system to study supply chain management decisions, analyzed and ranked multiple decision-making processes with entropy weight method and TOPSIS ranking method, and selected the optimal decision (Raj, 2016, Kumar, 2016, Sharma, 2016). Hussain Jamal (2020) conducted a comprehensive assessment of the investment risks and natural resources of countries along the "Belt and Road" through entropy weight-TOPSIS ranking, and provided the minimum risk recommendations for Chinese enterprises to invest abroad. The results showed that Singapore, Malaysia, Nepal, Bhutan, Russia, Armenia and the UAE are the most suitable for Chinese companies to invest in (Jamal, 2020, Zhou, 2020., Guo, 2020, Anwar, 2020).

This paper aims to be based on the economic environment of some oil and gas countries, so the selected indicators are the economic and environmental indicators of countries rich in oil and gas resources. Many scholars have also studied the economic environment assessment of oil and gas countries, but there is no unified evaluation system. Wang Yue (2016) studied the investment environment of oil and gas countries from nine aspects such as economic environment (Wang, 2016). He Bo et al. (2013) studied the integration of economic environment and political environment (He, 2013, An, 2013, Fang, 2013, Zhao, 2013, Ding, 2013). Liu Erhu (2018) divided it into four aspects: political environment, economic environment, infrastructure conditions and production factors (Liu, 2018, Chen, 2018).

Some scholars construct the evaluation index system and select the evaluation model for quantitative analysis, and the results are more scientific. Wang Xinmin et al. (2015) used Theil index to quantitatively study the investment environment of major oil and gas countries (Wang, 2015, Liu, 2015, Sun, 2015). Li Yu et al. (2016) constructed the index system through the Delphi method, evaluated the investment environment from six aspects, and divided the countries along the line into four strategic countries: priority investment area, key investment area, potential investment area and risk area (Li, 2016, Zheng, 2016, Jin, 2016, Wang, 2016, Li, 2016, Zhao, 2016, Huang, 2016, Dong, 2016). Wang Yue (2016) one of the 9 level one indicators and 58 two one indicators, one belt, one road, the main oil and gas cooperation countries, and the distribution of investment indicators (Wang,

2016). Wang Yaoqing and others (one) compare the advantages one of the "one belt, one road" main product from the perspective of the global industrial chain (Wang, 2017, Tun, 2017, Sun, 2017). Liu Erhu and Chen Ying (2018) used entropy weight method to measure the impact of economy on the investment environment of the five Central Asian countries (Liu, 2018, Chen, 2018). Li Youshu et al. (2019) used entropy weight method to evaluate investment in some energy countries, and used SE-DEA model and Malmquist index method to evaluate investment performance (Li, 2019, Li, 2019, Luo, 2019).

In the domestic research literature, scholars mostly build the investment environment evaluation indicators system to quantitatively evaluate the investment environment of various countries, so as to put forward corresponding investment suggestions. Although the research method of constructing the evaluation system is more scientific than the simple qualitative research. However, the comprehensive evaluation system is easy to be incomplete and omit indicators, resulting in inconsistent evaluation system and inconsistent research results. Therefore, this paper only evaluates and forecasts the economic environment to ensure the comprehensiveness of the indicators. In order to ensure the objectivity of data and results, the most objective research method entropy weight TOPSIS method is selected.

The structure of this paper is as follows, the second part is the Materials and Methods, the third part is the results and discussion, and the fourth part is the conclusions.

2 MATERIALS AND METHODS

2.1 Materials

According to the richness of oil and gas resources and the availability of data, this paper finally selects 18 countries as the research objects. According to the country guidelines of the Ministry of Commerce, Kazakhstan, Turkmenistan and Uzbekistan belong to Central Asia; Iran, Saudi Arabia, Kuwait, Qatar, UAE, Oman and Egypt belong to West Asia and North Africa; Indonesia, Malaysia, Thailand and Vietnam belong to Southeast Asian countries; There are also India, Russia, Pakistan and Azerbaijan, a total of 18 countries.

The data used in this paper are from the foreign guide of the world bank, the Ministry of Commerce of China and the Wall Street Journal. The economic environment is an important aspect that constitutes the soft environment. The quality of a country's

economic environment directly affects investor confidence. Generally speaking, a country with a better economic environment has a better environment in terms of education, infrastructure, roads, etc., and the investment risk is lower, and it is more favored by investors. Therefore, this paper constructs the following index system to evaluate the economic environment of various countries.

Based on the evaluation system in the reference literature of quantitative research, this paper screened out 5 first-level indicators and 9 secondary indicators of economic environment. Therefore, the economic environment evaluation system of my country's oil and gas resource cooperation countries is constructed.

Table 1: Evaluation indicators.

Primary indicators	Secondary indicators
Economic scale	Total GDP
	population
Economic level	Per capita GDP
	GDP growth rate
foreign trade	Proportion of total import and export in GDP
	Net FDI inflow
Economic stability	Inflation rate
	unemployment rate
economic system	Economic freedom

Explain the above evaluation system and indicators: since the economic freedom index cannot be measured by actual values, the reference to the relevant literature here is replaced by the score of the economic freedom of various countries in the report published by the Wall Street Journal.

2.2 Entropy Weight – TOPSIS

2.2.1 The Meaning of Entropy Weight Method and TOPSIS Method

Entropy was first introduced in thermodynamics to measure the degree of disorder in microscopic matter as it moves thermally. Later, Shannon proposed the "information theory", which quantitatively analyzes the problem with information entropy, so as to make an objective evaluation. Because the entropy weight method has the advantages of objectivity and strong persuasion, the entropy weight method is now widely used in the evaluation and analysis of economic, social, engineering and other fields. In this paper, the entropy weight method is also chosen because of its objectivity. It is completely based on the analysis of data to obtain results and is not easily affected by subjective factors.

The entropy weight method determines the weight of the indicator by measuring the disorder degree of

the data. That is to say, the more disordered the index, the more information it provides, the smaller its information entropy, and the greater its role in the evaluation system, so the greater the weight is given.

TOPSIS is to sort the compared objects by calculating the distance between the compared objects and the positive and negative ideal solutions when comparing multiple indicators or multiple schemes. Combined with the entropy weight method, on the one hand, the objective weight data calculated by the entropy weight method can be used, and on the other hand, TOPSIS can sort and compare multiple objects.

2.2.2 Entropy Weight Method and TOPSIS Sorting Calculation Process

We assume that there are m countries, and each country has a total of n last-level evaluation indicators. x_{ij} represents the jth indicator of the ith country. Y_{ij} represents the jth indicator of the ith country. (i=1, 2, ..., m; j=1, 2, ..., n)

a) Standardize processing and calculate information entropy

$$X'_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} \quad (1)$$

$$X'_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} \quad (2)$$

$$Y_{ij} = \frac{x'_{ij}}{\sum_{i=1}^m x'_{ij}} \quad (3)$$

The information entropy is E, and the information entropy of the jth index is E_j; constant K=-1/ln m, calculate information entropy:

$$E_j = K \sum_{i=1}^m Y_{ij} \ln Y_{ij} \quad (4)$$

If $Y_{ij} = 0$, then $\ln Y_{ij}$ The formula has no meaning, so it is defined at this time $Y_{ij} \ln Y_{ij} = 0$.

b) Determine index weight

Let the weight be w and the weight of the jth indicator be W_j .

$$W_j = \frac{1-E_j}{\sum_{j=1}^n (1-E_j)} \quad (5)$$

c) Calculate Euclidean distance

Let the positive distance be d_i^+ , the negative distance is d_i^- , the European distance of the ith country is d_i^+ or d_i^- . calculation:

$$d_i^+ = \sqrt{\sum_{j=1}^n (Y * W_j - \max Y * W_j)^2} \quad (6)$$

$$d_i^- = \sqrt{\sum_{j=1}^n (Y * W_j - \min Y * W_j)^2} \quad (7)$$

d) Calculate TOPSIS proximity and sort

The calculated proximity is used as the score of TOPSIS method in various countries.

$$c_i = \frac{d_i^-}{(d_i^- + d_i^+)} \quad (8)$$

According to the definitions of the entropy weight method and the TOPSIS method, the proximity is between 0 and 1, and the closer to 1, the better the soft environment of the country. Therefore, in this paper, the calculated Entropy Weight-TOPSIS proximity is ranked according to the economic environment of various countries.

3 RESULTS AND DISCUSSIONS

3.1 Weighting Results and Discussion

The weights of secondary indicators and tertiary indicators are calculated by entropy weight method, as shown in Table 2.

Table 2: Weight of evaluation indicators.

Primary indicators	weight	Secondary indicators	weight
Economic scale	0.45	Total GDP	0.16
		Population	0.29
Economic level	0.25	GDP per capita	0.17
		GDP growth rate	0.07
foreign trade	0.17	Proportion of total import and export to GDP	0.08
		Net FDI inflow	0.09
Economic stability	0.07	Inflation rate	0.03
		Unemployment rate	0.04
economic system	0.05	Economic freedom	0.05

The weights of the three indicators of population, GDP per capita and total GDP are relatively high, indicating that these three indicators are the most important in evaluating the economic environment and have the greatest impact on the economic environment. Countries with large populations may have greater market potential and have a better investment climate. Economic stability and economic system indicators have less weight, indicating less impact on the economic environment.

3.2 Evaluation Results and Discussion

Table3 calculates the TOPSIS proximity as scores and sorts all countries according to the results.

Table 3: Economic environment ranking of countries.

country	ranking	score
India	1	0.6509
Qatar	2	0.3407
The United Arab Emirates	3	0.2908
Indonesia	4	0.2665
Russia	5	0.2581
Vietnam	6	0.2557
Kuwait	7	0.2111
Malaysia	8	0.2063
Thailand	9	0.2017
Saudi Arabia	10	0.1928
Pakistan	11	0.1870
Turkmenistan	12	0.1542
Oman	13	0.1504
Egypt	14	0.1422
Kazakhstan	15	0.1341
Uzbekistan	16	0.1297
Iran	17	0.1159
Azerbaijan	18	0.1157

India scored the highest, indicating that India's economic environment is the best, mainly due to the country's large population and large economic aggregate. The economic development of India is similar to that of China. With large economic scale and rapid development, India is one of the most influential developing countries in the world. Followed by Qatar, the United Arab Emirates, Indonesia and Russia, these countries are favored by investors because of their large economic aggregate or high per capita GDP, stable economic policies and stable markets. Qatar and the United Arab Emirates have rich oil and gas resources and good economic environment. Although the population is small, the per capita GDP is relatively high. The economic system is very flexible, the tax burden on enterprises is minimal, and the restrictions on foreign investment are small. When Chinese companies choose countries to cooperate with, they can give priority to these countries with higher scores. They have a good economic environment.

Vietnam scored 6th, with a better economic environment. Vietnam's economy is developing at the fastest speed and has great potential for development. Moreover, the Communist Party of Vietnam is in power, and the government has high work efficiency and continuous policies, which is conducive to domestic political stability, economic development and regulation.

The economies of Uzbekistan, Iran and Azerbaijan are relatively backward. Uzbekistan is a small country with insufficient market potential and a small economy. Iran is affected by U.S. sanctions,

political instability, hampered oil exports and stagnant economic development. Unemployment and inflation are at high levels, people's living standards are declining, and foreign capital has less expectations. The disintegration of the Soviet Union has had a huge impact on Azerbaijan, and Azerbaijan's economy is constrained by the current oil and gas downturn. The economic environment of these countries is backward, and the risks of economic cooperation are relatively high. Therefore, investors should guard against economic risks in international cooperation.

4 CONCLUSIONS

This paper conducts a comparative study on the economic environment of 18 oil and gas resource cooperation countries. Nine measurement indicators are selected to construct an evaluation system, and entropy weight method and TOPSIS ranking method are used to evaluate the research objectives. The results show that population and per capita GDP have the highest weights and have the greatest impact on the economic environment. The ranking results of TOPSIS show that India, Qatar, and the United Arab Emirates are the three countries with the best economic environment. Although the economic environment of these three countries ranks high, there are still investment risks in each country. Before cooperation, enterprises must do a good job of investigation, consultation and planning, and fully understand the political, legal system, social customs and other conditions of the host country. Uzbekistan, Iran, and Azerbaijan are the three countries with the worst economic environment. Prioritizing cooperation with countries with a better economic environment can effectively expand the market and avoid risks; cooperation with countries with unstable economies may bring losses. However, these countries have abundant energy resources and they are potential resource cooperation countries. Carrying out oil and gas cooperation with these countries is conducive to ensuring the diversification of sources of China's oil and gas resources. It is necessary to be vigilant against risks in the economic environment. Chinese companies should establish an effective risk response system and not fight unprepared battles.

There are still research limitations in this paper, and the selected indicators are biased towards the macroscopic aspect. In the future research, the economic environment needs to be studied from the microscopic level. The factors affecting the economy

are complex, and it is hard to quantify all the influencing factors, so the established indicator system is not perfect.

REFERENCES

- Globerman, S. (2002) Global Foreign Direct Investment Flows: The Role of Governance Infrastructure. *World Development*, 30.
- He, B., An, H.Z., Fang, W., Zhao, H.Y., Ding, Y.H. (2013) Evaluation and optimization of global oil and gas resources investment environment. *Resources and industry*, 15: 114-118.
- Jamal, H., Zhou, K., Guo, S.L., Anwar, K. (2020) Investment risk and natural resource potential in "Belt & Road Initiative" countries: A multi-criteria decision-making approach. *Science of The Total Environment*.
- Li, Y., Zheng, J., Jin, X.T., Wang, Z., Li, Z.H., Zhao, M.Y., Huang, Y.B., Dong, S.C. (2016) "One belt, one road" investment environment comprehensive evaluation and Countermeasures. *Journal of the Chinese Academy of Sciences*, 31: 671-677.
- Li, Y.S., Li, L., Luo, Y.L. (2019) China's location choice one belt, one road and other countries: Based on investment environment and investment performance. *Economic issues*, 7: 115-122.
- Liu, E.H., Chen, Y. (2018) Comparative study on investment environment of five Central Asian countries under the background of Silk Road Economic Belt. *World geographic research*, 27: 100-107.
- Raj, A., Kumar, J., Sharma, H. (2016) Analysis of Rural E-commerce Evaluation in Heilongjiang Province Based on Entropy Weight Method. *Indian Journal of Public Health Research & Development*, 1.
- Wang, X.M., Liu, B.Q., Sun, J.F. (2015) Study on potential evolution and differential change trend of international oil and gas investment environment. *World economic research*, 2: 105-114 + 129.
- Wang, Y. (2016) Analysis and evaluation of one belt, one road main oil and gas investment environment. *Industrial technology and economy*, 35: 118-127.
- Wang, Y.Q., Tun, F.H., Sun, Z.H. (2017) "One belt, one road" oil and gas trade competitiveness measurement and cooperation potential evaluation: A Perspective of the whole industry chain. *Journal of the Pacific*, 25: 68-83.