Hindawi
Mobile Information Systems
Volume 2021, Article ID 9119262, 9 pages
https://doi.org/10.1155/2021/9119262

Research Article

Assessment of International Competitiveness of AI Industry Based on Positive and Negative Ideal Points Weighting Method

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Received 18 August 2021; Revised 13 September 2021; Accepted 16 September 2021; Published 26 September 2021

Academic Editor: Sang-Bing Tsai

China, the United States, the United Kingdom, Germany, and other major AI superpowers as research objects, this paper establishes the assessment index system with the diamond model, weights the international competitiveness indexes of AI industry in the four countries based on positive and negative ideal points, and applies the simulated annealing (SA) algorithm to obtain the final weights. Then, the TOPSIS assessment method is used to score and rank their international competitiveness of AI industry. It is concluded that the United States is on the leading position in the human factor, knowledge factor, capital factor, enterprise strategy structure/competitors, and policy laws and regulations. China has a complete infrastructure system and huge market demand. The leading of these indicators is also the reason why China can catch up in the development of some industries when it participates in the global value division. Europe also performs well in knowledge factors, capital factors, strategic structure/competitors, and policies and regulations but needs to invest more in AI industry infrastructure. Finally, this paper analyzes the advantages and disadvantages of the countries and reasons to provide comparative reference among different countries for AI industry.

1. Introduction

According to classical economic growth theory, labor and capital are two related factors of economic growth, while the factor of technological progress is reflected in total factor productivity (TFP). As technological progress, AI can not only increase TFP but also promote the demand and supply of the production and consumption sectors. AI is as significant to economic growth as big machines were to the first industrial revolution, electrification to the second, and information technology to the third. Therefore, AI is one of the core drivers of the fourth industrial revolution in terms of technological progress in increasing TFP.

At present, the world is undergoing stagnant economic growth and an expanding debt; meanwhile, the marginal effects of economic stimulus policies are waning. It is no longer sufficient to sustain the stable development of the world over the past few decades by only increasing capital investment and labor input. To achieve sustained and positive economic growth, it has become an urgent task to increase TFP or seek technological progress, and AI is expected to become the breakthrough point of the current economic growth problem. According to Accenture's analysis of 12 developed countries, such as the United States and the United Kingdom, AI technology is expected to drive a doubling of their annual economic growth by 2035 [1].

2. Assessment Index System for AI International Competitiveness

In 1990, Michael Porter conducted a historical study on the industries in 8 developed countries (the United States, the United Kingdom, Sweden, Switzerland, Japan, Italy, Germany, and Denmark) and 2 new industrial countries (South Korea and Singapore). He concluded that international competitiveness consists of 4 key factors: production, demand, performance of related industries, and corporate strategy and competitors [2]. In addition, as auxiliary factors, government and opportunities also play roles in international competitiveness [3]. This paradigm for analyzing the international competitiveness of the industry is named as the "diamond model." Porter's diamond model has made outstanding contributions to the development of competitiveness theory and become a classic model for studying industrial competitiveness theory.

When assessing the international competitiveness of AI industry with the diamond model, some improvements need to be made to the diamond model based on the characteristics shown in the development of AI industry.

Considering that AI technology can be applied to all industrial and living sectors, its downstream demand can already be completely replaced by GNP; that is, all domestic economic outputs are downstream application areas of AI technology. While its upstream industry chain support such as the communications industry, data industry, and cloud computing industry overlaps with infrastructure, so it does not need to be listed as an index. Finally, given the fact that natural resources have a very little impact on the development of AI industry, the analyzes of natural resources as well as the upstream and downstream industrial chains are skipped and integrated into other assessment indexes. Then, the diamond model-based assessment index system for the international competitiveness of AI industry is obtained; details are shown in Table 1.

3. Weight Main Indexes for International Competitiveness of AI Industry Based on Positive and Negative Ideal Points

3.1. Content of Positive and Negative Ideal Point Weighting Method. First, a sample set is constructed based on collected data of the mobile phone, including M indicators and N assessment objects. Second, on the basis of the assessor's judgment, the positive-ideal solution x^+ and negative-ideal solution x^- of the assessment value are determined, thereby having the maximum and minimum assessment value in the assessment process [4]. Third, on the basis of the sample set, the efficiency type (the larger the value, the better) and the cost type (the smaller the value, the better) of the index data are all transformed into the efficiency type, and then the data are normalized, so that all the data value interval is [0, 1], and for any x, there is $\alpha(x_i, w_i) = \sum_{i=1}^{m} x_i w_i \in [0, 1]$.

The cost function refers to the relation that makes the weight w^* optimal, so the optimal w^* makes the optimal function obtain the minimum value. With this model, the cost function can be divided into three parts, and their corresponding functions are as follows.

In the first part, it should first make sure that the optimal assessment object x^+ has a larger value than that of the worst assessment object x^- [5]. And, the larger the difference between them is, the more obvious the features of the positive and negative ideal points are. Based on the above, the first part of the function can be defined as follows:

$$g_1(w) = \begin{cases} +\infty, & \alpha(x^-, w) \le \alpha(x^+, w), \\ \left(\dfrac{1}{\alpha(x^+, w) - \alpha(x^-, w)}\right)^2, & \text{otherwise.} \end{cases} \tag{1}$$

According to equation (1), if $\alpha(x^+, w) \le \alpha(x^-, w)$, then $g_1(w)$will be $+\infty$, which can directly exclude the case that the value of the worst solution is larger than that of the optimal solution [6]. If $\alpha(x^+, w) \ge \alpha(x^-, w)$, as the difference between $\alpha(x^+, w)$ and $\alpha(x^-, w)$ goes from 0 to 1, $g_1(w)$ will decrease from $+\infty$ to 0, i.e, the larger the difference between $\alpha(x^+, w)$ and $\alpha(x^-, w)$is, the smaller $g_1(w)$ will be and the smaller the value of cost function will be [7].

In the second part, given that x^+ and x^- are positive ideal solution and negative ideal solution, respectively, the value of other assessment objects should fall within $[\alpha(x^-, w), \alpha(x^+, w)]$. In order to achieve this purpose, the second part of the function $g_2(w)$ can be set to be the minimum average of all assessment values that are not within this interval, and $g_2(w)$ can be defined as follows:

$$g_2(w) = \ln\,[1 - \operatorname{avg}(\{\beta(x_i, w) | i = 1 \sim N\})]^2. \tag{2}$$

And, we have

$$\beta(x_i, w) = \frac{|\alpha(x_i, w) - \alpha(x^+, w)| + |\alpha(x_i, w) - \alpha(x^-, w)| - [\alpha(x^+, w) - \alpha(x^-, w)]}{2}. \tag{3}$$

That is to say, $\beta(x_i, w)$ represents the difference between the sum of absolute differences between value $\alpha(x_i, w_i)$ of object x_i and the optimal and the worst value and 1/2 of the difference between the optimal and the worst value, i.e., the part of an assessment object's value that is not within $[\alpha(x^-, w), \alpha(x^+, w)]$, so the value interval is still [0,1], and the value is expected to be as small as possible. According to equation (2), if $avg(\{\beta(x_i, w) | i = 1 \sim N\})$ decreases from 1 to 0, $g_2(w)$ will decrease from $+\infty$ to 0, a correlation in line with the requirements for the second part of the cost function.

In addition to meet the requirements of positive and negative ideal points, the weighting model should be added to some constraints so as to avoid an overlarge value of the weight due to the large difference in data led by a purely objective weighting model, for example, entropy method and variation coefficient method [8, 9]. Therefore, a regulating factor can be added to the cost function. If the weight loses its balance [10], the regulating factor will become larger accordingly. It is obvious that the weight w is a discrete probability distribution in essence, so information entropy can be used to represent

Table 1: Data of assessment index for international competitiveness of AI industry.

Secondary index	Tertiary index	China	USA	UK	Germany
Infrastructure	Number of cellular mobile telephones (millions)	1605	404.49	77.55	107.32
	Number of fixed or pipeline broadband access (millions)	731.18	130.15	26.47	34.68
	Cloud computing industry score index	43.7	82	81.8	84
	Large-scale data center share of the world's total	8%	44%	6%	5%
Human resources	Index of skilled graduates	59.1	71.2	62.3	68.4
	Total number of AI professionals	18232	28536	7998	9441
	Number of AI talent	977	5158	1177	1119
	Active citizens' ability to use digital technologies	61	71.2	65.6	67.8
Intellectual resources	Number of AI patents (PCT)	2568	10892	646	1687
	Number of AI research paper output	369588	327034	96536	85587
	Share of the world's total in the number of AI research paper output institutions	5%	43%	5%	3%
	Number of colleges and universities with AI majors	20	168	20	7
Capital resources	Percentage of GDP for the number of domestic credit to private sectors	155.1	190.2	134.4	77.5
	Venture capital availability index	57	70.6	57.9	63.4
	Private AI investments share of the world's total	60%	29.1%	1.1%	0.2%
	Number of AI unicorns	12	16	3	0
Demand	GDP (billion USD)	13610	20540	2850	3948
	PLI (OECD = 100)	62	114	105	101
	Complexity index of consumer	58.2	68.8	62.1	62.2
	Consumer's confidence in AI	87	53	52	50
	Number of AI companies	1011	2028	392	111
Corporate strategy/ competitors	Professional management	59	78.9	71.1	71.8
	Salary-productivity relationship	60.5	71.1	62.2	69.8
	Percentage of GDP for R&D costs	2.1%	2.7%	1.7%	2.9%
	AI companies embracing disruptive ideas	53.8	68.1	59.3	63.3
	Competition distortion caused by subsidies	51.7	58.3	58.9	62
Policies and regulations	Number of AI policies	6	5	6	4
	Adaptability of legal frameworks to digital	59.5	78	64.78	67.3
	Business models	58.3			
	Patent protection	57.9	78.3	75.5	70.9
	Government long-term vision		66.2	51.4	59
Opportunities	International invention cooperation index	19.7	100	79.8	95.4
	Scale of digital economy (billion USD)	4729	12340.8	1728.7	2399.4
	5G patents share of the world's total	34%	14%	1%	0%

Source is IMF, OCED, and Statista.

the balance of weights, and the entropy function of w can be defined as follows:

$$\text{entropy}(w) = -\sum_{i=1}^{M} w_i \ln[w_i]. \tag{4}$$

It can be seen in the equation that if w_i completely loses its balance, i.e., $\exists w_i = 1$, the information entropy of w takes the value of 0; if completely balanced, namely, for $\forall w_i w_i = 1/M$, the maximum of the information entropy of w is $ln[M]$. So, the regulating factor can be defined as follows:

$$r(w) = \left(\frac{\ln[M]}{\text{entropy}(w)} - 1\right)^2. \tag{5}$$

According to equation (4), if the weight distribution changes from completely balanced to completely unbalanced, entropy (w) takes the value which gradually increases from 0 to $\ln[M]$, while $r(w)$decreases from $+\infty$ to 0. However, the cost function seeks the global minimum value, so a regulation factor K is needed before $r(w)$; otherwise, the value of equation (3) will tend to be completely balanced.

Therefore, the complete cost function is defined as follows.

$$g(w) = g_1(w) + g_2(w) + K * r(w). \tag{6}$$

In this equation, $K \geq 0$, and the value is dependent on the assessor as the case may be.

In conclusion, the optimal weighting can be expressed as a constraint equation:

$$\begin{aligned}&\min g(w),\\&S.t.\ w.\ \geq 0,\\&\min g(w),\\&w^T 1 = 1.\end{aligned} \tag{7}$$

3.2. Applying Simulated Annealing (SA) to Solve the Weighting Model Based on Positive and Negative Ideal Points. It can be seen from the establishing of the weighting model that the final mathematical model is a constrained equation, so SA can be applied to solve the optimal weight w^* by using MATLAB as a tool.

SA is applicable to find the optimal solution of a proposition in a big searching space [11, 12]. The principle of SA is inspired by the annealing process in thermodynamics; that is, by slowly decreasing the temperature at an initial temperature, the function can obtain a near optimal solution under the constraint conditions [13].

SA first determines an initial solution, then randomly changes the value of a parameter in the cooling process, and determines whether the new solution is the optimal solution according to the relationship between the current solution and the new solution [14] and continues to iterate until the temperature is below the threshold. Then, the final solution is the optimal weight w^*.

Four assessment objects are selected; that is to say, the datum on the international competitiveness of China, the United States, the United Kingdom, and Germany is brought into the model, and then the optimal solution is obtained by SA iteration.

SA sets the initial temperature $T = 10000$ degrees, the threshold $it = 0.1$, the temperature cooling rate $cool = 0.95$ and runs the program at $K = 0, 1, 10, 100, 1000$, and 10000. It can be seen in Figure 1 that while running about 250 times, the results tend to be flat.

The final results after weighting are as follows.

It can be seen from Table 2 that when $K = 0$, the sum of weights of infrastructure, capital resources, and opportunities almost equals to 0, showing that if regulating factor completely fails, the weights will be completely unbalanced; when $K = 10000$, all the weights tend to be 1/8, which is 1/M, and the weight indexes are completely unbalanced. Given all of the above, let $K = 100$.

4. A Comprehensive Assessment of International Competitiveness of AI Industry

The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method is mainly based on establishing the positive ideal solution and negative ideal solution of the multiattribute assessment problem and ranks by calculating the relative close degree of each assessment object. The idea of model establishment of the positive and negative ideal solution and the weighting method of the positive and negative ideal points share the same theoretical basis of the positive and negative ideal points, and the results of index weighting can also be used more reasonably. In actual practices, TOPSIS can not only obtain the overall score ranking of the assessment object but also its score ranking of each major category [15], which is of guiding significance to the specific analysis of the advantages and disadvantages of different objects on their international competitiveness of AI industry. Therefore, TOPSIS is highly suitable for assessing international competitiveness of AI industry.

Its calculating procedure is as follows:

(1) *Original Matrix Construction*. The original matrix is constructed for m assessment objects and n assessment indexes:

$$A = \begin{pmatrix} A_{11} & \cdots & A_{1n} \\ \vdots & \ddots & \vdots \\ A_{m1} & \cdots & A_{mn} \end{pmatrix}_{m\times n}. \tag{8}$$

(2) *Normalization*. TOPSIS requires all index data to be normalized as efficiency type (the larger the value, the better) or cost type (the smaller the value, the better) when assessing. This paper chooses efficiency type, which needs to transform all the indexes into efficiency type. Besides, normalized standard processing is needed in order to avoid inconvenience caused by different dimensions of quantity in the calculation of index data.

The normalizing formula is as follows:

$$C_{ij} = \frac{A_{ij} - \min\left(A_j\right)}{\max\left(A_i\right) - \min\left(A_j\right)}. \tag{9}$$

In this formula, $C_{ij} \in [0, 1]$.

Then, a normal matrix is obtained as follows:

$$C = \begin{pmatrix} C_{11} & \cdots & C_{1n} \\ \vdots & \ddots & \vdots \\ C_{m1} & \cdots & C_{mn} \end{pmatrix}_{m\times n}. \tag{10}$$

(3) *Index Weighting*. According to the above discussion, the optimal weight w^* is obtained.

(4) *Weighted Normal Matrix Construction*

$$\begin{aligned}&D = WC,\\&D = \begin{pmatrix} D_{11} & \cdots & D_{1n} \\ \vdots & \ddots & \vdots \\ D_{m1} & \cdots & D_{mn} \end{pmatrix}_{m\times n}.\end{aligned} \tag{11}$$

In this matrix, $D_{ij} = w_j \times c_{ij}$, $(i = 1, \quad 2,\ldots m;$ $j = 1, 2,\ldots n)$.

(5) *Determination of the Positive Ideal Solution T^+ and the Negative Ideal Solution T^-*

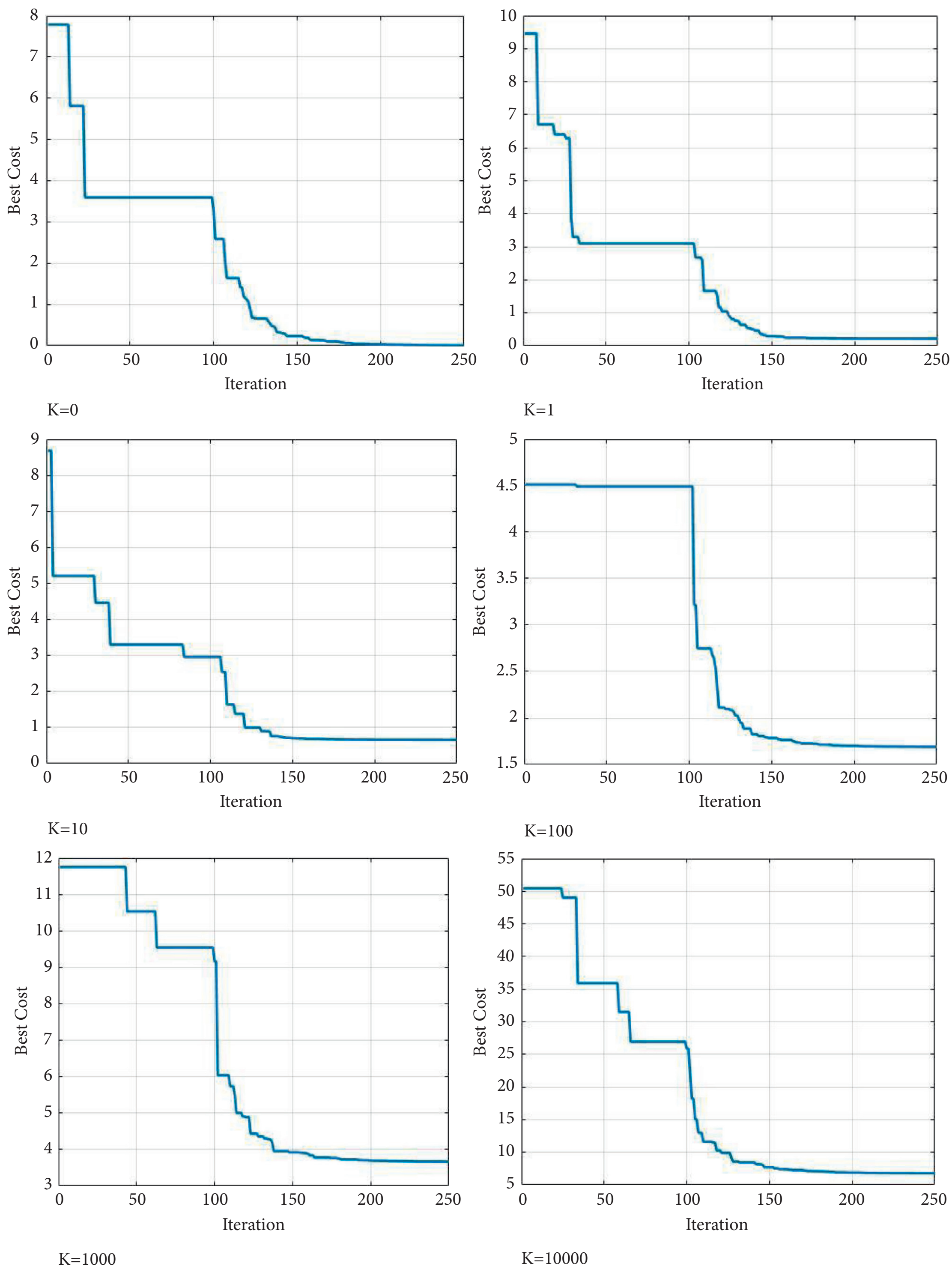

Figure 1: Optimization results of weighting cost function based on positive and negative ideal points at different K.

Table 2: Results of weighting based on positive and negative ideal points.

K	Infrastructure	Human resources	Intellectual resources	Capital resources	Demand	Corporate strategy structure/competitor	Polices and regulations	Opportunities
$K = 0$	0.29	0.00	0.01	0.48	0.01	0.01	0.01	0.20
$K = 1$	0.28	0.03	0.10	0.26	0.10	0.12	0.03	0.18
$K = 10$	0.23	0.05	0.12	0.23	0.13	0.17	0.05	0.15
$K = 100$	0.19	0.08	0.12	0.20	0.16	0.22	0.08	0.12
$K = 1000$	0.16	0.09	0.12	0.17	0.16	0.26	0.09	0.10
$K = 10000$	0.14	0.11	0.12	0.15	0.16	0.28	0.10	0.09

$$T^{+} = \left\{T_j^{+} \mid j = 1, 2, \ldots, n\right\} = \left\{\max T_{ij} \mid j = 1, 2, \ldots, n\right\}, \tag{12}$$

$$T^{-} = \left\{T_j^{-} \mid j = 1, 2,, \ldots, n\right\} = \left\{\min T_{ij} \mid j = 1, 2, \ldots, n\right\}. \tag{13}$$

(6) *Calculation of the Distance between Each Assessment Object and the Positive Ideal Solution and the Negative Ideal Solution*. Distance between assessment objects and the positive ideal solution is as follows:

$$E_i^{+} = \sqrt{\sum_{j=1}^{n} \left(T_{ij} - T_j^{+}\right)^2}. \tag{14}$$

Distance between assessment objects and the negative ideal solution is as follows:

$$E_i^{-} = \sqrt{\sum_{j=1}^{n} \left(T_{ij} - T_j^{-}\right)^2}. \tag{15}$$

(7) *Calculation of the Relative Close Degree between Assessment Objects and the Ideal Solutions.*

$$F_i = \frac{E_i^{+}}{E_i^{+} + E_i^{-}}, \quad i = 1, 2, \ldots, m. \tag{16}$$

F_i is ranked by its value, and the larger F_i is, the closer it is to the ideal solution. According to equation (16), $F_i$falls within the interval (0, 1), and the closer F_i is to 1, the closer the assessment object is to the optimal level.

After bringing the secondary index datum and the weighted results obtained in Chapter 2 into the TOPSIS assessment model, the score table for the international competitiveness of AI industry's assessment is obtained; the results are shown in Tables 3 and 4.

5. Analysis of International Competitiveness of AI Industry in Typical Countries

5.1. The United States: The AI Superpower Facing the Challenge Posed by Latecomers. By the total ranks, the United States is an AI Superpower with no doubt. Among the 8 indexes, the United States ranks first in 6, which is human resources, intellectual resources, demand, corporate strategy structure/competitors, policies and regulations, and opportunities, while the second in infrastructure and capital resources. Therefore, the United States is the top in this ranking, reflecting its strength as a superpower and a scientific and technological leader of the world. To be specific, as a long-term tradition, the United States lays great emphasis on basic research studies [16], leaving all others far behind it in human resources and intellectual resources, as shown in Figure 2. That is to say, the United States has been at the very forefront of the world's AI development. The well-developed business environment and the modern corporate culture that has developed for hundreds of years have also made its AI industry more mature than other competitors in corporate strategy structure/competition [17]. Moreover, its matured commercial rule of law also makes it ahead of others in policies and regulations [18]. In addition, the highly developed production and consumption domestic market have provided the United States sufficient demand, a strong support of AI industry development.

The United States is far ahead of others in most of its first-ranked indexes, while slightly ahead of second-ranked China in opportunities and demand. However, the fact that it falls behind China in 5G also causes the United States the bottleneck of technological development. The lack of related technology to support the AI development may be a noteworthy problem [19], which also makes it just slightly ahead of China in opportunities index and China is closely catching up. In addition, it is worth mentioning that on the demand side, some people's caution and suspicion about new technologies caused by the bipolarized American society have led to huge public concerns about AI, bringing hidden troubles to the large-scale application of AI technology in the United States [20]. Even if the United States develops the most advanced AI technology, if the public does not buy it and Americans are unwilling to provide private data, the development will definitely be hampered. This is why the United States has merely an edge in demand index compared with others; we can see this in Figure 3; American people do distrust in AI tech, so as the people in Europe [21]. The same problem goes to infrastructure. The aging and slow updating of its facilities make its infrastructure development a big problem because the United States has come to fall behind China in terms of the new infrastructure that AI industry needs. This posed a challenge for the United States to maintain its leadership.

After analyzing the data and rankings in the United States, we can conclude that the development of artificial intelligence industry's advantage lies in its emphasis on basic

Table 3: Scores and rankings of each assessment objects on the international competitiveness of AI industry.

Secondary index	Result	China	USA	UK	Germany
Infrastructure	Relative close degree	0.6122	0.4613	0.1405	0.1478
	Rank	1	2	4	3
Human resources	Relative close degree	0.2568	1	0.0569	0.0991
	Rank	2	1	4	3
Intellectual resources	Relative close degree	0.2914	0.9523	0.0536	0.0529
	Rank	2	1	3	4
Capital resources	Relative close degree	0.8122	0.6808	0.1811	0.0391
	Rank	1	2	3	4
Demand	Relative close degree	0.5715	0.7417	0.1127	0.0710
	Rank	2	1	3	4
Corporate strategy structure/competitor	Relative close degree	0.2327	0.8485	0.2956	0.8228
	Rank	4	1	3	2
Polices and regulations	Relative close degree	0.4850	0.7275	0.5862	0.3608
	Rank	3	1	2	4
Opportunities	Relative close degree	0.5583	0.6487	0.2383	0.2862
	Rank	2	1	4	3

Table 4: Total score and rankings of each assessment objects on the international competitiveness of AI industry.

Assessment objects	China	USA	UK	Germany
Relative close degree	0.5106	0.6737	0.1609	0.1702
Rank	2	1	4	3

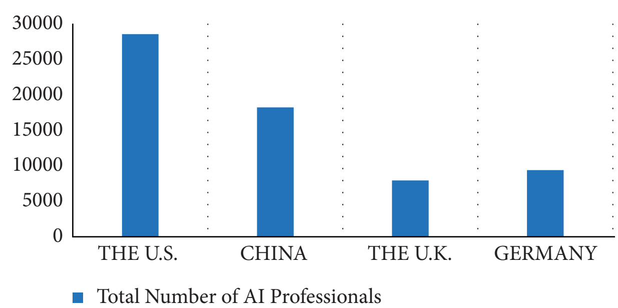

Figure 2: Total number of AI professionals.

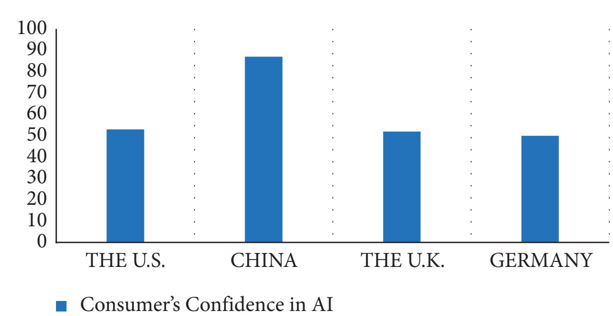

Figure 3: Consumer's confidence in AI.

scientific research and development of talent and technology advantages, as well as the mature enterprise strategic structure and sufficient capital for the development of the industry, and mature legal system on the business environment. However, its disadvantages cannot be ignored. The backward development of 5G has limited the US to continue to develop the most advanced AI technology, and the aging infrastructure also restricts the development and upgrading of the AI industry. What needs to be noted most is that the average American people's anxiety about the invasion of privacy, the manipulation and control of daily life brought by the technology giants, and the government's application of new AI technologies, as well as the replacement of their own jobs by machines, make the consumer demand of the public in the AI technology face unprecedented uncertainty. Social issues have also become the biggest obstacle for the United States to lead the development of the AI industry.

5.2. China: Gradually Getting Ahead of Others While Catching up with the United States. Although it falls behind the United States in these indexes, China has its advantages more than others except the United States. To be specific, China ranks first in 2 of the 8 indexes, infrastructure, and capital resources. China's infrastructure is at the forefront of the world, not only the traditional living infrastructure such as transportation, water, and electricity facilities but also the new infrastructure strongly advocated by China at present, including data centers, 5G, cloud computing, and other upstream infrastructure of AI [22], which is extremely important and lays a solid foundation for the rapid development of China's future AI industry. In terms of capital resources, China's great emphasis on AI industry has attracted a large amount of social capital, including state-owned capital, to invest in AI industry development [23]. The growing Chinese venture capital institutions also fund the development.

Besides two top rankings, China also ranks second in four other indexes, representing its ambition to challenge and surpass Western countries. Compared with traditional Western powers in the development of AI industry, the greatest weakness of China is the lack of scientific strategy structure of modern enterprises, mature industrial policies, and legal environment for business. This restricts the sound development of Chinese AI enterprises, which is also where China needs to continuously strengthen and improve.

In terms of demand, relatively low cost of living, huge market scale, and the emphasis and support from the government, enterprises and ordinary people on AI technology have formed a huge domestic market in China, which provides sufficient impetus for the development of AI industry in China. China's leadership in next-generation communication technology and its resolute embrace of globalization, as well as the Internet digital economy developed in the last 20 years, also provide China with an unparalleled opportunity to develop its AI industry, which provides ample opportunities for the development of China's AI industry.

In addition to these, China has other comparative advantages in the development of the AI industry, most notably in talent, technology, and capital. China's emphasis on computer science, mathematics, and other STEM subjects has been deeply rooted in the education view of ordinary people. In addition, Chinese enterprises have spent a lot of money on patented technologies for a long time, and China has made achievements in this regard.

5.3. The United Kingdom and Germany: Greater Emphasis on AI Industry Development Is Needed. The United Kingdom and Germany have moderate scores and rankings. However, the data fully suggest that the traditional European powers have encountered challenges of developing new technologies, especially when compared with the United States and China. Based on the data, it can be seen that the United Kingdom and Germany have a relatively better performance in corporate strategy structure/competitors and policies and regulations, which is directly linked to a sound business and legal environment and shows the development strength of traditional European powers.

However, when it comes to infrastructure, the European powers such as the United Kingdom and Germany have already fallen far behind China and the United States in an all-round way, a major constraint to their AI industry development. The shrinking market demand also led to their inability to compete with China and the United States in AI competition. Furthermore, the backward 5G technology and disadvantaged digital economy scale deprive these European countries of vital opportunities for AI industry development.

6. Conclusion

The United States is far and away in AI superpower and plays a leading role in the development of global AI industry. Be that as it may, the uncertainties led by the aging of infrastructure and other social problems pose a potential threat to the AI leadership of the United States. China starts to snap at its heels in AI industry development and can be called G2 with the United States given that China is able to compete with the United States on equal terms. However, China should intensify its efforts to improve its commercial rule of law environment and organization strategy of modern enterprises. The United Kingdom and Germany have maintained their strength of development as traditional powers, but they have difficulty in being able to increase their strength in AI industry development.

AI industry is an important booster of economic growth by facilitating the intelligent development of our society and also a core driver of the fourth industrial revolution. Whoever takes the leadership of AI industry can acquire the first-over advantage in the fierce competition in the future. No one can neglect AI's role of transforming future industrial development. However, each country has different conditions so that different policy frameworks are needed in the development path and serve as remedies for their disadvantages of development. This is a challenge for all.

Data Availability

The data refer to the references [3] to [14] and IMF, OCED, and Statista database.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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