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# Country Evaluation for China's Hydropower Investment in the Belt and Road Initiative Nations

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**Abstract:** With the implementation of China's "Going Out" strategy and "Belt and Road Initiative" (BRI) as well as the shortage of domestic hydropower market, the scale of hydropower investment along BRI by Chinese companies has expanded rapidly. However, these countries have great differences in politics, laws, economy, hydropower potential, social development and environmental constraints. Due to the inappropriate choice of countries for investment, many failure cases have also occurred. To specifically evaluate hydropower investment in these countries, this paper proposed a six-dimensional indicator system which can represent the characteristics of hydropower investment along BRI based on the analysis of the typical cases of overseas investment by Chinese enterprises. Furthermore, a fuzzy optimal model based on the Delphi-Entropy weight was constructed to evaluate the hydropower investment of 65 countries along BRI as well as a list of countries and corresponding investment grades are proposed. The result indicates that politics and hydropower industry factors are the key determinants of choosing the countries for conducting investment while legal, economic, social and environmental factors should also be covered. In conclusion, the optimal choices for China's hydropower investment along BRI are Russia, Pakistan, Malaysia, Kazakhstan and Indonesia and the strategy has been given accordingly. Moreover the policy recommendations from the perspective of nation and enterprise level have also been proposed.

**Keywords:** Belt and Road Initiative; hydropower investment evaluation; delphi-entropy weight; fuzzy optimal model

## 1. Introduction

In 2013, Chinese President Xi Jinping proposed the "Belt and Road Initiative" in accordance with changes in the world's situation which is the Chinese government's commitment to maintain the global trading and open economic system, and promote cooperation and mutual benefit between nations. China's BRI is of great significance to global economic development. By the end of 2019, China has signed about 200 documents with nearly 170 countries and international organizations regarding BRI cooperation. Chinese enterprises have participated in the investment and construction of about 320 overseas hydropower projects with a total installed capacity of 81 GW, which is more than 30 billion US dollars investment [1]. Hydropower is a clean and renewable energy with the properties of green, sustainability, high-efficiency and operation flexibility which can effectively reduce carbon dioxide emissions and optimize energy structure as well as the top priority choice for energy development in most countries along BRI [2]. Due to the hydropower resources that can be developed are very limited in China, investing in hydropower along BRI is of great significance to the sustainable development of Chinese enterprises abroad and can help BRI countries to improve electrification and reduce pollutant emissions as well.

BRI countries except China account for 42% of the world's population, but total GDP only accounts for 17% of the world [3]. Most of the areas along BRI are developing countries with poor economy, weak infrastructure, low electricity consumption and indicators such as per capita electricity consumption and per capita installed capacity, which are far below the world's average [4]. There are huge hydropower resources along BRI. The theoretical reserves and technologically developable amounts are respectively 12.57 trillion KWh per year and 4.94 trillion KWh per year, but the annual exploitation rate is only 15% [5]. Therefore, hydropower resources along BRI countries have great potential to be developed. According to the forecast, the total energy investment of the BRI economies will reach 27 trillion US dollars by 2050 [6].

With the implementation of the "Going-out" strategy and the "Belt and Road Initiative", Chinese enterprises have rapidly expanded hydropower investment overseas, unfortunately many losses have occurred. Hydropower projects have large investment, long construction, operation periods and many stakeholders involved as well as it will inevitably have a certain impact on the environment in the process of construction. The investors have to negotiate and sign the franchise agreement with host government, finalize the land acquisition and solve the environmental issues before obtaining the financing from the bank. There are regional differences in BRI countries. The economic level, hydropower potential, laws and policies, social security and conditions, religion faith and other aspects for each country is quite different so that hydropower investment along BRI is affected by many factors such as the host country's politics, laws, economy, electricity demand and hydropower industry, social development, environmental constraints and so on. It is necessary to evaluate the hydropower investment along BRI and select the appropriate countries for conducting investment.

Before BRI was put forward, many scholars conducted research on country risks of overseas investment which was limited to the analysis of single risk or single country, such as economy, political risk. Smith pointed out that exchange rate risk has a greater impact on enterprises' overseas investment, and further divided it into exchange and transaction risks [7]. On the basis of a large number of empirical studies, Boddewyn proposed that the factors which are likely to lead to political risks should be considered, including national sovereignty and interests [8]. Click analyzed the actual cases and data of American companies' foreign investment, and found that the country risk and financial risk of the host country can easily lead to political risks [9]. By investigating the influence degree of these factors in country risk assessment, Vij proposed that country risk is the result of the comprehensive influence of political, social and economic factors [10]. By establishing a gravity equation model, Chen conducted empirical research on actual cases and data of Chinese companies' overseas investment. The result shows that the economic indicator and geographic location of the host country are the main factors that affect overseas investment [11].

After BRI was proposed, many scholars have carried out research on the evaluation of investment in the countries along BRI, mainly focusing on the general energy and the study of certain types of energy such as oil and gas, coal, minerals or some other aspects, but the studies about hydropower investment is very limited. Xu established an evaluation indicator system from the aspects of politics, economy, electricity industry, society, environment and conducted risk evaluation on countries along BRI, and indicated that investment risk in West Asia and North Africa are relatively high while Central and Eastern Europe is the second place [12]. Ma established an indicator system for country evaluation based on the four aspects of coal reserves, consumption, production and trade in BRI, and proposed a list of major coal investment countries [13]. Taking Vietnam and Indonesia as examples, using the method of environmental stress testing to study China's overseas coal power investment projects, it is found that the coal price and exchange rate are the most sensitive economic factors for Vietnam and Indonesian's coal power projects respectively [14]. Wang used China's foreign trade data of minerals to construct a trade gravity model to evaluate the minerals investment in BRI, and came up with the country's ranking [15]. Zhou established a gas investment evaluation indicator system along BRI, including political situation, social condition, ecological environment, market quality, international cooperation and resource status indicators, and constructed a linear programming model

to propose ways to improve gas investment in countries along BRI [16]. Duan identified that the main risks of energy investment in BRI are political, regulatory, exchange, refinancing, and resource risks, and established a fuzzy comprehensive evaluation model based on entropy to evaluate energy investment risks of 50 countries along BRI. The result shows that the best countries for investment are Saudi Arabia, UAE, Pakistan, Kazakhstan and Russia [17]. Yuan pointed out that the risks of power investment in BRI include political, economic, power market, social, environmental and resource risks, and constructed a fuzzy comprehensive evaluation model based on entropy to evaluate the power investment risks of 21 countries along BRI [18]. Andrić identified the potential risks of the railway project along BRI and used fuzzy comprehensive assessment methods to assess the risks. It's found that design changes, design errors, complex terrain and geopolitical risks are the most critical risks in the railway projects. [19]. In addition, there are a few studies on new energy, port, high-speed railway, agriculture and environment [20–26].

Through the analysis of the above references, it can be concluded that the current researches regarding country evaluation of the investment along BRI are mainly as follows: (a) The evaluation of general investment risk and location selection of the BRI countries; (b) Country evaluation in case of a single risk factor; (c) Country evaluation of energy investment such as coal, oil and gas. However, there is no research on the evaluation of hydropower investment in BRI countries at present.

## 2. Materials and Methods

### 2.1. Indicator System for the Evaluation of Hydropower Investment in BRI Countries

The evaluation of hydropower investment in BRI countries is a complex system with multi-level, multi-objective and multi-dimension. To make an objective and reasonable evaluation, the representative and measurable evaluation indicators should be selected. As there is no relevant research on the country evaluation of hydropower investment and it is difficult to fully collect basic information and data of BRI countries, it is necessary to analyze the typical failure cases of Chinese enterprises' overseas investment and find key factors which are presented in Table 1 [27,28]. It shows that some cases which are caused by regime change and regional independent are related to political issue, some cases which are caused by approval procedures and misunderstanding of the local laws are related to legal issue, some cases which are caused by the inability to pay off debts are the parts of economic issue, some cases which are caused by the weakness in electric demand are related to electric market issue, some cases which are caused by the environmental resistance from government are related to environmental issue, while some cases which are caused by the war and security are related to social issue.

Based on the above cases and the specific characteristics of hydropower investment and the country evaluation research conducted by the other scholars in energy sector and other fields, we can see that different types of cases affected by different factors. Political issue is affected by government's governance, corruption, stability, bilateral relations, etc. Legal is issue affected by law enforcement, construction permits, environment of doing business, etc. Economic issue is affected by the financial foundation, Debt-paying ability, etc. Electric market issue is affected by the electricity market demand, potential, resource, etc. Social issue is affected by labor constraints, security, conflict, etc. Environmental issue is affected by environmental enforcement and resistance from the public, etc. Thus, this paper selects six dimensions, including political risk, legal system, economic foundation, hydropower industry, social development, environmental constraints factors and 24 specific indicators for country evaluation as follows:

The political dimension can be represented by government effectiveness, corruption index, government stability, investment dependence and the relationships with China. Effectiveness of the government reflects the quality of the host country's governance and the capability of independence from political pressure. Corruption index reflects the degree of corruption of the host country's political system. Government stability reflects the host country's ability to implement policies and maintain

the power. Investment dependence reflects the degree of dependence of the host country towards China in its investment. Relationships with China reflects important bilateral investment policies and investment attitudes and friendship by the host government.

**Table 1.** Summary of typical failure cases of Chinese enterprises' overseas investment.

Year	Cases	Results	Category
2000	Sichuan Electric Power Import and Export Corporation invested in Kaduri hydropower project in Georgia	The Georgian government was overthrown by the opposition, and the project site was attacked by the terrorist, which doubled the cost of the project	Political factor
2005	China Minmetals Corporation was acquiring Noranda Inc. of Canada	Canadian administrative authority was slow to approve and Noranda's market value soared during the approval period	Legal factor
2006	China Power Investment Corporation invested in Myitsone hydropower project in Myanmar	The Myanmar government unilaterally terminated the project on the grounds that the project affected the local ecological environment and people's livelihoods	Environmental factor
2007	China National Petroleum Corporation invested in petrochemical projects in Venezuela	Venezuela was unable to pay the cost and almost all investment projects in Venezuela were in suspension	Economic factor
2007	China Petrochemical Corporation invested in oil projects in Ethiopia	The project site was attacked and robbed by the extremely terrorist groups, resulting in the death of nine Chinese and kidnapping of seven Chinese	Social factor
2009	China Petrochemical Corporation invested in several oil and gas projects in Colombia and Syria	Regime change in Colombia and Syria led to project losses	Political factor
2009	China Railway Corporation invested in light rail project in Saudi Arabia	The corporation suffered huge losses due to misunderstanding the local laws and regulations of foreign investment, contracting and labor market	Legal factor
2011	Chinese enterprises invested in Libya	The war in Libya has affected personal's life and property and the project suffered losses	Social factor
2011	Powerchina and Sinochem Group invested seven energy projects overseas	Insufficient research on the electric market of the host country and misjudgment of electricity demand and gap resulted in project losses	Electric market factor
2012	China National Petroleum Corporation invested in oil projects in South Sudan	Changes in Sudan's political system and the establishment of South Sudan resulted in project losses	Political factor
2013	China North Industries Group was acquiring mining project in Myanmar	Suspended by the Myanmar government due to environmental issues	Environmental factor
2013	China Huaneng Group acquired some energy projects overseas	Continued weakness in electric market demand led to losses	Electric market factor
2014	State Grid invested in Kirirom hydropower project in Cambodia	Unable to pay the electricity charges led to continuous losses during the operation of the project	Economic factor
2015	China Communications Construction Group invested in Colombo Port City project in Sri Lanka	After the new government came to power, the project was re-examined and forced to be suspended for 18 months	Political factor
2015	China Gezhouba Group built Kisei hydropower station in Argentina	After the new government came to power, it assessed the project again and suspended all the payments	Political factor

The legal dimension can be represented by the legal system and foreign investment laws of the host country. Legal system reflects the strength towards the investors' protection and the quality of law's enforcement, which can be measured by the investor protection index and law enforcement indicator. Foreign investment laws reflect the host country's doing business environment and foreign investment restrictions, such as the degree of difficulty in the approval of starting a business and the degree of freedom in the business environment.

The economic dimension can be represented by the economic foundation and debt-paying ability of the host country. Economic foundation reflects the economy development and the intensity of

attracting foreign investment, including economic growth rate and investment openness. Debt-paying ability reflects the financial strength and debt situation and whether it will be able to pay electricity charges in the future, which can be measured by the ratio of fiscal revenue and expenditure to GDP and the ratio of foreign debt to foreign exchange reserves.

The hydropower industry dimension can be represented by the intensity of hydropower exploitation and the rest amount which can be developed, the potential of the electricity market and the urgency of electricity demand. The intensity of hydropower exploitation and the amount that can be developed reflect the supply of hydropower resources in host country. The potential of the electricity market and the urgency of electricity demand reflect the demand for electricity of the host country.

The social dimension can be represented by the level of education, labor market constraints, social security and internal conflicts of the host country. The level of education and labor market constraints measure the quality of the labor force and employment policies of the host country, and the social security and internal conflicts measure the society of the host country's degree of safety.

The environmental dimension can be represented by the environmental resistance from the public, environmental policies and the intensity of environmental governance. The environmental resistance reflects the public's resistance to the environmental protection of hydropower projects. The environmental policy and the intensity of environmental governance reflect the host country's environmental protection attitude towards developing hydropower projects and the implementation of environmental protection policies.

The indicator system has been established in Table 2.

**Table 2.** Evaluation indicator system for hydropower investment along BRI.

Dimensions	Indicators	Description	Date Source
Political Risk	Government effectiveness	The quality of the host government's governance and its independence from political pressure	WGI [29]
	Corruption index	Degree of government controls over corruption	WGI
	Government stability	The ability of the government to govern and maintain the power	WGI
	Degree of investment dependence	The host country's dependence on China's investment	WDI [30]
Legal System	Bilateral relations	The host country's friendly attitude towards Chinese companies investing in it	Chinese Foreign Ministry [31]
	Strength of investor protection index	The strength of the host country's legal system to protect investors	WB [32]
	Enforcing laws index	The quality and intensity of law enforcement in the host country	WB
	Dealing with construction permits	Difficulties and restrictions on the approval of starting a business in the host country	WB
Economic Foundation	Ease of doing business index	The business environment of the host country	WB
	GDP growth	Host country's GDP growth rate	WDI
	Trade openness	Foreign investment/GDP	WDI
	The financial strength of the host country	(fiscal revenue-fiscal expenditure)/GDP	IEF [33]
Hydropower Industry	Debt-paying ability	Foreign debt/foreign exchange reserves	IEF
	Intensity of hydropower exploitation	Hydropower resources developed/total resources	IHA [34]
	Electricity market potential	Calculated based on GDP per capita, electricity consumption per capita, installed capacity per capita and urbanization rate	WB
	Urgency of electricity demand	Expressed by the Electricity elasticity coefficient, Average growth rate of electricity consumption/Average growth rate of GDP	IHA
Social Development	The amount of hydropower that can be developed	The amount of hydropower resources that can be developed under the current technical level, unit is 100 million kWh/year	IHA
	Education level	Average years of education	WDI
	Labor constraints	the quality of the labor force and employment policies	EFW [35]
	social security	Crime Index	Numbeo [36]
Environmental Constraints	Internal conflict	The severity of the social, ethnic and religious conflicts	ICRG [37]
	Environmental resistance from the public	The public's resistance to the environmental protection of hydropower projects	BTI [38]
	Environmental policies	Enforcement of environmental protection policies	EPI [39]
	Intensity of environmental governance	Environmental Performance Indicators	EPI

## 2.2. Fuzzy Optimization Model for Hydropower Investment Evaluation of BRI Countries Based on Delphi-Entropy Weight

### 2.2.1. Determination of Indicator Weight

The methods for calculating the weight of indicators include subjective method and objective method.

The subjective method can use the experience of experts in related fields to determine the weight according to the importance of the indicator, such as Delphi method [40]. The Delphi method uses an anonymous method, allowing each expert to make his own judgment independently without being affected by other complicated factors. After several rounds of feedback in the forecasting process, the opinions of experts gradually become unified. This method fully considers the actual situation of the evaluation object, and the authorized result is relatively targeted, but it is easily affected by the subjective preference of experts, which makes the evaluation result subjectively random.

The objective method refers to use the value of indicators for weighting without considering human factors. The weight is determined entirely by statistical data which can avoid subjective influence, such as Entropy method [41]. Entropy was a thermodynamic concept and proposed by C.E. Shannon originally with the name of information entropy. The entropy method determines the weight of each indicator according to the amount of information that each indicator transmits to the decision maker. It has been widely used in hydropower investment evaluation and other fields. Compared with other objective methods, the entropy method is more suitable and accurate when dealing with a number of data.

As the hydropower investment in BRI is affected by politics, laws, economy, hydropower industry as well as other aspects and involves various stakeholders, it is quite different from China's domestic hydropower investment. Thus, the opinions from experts who have experienced and participated in the investment are very important. Meanwhile, the number of index data in this research is very large, which is very suitable to use entropy method. Considering the strength and weaknesses of these two methods plus the future of hydropower investment in BRI, this paper uses the comprehensive weighting method which is combining subjective method (Delphi) and objective method (Entropy) as the method to determine the weight of each indicator.

The Delphi method is developed on the basis of expert's judgment and meeting. After multiple rounds of anonymous consultation, the initial weight vector of each evaluation indicator is obtained on the basis of relatively consistent expert opinions. Then normalize the indicators to get the weight vector.

However, the Entropy method uses the thermodynamics and information theory of entropy to determine the weight of the indicator, and the process is as follows [42].

Step 1: Calculate the entropy value of the  $i^{\text{th}}$  indicator for the  $k^{\text{th}}$  dimension of  $m$  countries

$$H_i = -\frac{1}{\ln(m)} \sum_{j=1}^m (p_{ij} \ln(p_{ij})) \quad (1)$$

$$p_{ij} = (1 + x_{ij}) / \sum_{j=1}^n (1 + x_{ij}) \quad (2)$$

Step 2: Determine the entropy weight

The weight of the  $i^{\text{th}}$  indicator for the  $k^{\text{th}}$  dimension is

$$\omega_i'' = \frac{1 - H_i}{\sum_{i=1}^n (1 - H_i)} \quad (3)$$

Step 3: Using the linear method to determine the comprehensive weight of each indicator

$$\omega = \alpha\omega' + (1 - \alpha)\omega'' \quad (4)$$

where  $\omega$  represents the comprehensive weight,  $\omega'$  is the Delphi weight while  $\omega''$  is entropy weight. The meaning of  $\alpha$  is subjective preference coefficient which is given by the decision maker based on preference while  $(1 - \alpha)$  is objective preference coefficient,  $\alpha \in [0,1]$ . In this paper, let  $\alpha = 0.6$ .

### 2.2.2. Establishment of Fuzzy Optimization Model

Fuzzy optimization method is the extension and development of fuzzy comprehensive evaluation method, and its theoretical basis is also fuzzy mathematics. It establishes a multi-level fuzzy optimization theoretical model by constructing an objective function in a fuzzy environment, and gradually performs fuzzy optimization from a low level to a high level. It puts forward the concept of relative membership degree, expands the variation range of the membership degree of the evaluation system, reduces the subjective arbitrariness of the membership function to a certain extent, and at the same time avoids the defect of the fuzzy comprehensive evaluation method, that is, the ranking difference tends to be evened. The fuzzy optimization model method is more suitable and accurate especially when the number of the quantitative indicators is large in the evaluation system.

In addition, there are a large number of uncertainties in hydropower investment risk, including randomness and ambiguity. Evaluation for hydropower investment in BRI is a multi-objective, multi-level and complex issue. Consequently, this paper uses fuzzy optimization model based on Delphi-Entropy weight method to evaluate hydropower investment in BRI countries, which is relatively innovative and could avoid defect of other models.

The indicator system  $G$  includes  $q$  dimensions,  $G = \{G_1, G_2, \dots, G_q\}$ , which is called high-level indicator set. There are several indicators under the high-level indicator set. The  $t^{\text{th}}$  dimension includes  $m_t$  indicator,  $G_t = \{G_1^{(t)}, G_2^{(t)}, \dots, G_{m_t}^{(t)}\}$ , which is called low-level indicator set. The process for establishing the fuzzy optimization model is as follows:

#### (1) Fuzzy Optimization of Low-level Indicator Set $G_t$

##### Step 1: Build an relative membership matrix

Using the vector  $X_i^{(t)}$  to represent the  $m_t$  indicator's value of  $G_t$  for  $i$  country, where  $x_i^{(t)} = (x_{1i}^{(t)}, x_{2i}^{(t)}, \dots, x_{m_i}^{(t)})^T$ ,  $i = 1, 2, \dots, n$ .

The  $m_t$  indicator's value of  $G_t$  for  $n$  countries is:

$$X^{(t)} = \begin{bmatrix} x_{11}^{(t)} & x_{12}^{(t)} & \dots & x_{1n}^{(t)} \\ x_{21}^{(t)} & x_{22}^{(t)} & \dots & x_{2n}^{(t)} \\ \dots & \dots & \dots & \dots \\ x_{m_t 1}^{(t)} & x_{m_t 2}^{(t)} & \dots & x_{m_t n}^{(t)} \end{bmatrix}_{m_t \times n} = (x_{ki}^{(t)})_{m_t \times n}$$

where  $k = 1, 2, \dots, m_t$  and  $i = 1, 2, \dots, n$ .

##### Step 2: Normalization of Each Indicator

Standardize each indicator and convert them into a standard matrix. Generally, there are three types of the indicators: benefit type (the larger the better), cost type (the smaller the better) and intermediate type (which tends to be the best in the middle), which can be normalized by the following equations [43]:

For the benefit type,

$$r_{ki}^{(t)} = \frac{x_{ki}^{(t)} - \min(x_{ki}^{(t)})}{\max(x_{ki}^{(t)}) - \min(x_{ki}^{(t)})} \quad (5)$$

For the cost type,

$$r_{ki}^{(t)} = 1 - \frac{x_{ki}^{(t)} - \min(x_{ki}^{(t)})}{\max(x_{ki}^{(t)}) - \min(x_{ki}^{(t)})} = \frac{\max(x_{ki}^{(t)}) - x_{ki}^{(t)}}{\max(x_{ki}^{(t)}) - \min(x_{ki}^{(t)})} \quad (6)$$

For the intermediate type,

$$r_{ki}^{(t)} = \begin{cases} \frac{x_{ki}^{(t)} - \min(x_{ki}^{(t)})}{x_{ki}^{(t)*} - \min(x_{ki}^{(t)})} \\ 1 \\ \frac{\max(x_{ki}^{(t)}) - x_{ki}^{(t)}}{\max(x_{ki}^{(t)}) - x_{ki}^{(t)*}} \end{cases} \quad (7)$$

where  $x_{ki}^{(t)*}$  is the ideal value of the indicator,  $\max(x_{ki}^{(t)})$  is the maximum of the  $k^{\text{th}}$  indicator of the  $t^{\text{th}}$  dimension,  $\min(x_{ki}^{(t)})$  is the minimum of the  $k^{\text{th}}$  indicator of the  $t^{\text{th}}$  dimension and

$$\begin{cases} \min(x_{ki}^{(t)}) \leq x_{ki}^{(t)} \leq x_{ki}^{(t)*} \\ x_{ki}^{(t)} \leq x_{ki}^{(t)*} \\ x_{ki}^{(t)*} \leq x_{ki}^{(t)} \leq \max(x_{ki}^{(t)}) \end{cases}$$

The optimal membership matrix of  $G_t$  is

$$R^{(t)} = \begin{bmatrix} r_{11}^{(t)} & r_{12}^{(t)} & \cdots & r_{1n}^{(t)} \\ r_{21}^{(t)} & r_{22}^{(t)} & \cdots & r_{2n}^{(t)} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m_t 1}^{(t)} & r_{m_t 2}^{(t)} & \cdots & r_{m_t n}^{(t)} \end{bmatrix} = (r_{ki}^{(t)})_{m_t \times n}$$

where  $k = 1, 2, \dots, m_t$  and  $i = 1, 2, \dots, n$ .

**Step 3:** Determine the Country's Membership

Each country in the evaluation system subordinates to the superior scheme or the inferior scheme with a certain degree of membership, which is represented by the fuzzy matrix as follows:

$$G^{(t)}_{2 \times n} = \begin{bmatrix} g_{11}^{(t)} & g_{12}^{(t)} & \cdots & g_{1n}^{(t)} \\ g_{21}^{(t)} & g_{22}^{(t)} & \cdots & g_{2n}^{(t)} \end{bmatrix}_{2 \times n}$$

$$\text{Where } \begin{cases} 0 \leq g_{ui}^{(t)} \leq 1 \\ \sum_{u=1}^2 g_{ui}^{(t)} = 1 \quad (u = 1, 2; i = 1, 2, \dots, n) \\ 0 \leq \sum_{u=1}^2 g_{ui}^{(t)} \leq n \end{cases}$$

$g_{ui}^{(t)}$  represents the membership degree of the  $i$  country subordinating to the superior scheme (when  $u = 1$ ) or the inferior plan (when  $u = 2$ ).

**Step 4:** Determine the Optimal Membership

According to the optimization criterion, the optimal membership model for the  $i$  country relative to the low-level indicator set  $G_t$  is as follows:

$$g_{ii}^{(t)*} = \frac{1}{1 + \left\| \frac{\omega^{(t)} \times (r_i^{(t)} - a^{(t)})}{\omega^{(t)} \times (r_i^{(t)} - b^{(t)})} \right\|} = \frac{1}{1 + \left\{ \frac{\sum_{k=1}^{m_t} [\omega_k^{(t)} \times (r_{ik}^{(t)} - a_k^{(t)})]^p}{\sum_{k=1}^{m_t} [\omega_k^{(t)} \times (r_{ik}^{(t)} - b_k^{(t)})]^p} \right\}^{\frac{2}{p}}} \quad (8)$$

where  $p \geq 1$ ,  $t = 1, 2, \dots, q$  and  $i = 1, 2, \dots, n$ .  $\omega_k^{(t)}$  is the weight of the  $k^{\text{th}}$  indicator.  $a_k^{(t)}$  represents the maximum relative membership value of  $n$  country to the  $k^{\text{th}}$  indicator,  $b_k^{(t)}$  represents the minimum relative membership value of  $n$  country to  $k^{\text{th}}$  indicator.

Generally  $p = 2$  which is Euclidean Distance, then  $g_{ii}^{(t)*}$  can be defined as:

$$g_{ii}^{(t)*} = \frac{1}{1 + \frac{\sum_{k=1}^{m_t} [\omega_k^{(t)} \times (r_{ik}^{(t)} - a_k^{(t)})]^2}{\sum_{k=1}^{m_t} [\omega_k^{(t)} \times (r_{ik}^{(t)} - b_k^{(t)})]^2}} \quad (9)$$

where  $t = 1, 2, \dots, q$  and  $i = 1, 2, \dots, n$ .  $g_{ii}^{(t)*}$  is the basis for the higher level fuzzy optimization.

(2) Fuzzy Optimization of High-level Indicator Set G

Let  $g_{ii}^{(t)*} = g_{ii}$ , Where  $t = 1, 2, \dots, q$  and  $i = 1, 2, \dots, n$ .

The optimal membership matrix of high-level indicator set G is defined as:

$$G_{q \times n} = \begin{bmatrix} g_{11} & g_{12} & \cdots & g_{1n} \\ g_{21} & g_{22} & \cdots & g_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ g_{q1} & g_{q2} & \cdots & g_{qn} \end{bmatrix}_{q \times n} = (g_{ti})_{q \times n}$$

where  $t = 1, 2, \dots, q$  and  $i = 1, 2, \dots, n$ .

Similar to the process for calculating the optimal membership of  $G_t$ , the optimal membership model for the  $i$  country relative to the high-level indicator set G is as follows:

$$s_{ii}^* = \frac{1}{1 + \frac{\sum_{t=1}^q [\omega_t \times (g_{ii} - A_t)]^2}{\sum_{t=1}^q [\omega_t \times (g_{ii} - B_t)]^2}} \quad (10)$$

where  $i = 1, 2, \dots, n$ ,  $\omega = (\omega_1, \omega_2, \dots, \omega_q)^T$  and  $\sum_{t=1}^q \omega_t = 1, 0 \leq \omega_t \leq 1$ .  $A_t$  represents the maximum relative membership value of  $n$  country to the  $t^{\text{th}}$  dimension,  $B_t$  represents the smallest relative membership value of  $n$  country to the  $t^{\text{th}}$  dimension.

At last, the result for country evaluation and the investment ranking will be determined after calculating the optimal membership value  $s_{ii}^*$  of each country.

### 2.3. Selecting the Countries for the Evaluation

There are 65 countries along BRI and not every country should be evaluated [44]. The countries which should not be considered in the evaluation research are as follows:

(1) The amount of hydropower resources that can be developed is extremely low and the potential is insufficient. The investment in such countries is not sustainable. These countries are Singapore, Maldives, Moldova, Bahrain, Kuwait, Oman, Yemen, Jordan, UAE, Qatar, Macedonia, Armenia, Montenegro, Saudi Arabia, Estonia, Lithuania, Slovakia, Azerbaijan, Slovenia, Bosnia and Herzegovina, Lebanon, Turkmenistan, Latvia, Croatia, Sri Lanka, and Brunei.

(2) The political situation is extremely unstable. If the regime changes frequently, internal affairs are interfered by the other country, or wars and conflicts occur from time to time, it would easily lead to breach the contract by the host government and cause losses to investors. These countries are Afghanistan, Iraq, Syria, Ukraine, Israel, and Palestine.

(3) No diplomatic relations have been established with Chinese. Diplomatic relations reflect the basis of exchanges between the two countries. When investment problems arise, it can be coordinated

through diplomacy. A better diplomatic relationship is an important buffer to reduce investment risks, and is the most basic guarantee. Therefore, the country that has not established diplomatic relations with China should not be considered. This country is Bhutan.

(4) The legal system is extremely incomplete. If the laws, especially for foreign investment and the hydropower industry is missing or unclear, there will be many uncertain terms and the fundamental rights and interests of investors cannot be guaranteed. Therefore, the country with extremely weak legal system should not be considered. This country is East Timor.

(5) Environmental resistance is highly strong. The construction of hydropower projects have a certain impact on the environment more or less, and different countries have different policies and intensity on environmental protection. The project cost always increased due to the need to meet the environmental protection requirements or construct additional projects for the social and environmental development required by the host country. The public resistance and demonstration will result in long-term suspension and big losses to the project. Therefore, the country with strongly environmental resistance should not be considered. This country is Brunei.

Apart from the above 34 countries, the following 31 countries listed in Table 3 are selected as evaluation objects.

**Table 3.** The countries for hydropower investment evaluation along BRI.

No	Country	Region
S1	Egypt	Africa
S2	Pakistan	South Asia
S3	Belarus	Commonwealth of Independent States
S4	Bulgaria	Central Eastern Europe
S5	Poland	Central Eastern Europe
S6	Russia	Commonwealth of Independent States
S7	Philippines	Southeast Asia
S8	Kazakhstan	Central Asia
S9	Kyrgyzstan	Central Asia
S10	Cambodia	Southeast Asia
S11	Czech Republic	Central Eastern Europe
S12	Laos	Southeast Asia
S13	Romania	Central Eastern Europe
S14	Malaysia	Southeast Asia
S15	Mongolia	East Asia
S16	Bangladesh	South Asia
S17	Myanmar	Southeast Asia
S18	Albania	Central Eastern Europe
S19	Serbia	Central Eastern Europe
S20	Tajikistan	Central Asia
S21	Thailand	Southeast Asia
S22	Turkey	West Asia
S23	Uzbekistan	Central Asia
S24	Greece	Central Eastern Europe
S25	Hungary	Central Eastern Europe
S26	Iran	West Asia
S27	India	South Asia
S28	Indonesia	Southeast Asia
S29	Vietnam	Southeast Asia
S30	Nepal	South Asia
S31	Georgia	Commonwealth of Independent States

The country evaluation of hydropower investment along BRI effected by many factors and the evaluation indicator system is very complicated. In order to provide a strategy for investing in hydropower in BRI countries and facilitate investors to choose the right country based on their core competitiveness and anti-risk capabilities, the BRI countries are divided into five types of investment levels according to the comprehensive evaluation scores, that are priority countries, active tracking countries, potential country, long-term tracking countries, and countries are not considered for the time being.

### 3. Results and Analysis of the Risk

#### 3.1. Weights of the Indicator System

The author invited the experts from investors, lenders, insurers, law firms, EPC contractors, owner's engineers, consultants, design institutes and host government who are mainly engaged in hydropower investment along BRI to give scores on each indicator. Base on the Delphi method, the weight of each indicator is displayed in Table A1.

According to the value of each indicator (Table A2) and Equations (1)~(4), the Entropy weight of each indicator is calculated and the Delphi-Entropy comprehensive weights are displayed in Table A1.

#### 3.2. Determine the Optimal Membership

Take the low-indicator set as an example,  $G_1 = \{C_{11}, C_{12}, C_{13}, C_{14}, C_{15}\} = \{\text{Government effectiveness, Corruption index, Government stability, Degree of investment dependence, Bilateral relations}\}$ . According to the value of each indicator (Table A2) and Equations (5)~(10), standardize the indicator value and calculate the optimal membership matrix R of the low-level indicator set G (see Appendix A). In the same way, the optimal membership matrix of all low-level index sets can be obtained.

$$g_1^{(1)*} = (g_{11}^{(1)}, g_{12}^{(1)}, g_{13}^{(1)}, g_{14}^{(1)}, g_{15}^{(1)}) = (0.43, 0.23, 0.76, 0.51, 0.33, 0.92)$$

Calculate the relative weight vector of each low-level indicator, the value is

$$\omega = (\omega_1, \omega_2, \omega_3, \omega_4, \omega_5) = (0.194, 0.140, 0.092, 0.312, 0.151, 0.111)$$

Correspondingly using the same method of optimal membership of each low-level indicator to calculate the optimal membership of each country subordinating to the high-level scheme, the value is  $S_1 = 0.381$ .

#### 3.3. Result for the Evaluation

Calculate the other countries' optimal membership refer to the process for  $S_1$ , the value is

$$S = (0.381, 0.716, 0.432, 0.519, 0.570, 0.751, 0.449, 0.662, 0.480, 0.506, 0.564, 0.559, 0.551, 0.705, 0.360, 0.355, 0.386, 0.371, 0.427, 0.454, 0.398, 0.583, 0.469, 0.379, 0.363, 0.367, 0.495, 0.658, 0.532, 0.627, 0.481)$$

In order to provide a reference for investor, the above 31 countries are divided into Priority countries ( $S \geq 0.6$ ), Active tracking countries ( $0.5 < S \leq 0.6$ ), Potential countries ( $0.4 \leq S < 0.5$ ), Long-term tracking countries ( $S < 0.4$ ) and Unsuitable for investment countries in the basis of the above analysis. The results of the country evaluation are shown in Figure 1 and Table 4.

**Table 4.** The list and grade of the country for hydropower investment along BRI.

Grade	Result for the Evaluation
Priority countries	Russia, Pakistan, Malaysia, Kazakhstan, Indonesia, Nepal
Active tracking countries	Turkey, Poland, Czech Republic, Laos, Romania, Vietnam, Bulgaria, Cambodia
Potential countries	India, Georgia, Kyrgyzstan, Uzbekistan, Tajikistan, Philippines, Belarus, Serbia, Myanmar
Long-term tracking countries	Thailand, Egypt, Greece, Albania, Iran, Hungary, Mongolia, Bangladesh
Unsuitable for investment countries	Singapore, Maldives, Moldova, Bahrain, Kuwait, Oman, Yemen, Jordan, UAE, Qatar, Macedonia, Armenia, Montenegro, Saudi Arabia, Estonia, Lithuania, Slovakia, Azerbaijan, Slovenia, Bosnia and Herzegovina, Lebanon, Turkmenistan, Latvia, Croatia, Sri Lanka, Afghanistan, Iraq, Syria, Ukraine, Israel, Palestine, Bhutan, East Timor, Brunei

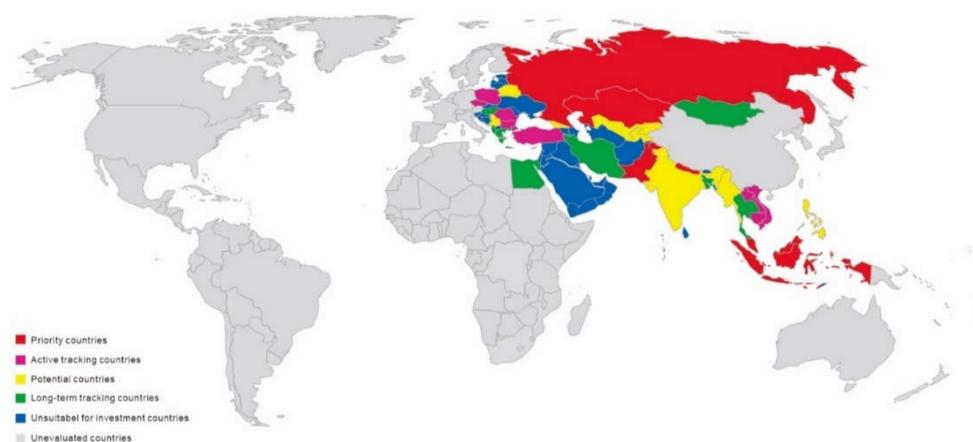


Figure 1. Hydropower investment map for BRI countries.

## 4. Conclusions and Implications

### 4.1. Research Conclusions and Recommendations

In summary, in country evaluation system, hydropower industry weight is the largest, and then is political risk weight. These two indicators have the greatest impact on the evaluation results. It indicates that the hydropower industry and political factors should be regarded as top priority when choosing a country in BRI for conducting investment. Consequently, for some countries with a basis of long-term cooperation with China and the Overseas Investment Insurance from Sinosure has been purchased, economic factor will not be considered at the most important factor affecting hydropower investment. Besides these factors, indicators of legal, social, environmental are also important factors which should be considered as well.

Compared with the results of country evaluation, hydropower investment does have its own particularity. The recommendations for hydropower investment in BRI countries are as follows:

(1) For priority countries, such as Russia, Pakistan, Malaysia, Kazakhstan, Indonesia and Nepal, the general situation of the six dimensions is very impressive, and the investment risk is relatively low. It is recommended the investor should get the Development Rights of some hydropower projects with good indicators from the host government and carry out feasibility study.

(2) For actively tracking countries, such as Turkey, Poland, Czech Republic, Laos, Romania, Vietnam, Bulgaria and Cambodia, the six dimensions are relatively good. The detailed electricity market research should be conducted and preliminary work such as due diligence should be carried out.

(3) For potential countries, such as India, Georgia, Kyrgyzstan, Uzbekistan, Tajikistan, Philippines, Belarus, Serbia and Myanmar, the six dimensions of such countries are at a medium level. Hydropower investment shall be made prudently and the time schedule for the investment should be controlled under a reasonable pace. The project risk analysis and preliminary studies should be carried out as well.

(4) For long-term tracking countries, such as Thailand, Egypt, Greece, Albania, Iran, Hungary, Mongolia, Bangladesh, the six dimensions are poor. The opportunities for investment in hydropower projects are not good recently, but the investor should closely follow it in a long time manner and wait for the indicators to be improved before investing.

(5) For the countries which are unsuitable for investment, such as Afghanistan, Iraq, Syria, Bhutan, East Timor, Brunei, etc., one or several indicators are extremely poor and the investors will face a serious risk as soon as starting hydropower investment. These countries should not be considered at present.

#### 4.2. Policy Proposal

(1) Hydropower investment in the future should be focused on Russia, Pakistan, Malaysia, Kazakhstan and Indonesia. Russia has fantastic hydropower reserves of 1670 TWh per year with a development rate of only 10%, mainly concentrating in Far East and Siberia, ranking first in BRI countries [5]. In the future, it will gradually reduce its dependence on oil and natural gas and transform to intensively utilize hydropower and other renewable energies. Pakistan is very rich in hydropower resources and the amount is 475 TWh per year of which only 16% has been developed [5]. Meanwhile China and Pakistan are all-weather strategic cooperative partners. With the rapid construction of projects under the China-Pakistan Economic Corridor, electricity demand in Pakistan will highly increase and electricity market gap will grow wider. Therefore, Pakistani government has given many preferential policies for hydropower development in order to attract foreign investment, but the issue of power triangle debt should be highly focused on as well. Malaysia and Indonesia have great potential for hydropower development with low development rate, stable politics, good business environment and strong economic development. At present, most of Chinese enterprises have only got the EPC contract from hydropower market. Once hydropower investment business is widely rewarded, these two countries will be a very good choice. Kazakhstan also has abundant hydropower resources which mainly concentrated in the cross-border river between China and Kazakhstan, such as Ili River and Irtysh River. In the future, Chinese enterprises should focus on cooperation on these cross-border rivers. The theoretical reserves of hydropower resource in Nepal is 83,000 MW but the current exploitation rate is less than 2% [45]. The domestic energy demand is in rapid growth, and there is a huge market for power delivery to India. Although the economy is poor, Nepal's infrastructure has been upgraded with the assistance of various countries and international financial organizations. Nowadays, hydropower development in Nepal is being fully launched. Chinese enterprises should focus on cross-border electricity market.

(2) From the perspective of national level, as Chinese enterprises accelerate their investment in hydropower in BRI countries, some problems about disorderly development and vicious competition occurred. It is suggested that national administrative department make overall planning in hydropower development and investment in BRI countries, conducting a good analysis of the typical country risk base on the various factors' influences, providing guidance to Chinese enterprises and reminding them of specific risks in a timely manner. In order to avoid viciousness competition, the authorities should combine the core capabilities and professional expertise of each enterprise to create a coordinated development environment. Finally, accelerating the pace of "going out", creating an upgraded version of China's hydropower "going out", and driving the enterprises of planning, design, equipment, construction, finance, insurance and other industries which are related to the hydropower chain to go abroad together.

(3) From the perspective of Chinese enterprises, they should invest and build hydropower projects based on the principle of sustainability rather than covering all countries along BRI. Hydropower investment requires a number of manpower, material resources and financial resources, it will cause a great waste of time and early-stage input once there are no follow-up projects after a single project is commissioned. Therefore, the enterprises should fully assess the risks of host country where the project is located and make a rational decision before investing in a specific project. In addition, different enterprises have different core competitiveness and anti-risk capabilities. For the different types of the countries recommended above, the enterprises should choose the countries which are suitable to them and right time being for conducting the hydropower investment. In the meanwhile, it is necessary to properly handle the relationship with the host government, military, local people, news media and other parties, participate in social welfare actively, establish a good image and finally make hydropower investment in BRI countries sustainable.

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## Appendix A

Standardize the indicator value and calculate the optimal membership matrix R of the low-level indicator set G.

$$R^{(1)} = \begin{bmatrix} G_1 & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} \\ S_1 & 0.24 & 0.06 & 0.80 & 0.11 & 0.53 \\ S_2 & 0.24 & 0.60 & 0.63 & 0.88 & 1.00 \\ S_3 & 0.28 & 0.76 & 0.76 & 0.56 & 0.68 \\ S_4 & 0.60 & 0.60 & 0.69 & 1.00 & 0.38 \\ S_5 & 0.88 & 0.24 & 0.63 & 0.00 & 0.46 \\ S_6 & 0.48 & 0.76 & 0.46 & 0.25 & 0.83 \\ S_7 & 0.60 & 0.52 & 0.35 & 0.13 & 0.33 \\ S_8 & 0.48 & 0.80 & 0.17 & 0.69 & 0.73 \\ S_9 & 0.24 & 1.00 & 0.35 & 0.88 & 0.48 \\ S_{10} & 0.24 & 0.56 & 0.28 & 0.88 & 0.74 \\ S_{11} & 0.96 & 0.40 & 0.59 & 0.33 & 0.42 \\ S_{12} & 0.36 & 0.56 & 0.28 & 0.88 & 0.70 \\ S_{13} & 0.52 & 0.56 & 0.56 & 0.16 & 0.41 \\ S_{14} & 1.00 & 0.40 & 0.65 & 0.64 & 0.52 \\ S_{15} & 0.36 & 0.60 & 0.52 & 0.05 & 0.38 \\ S_{16} & 0.24 & 0.20 & 0.65 & 0.15 & 0.50 \\ S_{17} & 0.00 & 0.80 & 0.00 & 0.88 & 0.44 \\ S_{18} & 0.64 & 0.40 & 0.50 & 0.70 & 0.42 \\ S_{19} & 0.56 & 0.40 & 0.43 & 0.23 & 0.50 \\ S_{20} & 0.20 & 1.00 & 0.35 & 0.88 & 0.54 \\ S_{21} & 0.68 & 0.60 & 0.61 & 0.17 & 0.68 \\ S_{22} & 0.72 & 0.40 & 0.63 & 0.68 & 0.31 \\ S_{23} & 0.24 & 1.00 & 0.35 & 0.35 & 0.54 \\ S_{24} & 0.72 & 0.60 & 0.83 & 0.33 & 0.43 \\ S_{25} & 0.80 & 0.20 & 0.52 & 0.33 & 0.44 \\ S_{26} & 0.36 & 0.80 & 1.00 & 0.89 & 0.47 \\ S_{27} & 0.48 & 0.40 & 0.74 & 0.19 & 0.00 \\ S_{28} & 0.52 & 0.20 & 0.80 & 0.35 & 0.47 \\ S_{29} & 0.48 & 0.40 & 0.48 & 0.57 & 0.31 \\ S_{30} & 0.51 & 0.20 & 0.87 & 0.26 & 0.54 \\ S_{31} & 0.76 & 0.00 & 0.54 & 0.19 & 0.25 \end{bmatrix}$$

$$g = \begin{bmatrix} G_1 & G_2 & G_3 & G_4 & G_5 & G_6 \\ S_1 & 0.43 & 0.23 & 0.76 & 0.51 & 0.33 & 0.92 \\ S_2 & 0.74 & 0.61 & 0.94 & 0.65 & 0.02 & 0.51 \\ S_3 & 0.68 & 0.24 & 0.70 & 0.51 & 0.77 & 0.29 \\ S_4 & 0.74 & 0.63 & 0.91 & 0.38 & 0.92 & 0.44 \\ S_5 & 0.42 & 0.81 & 0.89 & 0.50 & 0.93 & 0.30 \\ S_6 & 0.59 & 0.48 & 0.78 & 0.75 & 0.40 & 0.93 \\ S_7 & 0.31 & 0.34 & 0.99 & 0.57 & 0.24 & 0.44 \\ S_8 & 0.62 & 0.80 & 0.79 & 0.46 & 0.64 & 0.82 \\ S_9 & 0.63 & 0.35 & 0.95 & 0.48 & 0.45 & 0.88 \\ S_{10} & 0.56 & 0.19 & 1.00 & 0.60 & 0.36 & 0.79 \\ S_{11} & 0.57 & 0.79 & 0.90 & 0.49 & 1.00 & 0.38 \\ S_{12} & 0.59 & 0.18 & 0.98 & 0.59 & 0.10 & 0.84 \\ S_{13} & 0.39 & 0.63 & 0.96 & 0.50 & 0.91 & 0.36 \\ S_{14} & 0.73 & 0.98 & 0.94 & 0.47 & 0.83 & 0.50 \\ S_{15} & 0.30 & 0.56 & 0.39 & 0.47 & 0.39 & 0.57 \\ S_{16} & 0.26 & 0.02 & 0.96 & 0.63 & 0.48 & 0.17 \\ S_{17} & 0.40 & 0.01 & 0.95 & 0.65 & 0.23 & 0.69 \\ S_{18} & 0.56 & 0.83 & 0.58 & 0.36 & 0.52 & 0.65 \\ S_{19} & 0.36 & 0.54 & 0.88 & 0.53 & 0.65 & 0.82 \\ S_{20} & 0.63 & 0.20 & 0.96 & 0.54 & 0.46 & 0.67 \\ S_{21} & 0.58 & 0.85 & 0.93 & 0.47 & 0.30 & 0.27 \\ S_{22} & 0.58 & 0.77 & 0.91 & 0.49 & 0.42 & 0.59 \\ S_{23} & 0.50 & 0.36 & 0.98 & 0.56 & 0.50 & 0.64 \\ S_{24} & 0.64 & 0.69 & 0.42 & 0.47 & 0.72 & 0.38 \\ S_{25} & 0.43 & 0.60 & 0.79 & 0.26 & 0.98 & 0.35 \\ S_{26} & 0.79 & 0.08 & 0.97 & 0.26 & 0.34 & 0.72 \\ S_{27} & 0.29 & 0.27 & 0.92 & 0.72 & 0.57 & 0.13 \\ S_{28} & 0.44 & 0.50 & 0.94 & 0.57 & 0.44 & 0.46 \\ S_{29} & 0.40 & 0.43 & 0.93 & 0.48 & 0.41 & 0.80 \\ S_{30} & 0.46 & 0.26 & 0.91 & 0.70 & 0.42 & 0.22 \\ S_{31} & 0.28 & 0.94 & 0.97 & 0.49 & 0.85 & 0.21 \end{bmatrix}$$

Table A1. Weights of the indicator system.

Dimensions	Delphi	Entropy	Delphi-Entropy	Indicators	Delphi	Entropy	Delphi-Entropy
Political Risk	0.233	0.208	0.218	Government effectiveness	0.055	0.059	0.057
				Corruption index	0.038	0.031	0.034
				Government stability	0.051	0.045	0.047
				Degree of investment dependence	0.044	0.052	0.049
				Bilateral relations	0.045	0.021	0.031
Legal System	0.141	0.122	0.130	Strength of investor protection index	0.041	0.022	0.030
				Enforcing laws index	0.036	0.047	0.043
				Dealing with construction permits	0.030	0.027	0.028
				Ease of doing business index	0.034	0.026	0.029
Economic Foundation	0.167	0.113	0.135	GDP growth	0.042	0.043	0.043
				Trade openness	0.038	0.028	0.032
				The financial strength of the host country	0.042	0.015	0.026
				Debt-paying ability	0.045	0.027	0.034
Hydropower Industry	0.208	0.334	0.284	Intensity of hydropower exploitation	0.047	0.041	0.043
				Electricity market potential	0.051	0.103	0.082
				Urgency of electricity demand	0.052	0.049	0.050
				The amount of hydropower that can be developed	0.058	0.141	0.108
Social Development	0.139	0.113	0.123	Education level	0.031	0.028	0.029
				Labor constraints	0.035	0.031	0.033
				social security	0.040	0.030	0.034
				Internal conflict	0.033	0.024	0.028
Environmental Constraints	0.112	0.110	0.111	Environmental resistance from the public	0.039	0.048	0.044
				Environmental policies	0.037	0.031	0.033
				Intensity of environmental governance	0.036	0.031	0.033

Table A2. Original data and standard data of Political dimension.

Country	Original Data					Standardized Data				
	Government Effectiveness	Corruption Index	Government Stability	Degree of Investment Dependence	Bilateral Relations	Government Effectiveness	Corruption Index	Government Stability	Degree of Investment Dependence	Bilateral Relations
Egypt	-0.80	2.00	5.50	0.10	7.46	0.24	0.60	0.80	0.11	0.53
Pakistan	-0.80	2.00	6.40	0.67	8.92	0.24	0.60	0.63	0.88	1.00
Belarus	-0.70	1.60	5.70	0.44	7.92	0.28	0.76	0.76	0.56	0.68
Bulgaria	0.10	2.00	6.10	0.76	7.00	0.60	0.60	0.69	1.00	0.38
Poland	0.80	2.90	6.40	0.02	7.23	0.88	0.24	0.63	0.00	0.46
Russia	-0.20	1.60	7.30	0.21	8.38	0.48	0.76	0.46	0.25	0.83
Philippines	0.10	2.20	7.90	0.12	6.85	0.60	0.52	0.35	0.13	0.33
Kazakhstan	-0.20	1.50	8.90	0.53	8.08	0.48	0.80	0.17	0.69	0.73
Kyrgyzstan	-0.80	1.00	7.90	0.67	7.31	0.24	1.00	0.35	0.88	0.48
Cambodia	-0.80	2.10	8.30	0.67	8.12	0.24	0.56	0.28	0.88	0.74
Czech Republic	1.00	2.50	6.60	0.27	7.12	0.96	0.40	0.59	0.33	0.42
Laos	-0.50	2.10	8.30	0.67	8.00	0.36	0.56	0.28	0.88	0.70
Romania	-0.10	2.10	6.80	0.14	7.08	0.52	0.56	0.56	0.16	0.41
Malaysia	1.10	2.50	6.30	0.49	7.42	1.00	0.40	0.65	0.64	0.52
Mongolia	-0.50	2.00	7.00	0.06	7.00	0.36	0.60	0.52	0.05	0.38
Bangladesh	-0.80	3.00	6.30	0.13	7.38	0.24	0.20	0.65	0.15	0.50
Myanmar	-1.40	1.50	9.80	0.67	7.19	0.00	0.80	0.00	0.88	0.44
Albania	0.20	2.50	7.10	0.54	7.12	0.64	0.40	0.50	0.70	0.42
Serbia	0.00	2.50	7.50	0.20	7.38	0.56	0.40	0.43	0.23	0.50
Tajikistan	-0.90	1.00	7.90	0.67	7.50	0.20	1.00	0.35	0.88	0.54
Thailand	0.30	2.00	6.50	0.15	7.92	0.68	0.60	0.61	0.17	0.68
Turkey	0.40	2.50	6.40	0.52	6.77	0.72	0.40	0.63	0.68	0.31
Uzbekistan	-0.80	1.00	7.90	0.28	7.50	0.24	1.00	0.35	0.35	0.54
Greece	0.40	2.00	5.30	0.27	7.15	0.72	0.60	0.83	0.33	0.43
Hungary	0.60	3.00	7.00	0.27	7.19	0.80	0.20	0.52	0.33	0.44
Iran	-0.50	1.50	4.40	0.68	7.27	0.36	0.80	1.00	0.89	0.47
India	-0.20	2.50	5.80	0.16	5.81	0.48	0.40	0.74	0.19	0.00
Indonesia	-0.10	3.00	5.50	0.28	7.27	0.52	0.20	0.80	0.35	0.47
Vietnam	-0.20	2.50	7.20	0.45	6.77	0.48	0.40	0.48	0.57	0.31
Nepal	-0.12	3.00	5.10	0.21	7.50	0.51	0.20	0.87	0.26	0.54
Georgia	0.50	3.50	6.90	0.16	6.58	0.76	0.00	0.54	0.19	0.25

Note: The calculations for other dimensions are similar. Due to space limitations, it is not shown here in detail.

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