

Research Article

Design of Intelligent Environment Observation and Decision Support for Regional World Economy

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In order to avoid the risk of marginalization of low-level areas in the process of economic globalization, regional economies have also developed from this, which is important for the regional world economy in a smart environment. Observation and decision support have also attracted much attention from academia. Based on the important situation of regional world economic development, scholars have conducted a lot of research studies; this paper studies the development trend of the regionalized world economy in the intelligent environment under the network of interconnected objects and uses decision support technology and sensor networks to observe and design decision support for the regionalized world economy. Association rule mining technology is used to conduct data mining and data collection on the relevant data in the regionalized world economy, cluster analysis is used to sort and calculate the mined experimental data, and the experimental data model is extracted through the decision tree algorithm. This study collects various data on the number of trade agreements in 2015–2019, the expansion of free trade zones, the import and export trade rates of the EU, North America, and the Asia-Pacific region, and the currency circulation in each region of the world and also organize, observe, and analyze the regional world economy. The final results show that, from 2015 to 2019, free trade areas in various regions of the world are expanding every year. There are 12 free trade areas in Western Europe, the Middle East, the Mediterranean, Central and Eastern Europe, and Russia. At the same time, North America, Asia-Pacific, and the EU pay more attention to intraregional trade, especially the annual trade rate of the EU of more than 50%. The regional world economy still has a trend of development in modern society and even in the next few decades, and the regional world economy has a certain role in promoting the economic development of various countries and regions. The regional world economy still has a development trend in modern society and even in the next few decades. It has a certain promoting effect on the economic development of various countries and regions. It is an inevitable trend of world economic development and the only way to economic globalization.

1. Introduction

1.1. Background Meaning. In the era of globalization of the world economy, there are still some regions with low levels of development that cannot be driven to develop and, therefore, are gradually marginalized. In order to prevent these regions from being gradually marginalized, the theory of regional world economy was born. The regional world economy is the regionalization of the world economy. It is of great significance to carry out regional economic development in these regions with low development level and to narrow the gap between the rich and the poor. The regional world economy has also developed from it, and it has gradually become the research object of many scholars in

current society. The regional world economy develops in the era of advanced intelligent environments such as the Internet of Things and wireless networks. Therefore, whether the regional world economy can survive in this environment has become the focus of everyone. The following observation and decision support design has also become a research focus of scholars.

Researching and understanding the development of the regional world economy in a smart environment is of great help to the understanding of the relationship between globalization and regionalization of the current world economy and is of great significance to my country's future economic regionalization and globalization strategy. Moreover, the regional world economy has enabled various regions with comparable

economic strength to appear on the world economic stage, and cooperation and competition between various regions coexist, thus slowing down the pace of global economic globalization. In international trade, the regional world economy has promoted trade and investment between countries and promoted the flow of capital, technology, commodities, and human resources; with the establishment and development of a regional world economy, for regional world economic development, member states cannot treat their own countries equally with other countries. All member states in the region will implement various preferential trade policies to reduce internal barriers and, on the other hand, increase trade barriers between regions. However, for developing countries, the regional world economy will have some adverse effects on developing countries in the early stages of development, making them face huge difficulties in foreign trade and in attracting foreign capital.

1.2. Related Work. Many scholars have conducted many studies on regional economy and decision support technology. Batabyal follows the views of Batabyal and Beladi and theoretically studies a regional economy that produces final or consumer goods through material and creative capital [1]. Reichert discussed the multiattribute aspect of decision support, that is, the method of supporting decision-making when there are multiple conflicting goals [2], but this method has certain defects. Jones examined the current concepts and empirical thinking about economic regionalization in the global economy, especially based on the debate about the possible shrinking of economic globalization in the second decade of the twenty-first century [3]. Melnyk conducted a numerical research study on decision support technology, allowing decision support technology recommendations to be used as a practical tool during sprint planning, and provided a method for evaluating the adequacy of the proposed technology [4], but this method easily leads to errors in experimental results. It has strong practicability. If the results can be improved, it will be well applied. The purpose of the study of Danial-Saad is to evaluate the availability of ontology-supported computer-assisted technology recommender (OSCAR), clinical decision support system (CDSS) for assistive technology adaptation process, and its impact on the learning matching process and to determine the difference between the two relationships [5]. In order to help decision-making departments to understand the information of regional economic development in time, by analyzing the influencing factors of the regional economy and combining with the decision-making model, Wang constructed the economic forecasting early warning model and economic policy simulation model of the decision-making system [6], but the research study is acquiring data. The time is too complicated, and the operation is cumbersome.

1.3. Innovation of This Study. In order to understand the development of the regional world economy in the future, this study conducts observation and decision support design for the regional world economy. The innovations of this study are mainly reflected in these aspects: (1) the

experiment in this study mainly observes the development trend of the regional world economy in a smart environment and combines the Internet of Things technology to make a decision support design for the regional world economy. (2) This study uses a combination of graphics, tabular data, formulas, and text to observe and analyze the regional world economy, so that the analysis results can be seen more intuitively and clearly.

2. Proposed Method

2.1. Internet of Things. The Internet of Things (IoT) is the integration of intelligent perception, radio frequency identification technology, ubiquitous computing, and ubiquitous networks. The Internet of Things is composed of heterogeneously connected devices, which further expand the boundaries of the world through physical entities and virtual components [7, 8]. The Internet of things can also be understood as the extended Internet. It can connect any item to the Internet through radio frequency identification (RFID), sensors, global positioning systems, scanners, and other sensor devices for information exchange and data communication [9, 10]. Realize the intelligent identification, positioning, monitoring, cloud management, and other functions of items. For the Internet of Things, the academic community has proposed a three-dimensional conceptual model [11], as shown in Figure 1.

The Internet of Things is characterized by heterogeneous technologies, which agree to provide innovative services in various application domains [12, 13]. The Internet of Things technology applies various new technologies developed in network interconnection to all aspects of life. The Internet of Things not only refers to the network that connects things to things but also things to people and people to people. It also includes terminal equipment, monitoring equipment, commodity radio frequency tags and other equipment in life that realize the interconnection of information and data through wired or wireless communication networks, and products that integrate everything under cloud computing. To realize the communication between things, the Internet needs the network as a bridge to connect. The communication and networking technology of the Internet of Things mainly completes the reliable transmission of perception information. The idea of the Internet of Things makes the Internet more immersive and unavoidable [14]. The structure is shown in Figure 2.

As the source of various information in the network, the perception layer is similar to the five senses of the human body. Its main function is to complete the placement, state recognition of objects, and collect information. The equipment mainly includes radio frequency identification (RFID) equipment, various sensors, and so on. The network layer remotely sends and processes the information collected from the perception layer. This usually refers to wired networks, wireless networks (such as the Internet), 3G mobile networks, sensor networks, and mutual convergence networks. The application level is usually deeply integrated with industrial technologies to integrate service technologies in various industries.

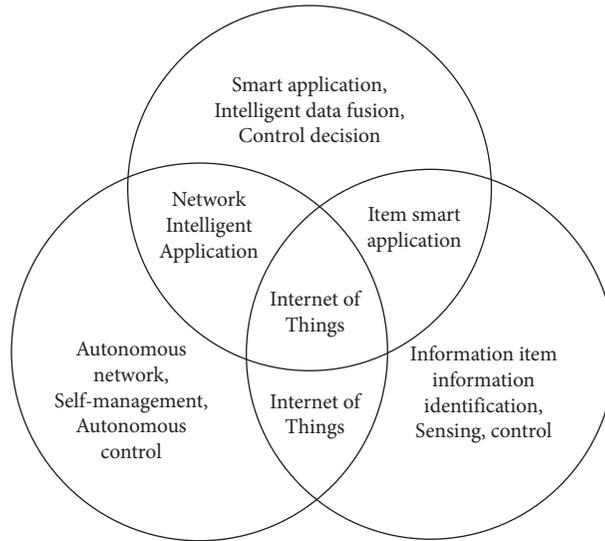


FIGURE 1: Three-dimensional conceptual model of the Internet of Things.

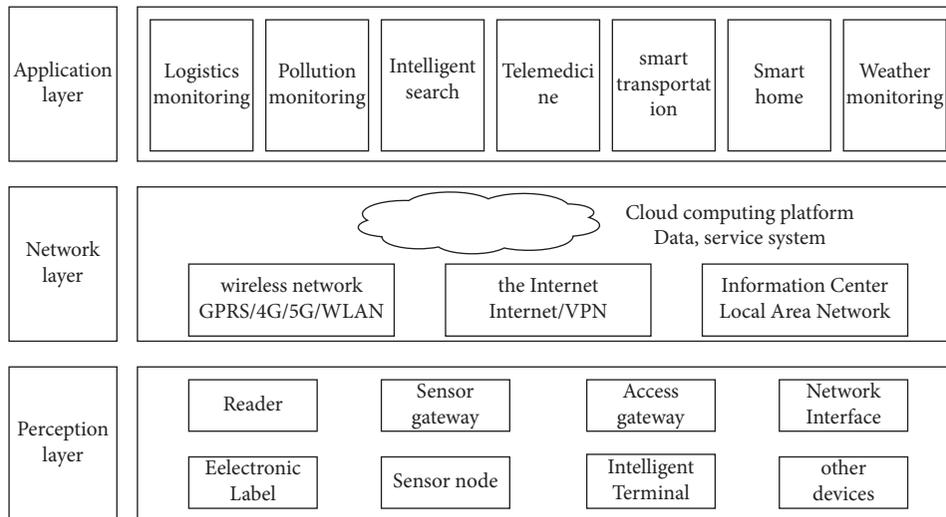


FIGURE 2: Architecture diagram of the Internet of Things.

2.2. *Smart Environment.* The intelligent environment gradually penetrates into our daily life and provides various conveniences for our daily life [15]. Advances in sensor networks and the fields of electronics and environmental intelligence have enabled us to create smart environments [16]. The description of the smart environment in the book of Cook refers to an environment in which knowledge can be acquired and applied according to the needs of residents to improve their lives. The American National Institute of Standards and Technology defines a smart environment as a space composed of a microcomputer system and multifunctional sensors, using effective interactive methods, so that users can quickly obtain spatial information and enjoy corresponding services. According to the definition of Mark, a smart environment is a real-world scene that is constructed by interweaving sensors, arithmetic units, displays, and computing units, connecting everyday objects around us with the Internet. The intelligent environment provides us

with a lot of intelligent services. In our daily life, there are mainly three directions, namely, intelligent home environment, intelligent working environment, and intelligent public places [17, 18]. Its construction involves many computer technologies, as shown in Figure 3.

The main purpose of the smart environment is to satisfy people’s higher living standards and work experience. The functions of the smart environment are as follows: (1) it can monitor the environment of the user and provide more comfortable services anytime and anywhere according to user needs; (2) the automatic proxy function can replace the user to complete some repetitive tasks; and (3) the smart environment can be used to complete some unsafe things or some physical tasks. The realization of smart environment functions requires a large number of small and microsmart devices. These devices need to have sensing and communication capabilities, and they need to be able to provide powerful computing capabilities for the smart environment.

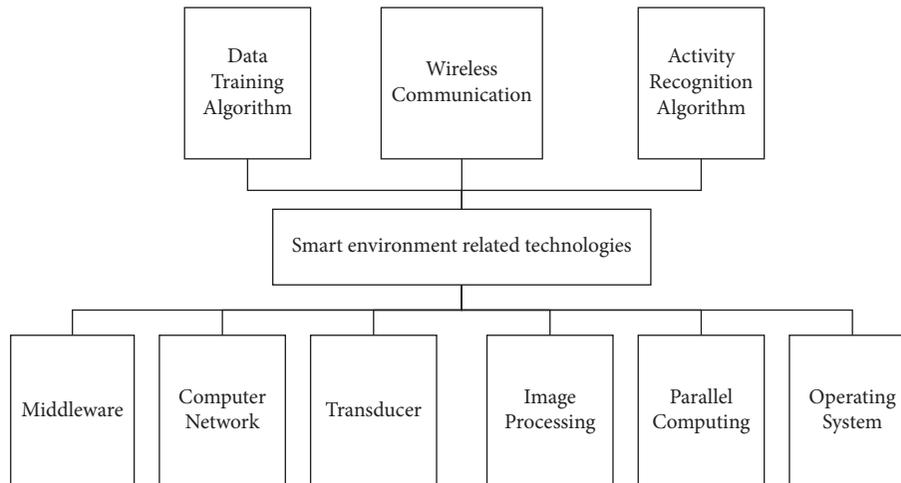


FIGURE 3: Technology diagram related to the smart environment.

For example, if users want to realize smart functions in a smart environment, they must use smart devices such as mobile terminals, mobile phones, and computers. The communication interaction in the intelligent environment provides users with intelligent services anytime and anywhere.

Sensor pattern mining (SPM) is also dynamic, and it is a popular research problem in the ubiquitous intelligent technology to improve human life [19]. The sensor node in the intelligent environment is a typical embedded device with data communication and certain information storage capabilities, which can be used to collect and measure environmental information, but the energy supply is limited. It is composed of four basic modules: energy module, microprocessor module, communication module, and perception module. The relationship between them is shown in Figure 4.

It is sent to the sink node through hop count or multihop relay, and the sink node analyzes the received information and finally sends the analysis and processing results to the user terminal through the Internet, satellite, mobile network, etc., so as to realize efficient user monitoring and management environment. The working principle of the intelligent environment is shown in Figure 5.

2.3. Regional World Economy. The regional world economy is the regionalization of the world economy. It means that countries or regions in a specific region reach a certain kind of economic cooperation commitment or form a certain form of economic cooperation organization to seek the liberalization of the circulation of goods or factors in the region and the division of production. , until various economic policies and regional economic systems form a certain degree of unity. Due to the dynamic nature of economic space, economic regionalization is particularly complicated [20, 21].

The regional world economy is a double-edged sword for economic development. Because different countries are economically interdependent and competitive, a regional

world economy has emerged under these economic and social conditions. The common development of different countries or regions in the region can be achieved through regional economic integration. There is cooperation and competition among the various regions of the regional world economy. However, in the early stages of the regional world economy, competition is the main aspect. Contradictions and conflicts will occur within the region, and cooperation between regions will not proceed smoothly. In addition, the conflicts in the region are more complex than those between countries, and coordination is more difficult. Therefore, in some respects, the regional world economy will slow down the process of economic globalization to a certain extent. Overall, the regional world economy has both positive and negative aspects to the pattern and development of economic globalization. The regional world economy is the product of fierce world economic competition and is the only way for world economic growth.

The regional economy is a very important aspect of regional economic planning [22]. This is also the basic form of the regional world economy. It is not based on time, but it is measured by the level of economic development of the countries participating in regionalization and whether the customs and other trade barrier policies between countries are integrated. Trade protectionist measures can be taken to strengthen regional ties and alliances [23]. Therefore, different regional economic integration organizations can take different forms. The main goal of the cohesion policy is to reduce the differences between regional economic development [24]. From the perspective of the development of regional economic integration, regionalization is a process of globalization. In this process, countries participating in regionalization will gradually realize globalization through foreign trade policies, regulating the flow of domestic producers and coordinating monetary and fiscal policies.

2.4. Decision Support. Decision support is a leading concept, and just a few years after its formation, decision support systems emerged. Decision support refers to the use of

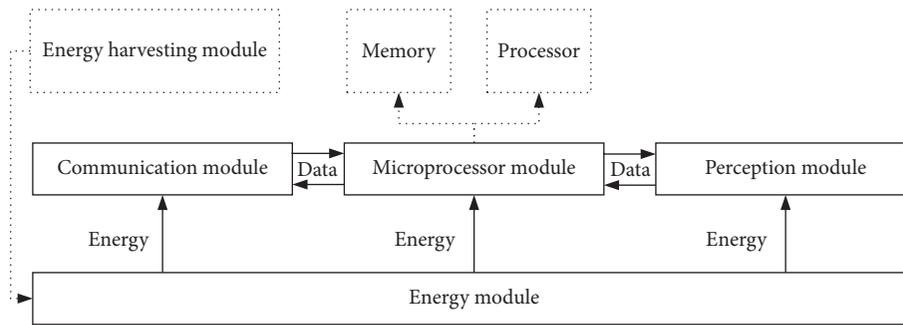


FIGURE 4: Sensor node structure diagram.

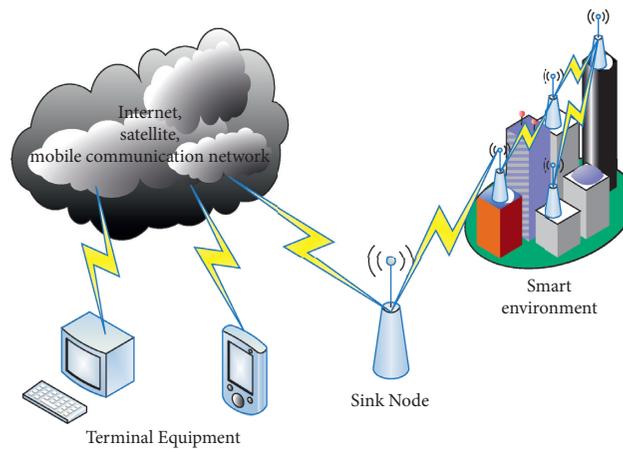


FIGURE 5: Working principle diagram of the smart environment.

computers to help decision makers make decisions in unstructured tasks. This is to support rather than replace the decision of the decision maker and can improve the effectiveness of the decision. The audience of the decision support system (DSS) is those users who need to make semi-structured or unstructured decisions. The system provides intelligent support for making effective decisions in different fields. For the complex and changeable regional world economy, there are a variety of problems. Using scientific and reliable decision support technology to analyze and make decisions on regional world economic problems can help decision makers on a fair basis. Decision support system can help decision makers improve the level and quality of decision-making, relying on a variety of useful information and analysis tools, to provide decision makers with a simulation program and environment, can help decision makers build problem models, and can help with problem analysis.

The decision support system is mainly composed of the data part, model part, and human-computer interaction part. To realize a decision support system, a database, a database management system, a model library and a model library management system, interactive computer hardware and software, graphics or other advanced display devices, and a user-friendly modeling language are necessary. The structure of the new decision support system is shown in Figure 6.

Decision support technology enables decision-making to be established on a more scientific and reliable basis. Decision-making includes the use of digitization, modeling, etc. Decision-making includes not only hard techniques that provide quantitative and qualitative analysis methods, but also soft techniques that provide collective wisdom of experts. The core technology of decision support includes data warehouse, OLAP, and data mining. Online analytical processing (OLAP) is one of the most powerful and outstanding technologies for knowledge discovery in decision support systems. Data mining can satisfy the relevant mathematical calculations of the research object. Its tasks and related algorithms are as follows:

- (1) Association rule mining task: association rules reflect interesting associations between large amounts of data and are one of the most active research directions in data mining. Suppose $I = \{i_1, i_2, \dots, i_m\}$ is a collection of items. Rule $A \implies B$ has confidence c in transaction D , assuming that the percentage of both transactions A and B in D is c , and its conditional probability is $P(B|A)$. So there are

$$\begin{aligned} \text{Support}(A \implies B) &= P(A \cup B), \\ \text{Confidence}(A \implies B) &= P(B|A). \end{aligned} \tag{1}$$

- (2) Classification and prediction tasks: classification and prediction are two forms of data analysis, which can

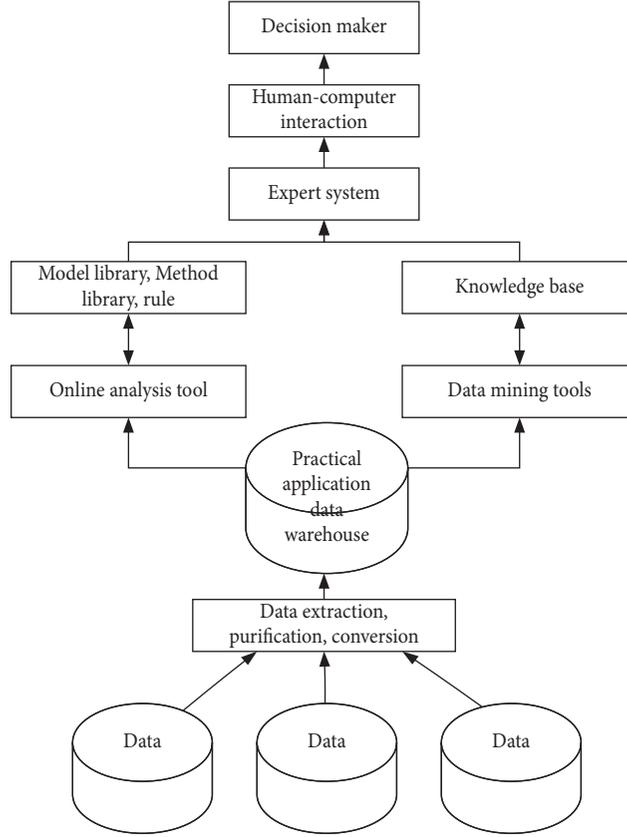


FIGURE 6: Structure diagram of the new decision support system.

be used to extract models describing important data categories or predict future data trends. Their typical algorithms include decision tree algorithm, Bayesian algorithm, and neural network algorithm. The decision tree algorithm can quickly create data mining models, the model rules are easy to interpret, and its predictions are also very efficient. Suppose X is a collection of x data samples. Assuming that the category attribute has m different values, m different classes C_i ($i = 1, 2, \dots, m$) are defined. The expected information needed to classify a given sample is as follows:

$$I(s_1, s_2, \dots, s_m) = - \sum_{i=1}^m p_i \log_2(p_i), \quad (2)$$

where p_i is the probability that any sample belongs to C_i and is estimated with s_i/s .

Suppose that the attribute Y has y different values $\{a_1, a_2, \dots, a_y\}$. The attribute Y can be used to divide S into y subsets $\{S_1, S_2, \dots, S_y\}$, where S_j contains some samples in S that have the value a_j on Y . The entropy or expected information divided into subsets according to Y is

$$E(Y) = \sum_{j=1}^y \frac{s_{1j} + \dots + s_{mj}}{s} I(s_{1j}, s_{2j}, \dots, s_{mj}). \quad (3)$$

For a given subset S_j :

$$I(s_{1j}, s_{2j}, \dots, s_{mj}) = - \sum_{i=1}^m P_{ij} \log_2(P_{ij}), \quad (4)$$

where $P_{ij} = s_{ij}/|S_j|$ is the probability that the sample in S_j belongs to class C_i . The coding information obtained by branching on Y is as follows:

$$\text{Gain}(Y) = I(s_1, s_2, \dots, s_m) - E(Y). \quad (5)$$

3. Experiments

3.1. Test Subject. This study mainly selects three regional trade organizations in the World Regional Trade Organization, North America, the European Union, and the Asia-Pacific region for analysis. Organize, observe, and analyze the regional world economic situation by collecting various data such as the number of trade agreements in 2015–2019, the scale of free trade zones, and the import and export trade rates between the EU and North America, and Asia. Among them, the most representative and well-known regional trade organizations are the European Union and the European Free Trade Association.

3.2. Experimental Data

3.2.1. Number of Regional Trade Agreements. Most WTO members have joined one or more regional trade agreements. Since the rise of regional trade, regional trade

agreements have shown a trend of substantial increase. According to WTO statistics, the number of regional trade agreements worldwide from 2015 to 2019 is listed in Table 1.

According to the data in Table 1, we can see that the number of regional trade agreements affected by the world financial crisis has declined in 2018, the total number of regional trade agreements in the remaining years is more than 30, the number of effective agreements and active agreements has exceeded ten, and the number of agreements still being negotiated is relatively small.

3.2.2. Expansion of Free Trade Zone. The number of regional trade agreements has increased each year, and the number of free trade zones aimed at eliminating tariff and nontariff barriers and realizing free trade is also increasing. Table 2 shows the expansion trend of free trade areas between regions in the world.

According to the data in Table 2, we can see that the free trade zones in all regions of the world expand every year, but the amount of expansion is small. In the expansion statistics of free trade areas in various regions of the world, the number of expansions of free trade areas in Africa is the least, and the total number of expansions in Asia and Oceania is 7. The sum of expansions in other regions accounts for a relatively high number, of which the free trade areas of the Americas have the largest number of expansions.

3.2.3. Trade Relations. There is a relationship of mutual competition and mutual cooperation between regions in the world. Trade exports and trade imports between regions can well reflect the trade relationship between regions. The trade import and export relations among various regions are shown in Table 3.

According to the trade relationship table, the import and export trade rate data of North America, the European Union, and Asia can be known. The EU's export trade rate to Asia is not high, generally less than 10%, and the EU's export trade to North America is also low; Asia's export trade rate to North America is about 10% higher than that of the EU; The export trade rate between North America and the European Union to Asia is basically the same. The three regions of North America, the Asia-Pacific, and the European Union pay more attention to intraregional trade. The EU places more emphasis on intraregional trade, with an annual trade rate of more than 50%.

4. Discussion

4.1. Correlation Analysis of Regional Economic Indicators. There are many factors related to the development of the regional economy, and the correlation analysis of these factors is carried out. In order to make the cross-correlation of different indicators comparable, try to make the

correlation coefficient between the indicators to fall between $[-1, 1]$. Take the calculation of the cross-correlation between GDP growth rate and fixed investment growth rate as an example. $\rho(\tau)$ represents the correlation coefficient between $x(t + \tau)$ and $y(t)$. Take out the sequence $y(1983: 2006 - \tau)$ and $x(1983 + \tau: 2006)$, and turn these two series into a series with a mean value of 0 and a module of 1, denoted by a and b , respectively, then $\rho(\tau) = a \cdot b$.

From the indicator correlation analysis chart, it can be concluded that fixed asset investment has the largest comprehensive contribution to GDP growth. The two economic indicators, actual utilization of foreign capital and total foreign trade exports, have the most direct effect on GDP growth. Due to the continuity and sustainability of economic development, the development and changes in regional GDP are closely related to the GDP of previous years, as shown in Figure 7.

4.2. Trade Effect Analysis. The expansion and development of free trade zones are indispensable for the development of the regional world economy. This study analyzes the trade import and export volume of the North American Free Trade Area, the European Union, and the Asia-Pacific Cooperation Organization. The trade import and export volume sorted out is shown in Figure 8.

According to the analysis of trade import and export volume in Figure 8, it can be seen that North America's trade import volume and trade export volume have the same trend, and the trade export volume has been steadily greater than the trade import volume; the volume of trade imports in the EU fluctuates greatly, with the largest number of imports in 2017. The volume of the EU trade exports was lower than that of trade imports from 2016 to 2017; the volume of trade imports and exports in the Asia-Pacific region showed an upward trend from 2015 to 2017.

4.3. Currency Regional Analysis. Currency is a very important tool in the trade market. It can be used to pay for goods and measure the price of goods. The regionalization of currency is also an important phenomenon of the regional economy. The currencies of various economic regions include the following: RMB, US dollar, Japanese yen, euro, etc. Regional analysis of currencies can also indirectly understand the development of the regional world economy and future trends. After analyzing the circulation of the four currencies of RMB, US dollar, Euro, and Japanese yen in each region, the final result is shown in Figure 9.

It can be seen from the currency circulation situation in Figure 9 that the degree of regionalization of currency is relatively serious, the circulation of each currency in the region is relatively high, the circulation outside the region is less, and most of them are converted into currencies in other regions and then traded.

TABLE 1: Quantity table of regional trade agreements.

Year	Effective RTA	Active RTA	RTA under negotiation	Total RTA
2015	15	10	6	31
2016	17	13	9	39
2017	20	11	6	37
2018	10	8	5	23
2019	13	14	7	34

TABLE 2: The expansion trend of the world's regional free trade areas.

Year	Western Europe, Middle East, and Mediterranean	Central Europe, Eastern Europe, and Russia	America	Asia and Oceania	Africa
2015	2	1	3	1	0
2016	2	4	2	2	1
2017	3	2	3	1	1
2018	1	2	1	0	1
2019	4	3	2	3	3
Total	12	12	11	7	6

TABLE 3: Trade relationship table.

Export area	Import area	2015	2016	2017	2018	2019
		Trade ratio (%)				
North America	North America	42.1	40.6	48.3	54.7	56.1
Asia	Asia-Pacific	31.3	36.7	43.6	42.6	44.3
European Union	European Union	55.2	61	57.4	57.4	60.4
North America	Asia	18.6	22.3	21.2	16.2	20.6
North America	European Union	18.5	21.2	16.3	14.6	17.9
Asia	North America	32.3	28.1	26.8	26.9	29.9
Asia	European Union	12.6	17.5	13.7	13.7	14.5
European Union	North America	11.4	8.5	10.0	12.3	9.7
European Union	Asia	5.7	6.1	8.9	7.4	6.6

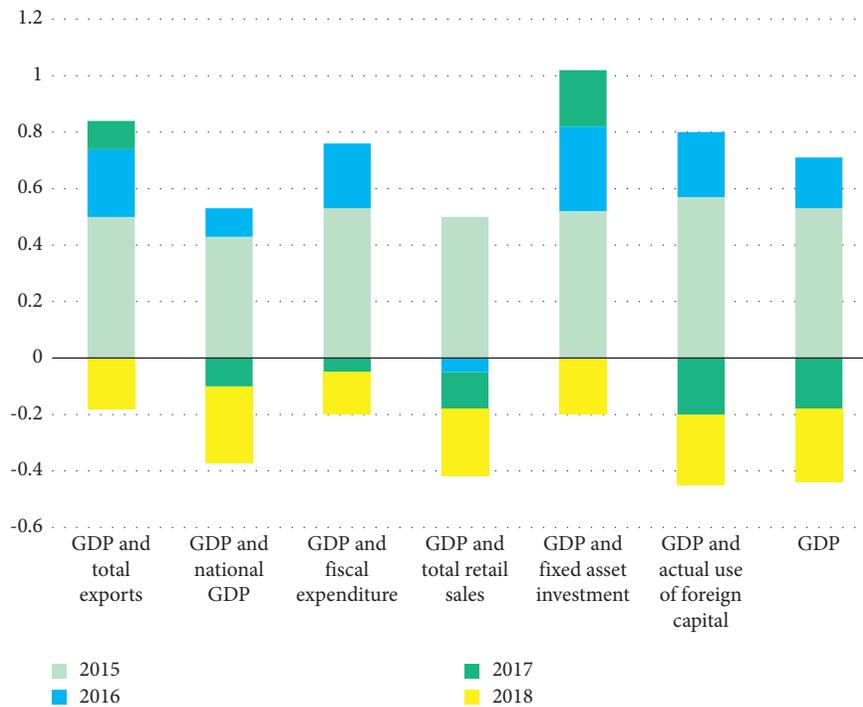


FIGURE 7: Indicator correlation analysis diagram.

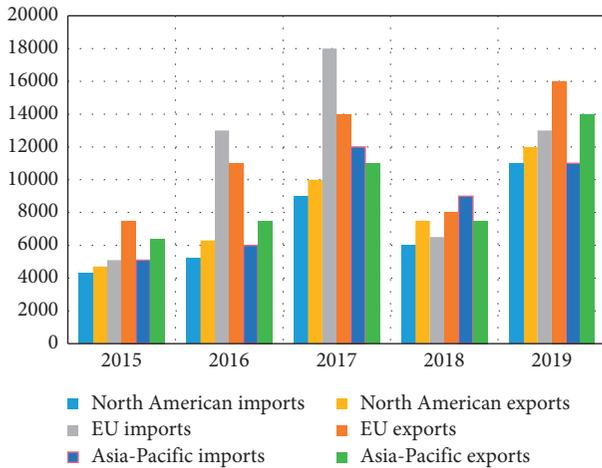


FIGURE 8: Trade import and export volume chart.

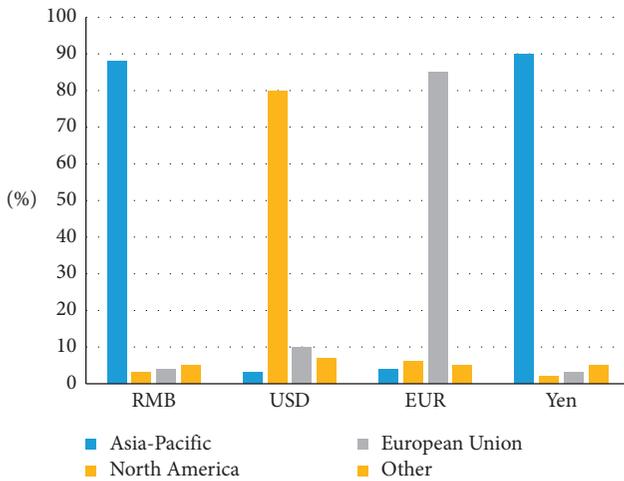


FIGURE 9: Diagram of currency circulation.

5. Conclusions

The regional world economy is a double-edged sword for the development of the world economy today. It has a significant impact on the process of economic globalization, the development of international trade, and the economic development of developing countries. In the short term, the regionalization of the world economy has slowed down the globalization of the world economy, but in the long term, economic regionalization is an inevitable stage of economic globalization. From the establishment of regional economic cooperation organizations, the gradual implementation of free trade within the region, the promotion of managed trade, and finally with the importance of multilateral trade relations, the current regionalization trend may be reversed. The regional world economy is an important trend in today's world economic development, and all regional economic organizations in the world are promoting the development of regional and economic development.

This study is just a simple observation and analysis of the regional world economy, and there are still many deficiencies in some aspects. The subjects selected in this study

are only North America, the European Union, and the Asia-Pacific Cooperation Organization. The subjects of the experiment are few, and the regional economic situation may be too one-sided. This study pays more attention to the observation of the regional world economy and does not describe the content of its decision support design. Due to time factors and other reasons, there are many perspectives that can be further expanded and extended. In the future research, these deficiencies will be improved and the experiments in this study will be improved.

Data Availability

This article mainly selects data from three regional trade organizations in the World Regional Trade Organization, North America, the European Union, and the Asia-Pacific region for analysis.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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