Research on Measurement of Trade Facilitation in APEC Countries

Xiaolan Lu[*], Jun Ye

School of Business, Jianghan University, Wuhan, China

[*]luxiaolan@jhun.edu.cn

Abstract

With the continuous advancement of economic globalization and regional economic integration, the economic and trade relations between countries in the world have become more and more close, and "trade facilitation" has become an important factor affecting international trade. Based on the panel data from 2013 to 2019, this paper constructs a trade facilitation index system and uses the Global Principal Component Analysis method to measure the trade facilitation level of APEC countries, and analyzes its temporal and spatial characteristics. The results show that the level of trade facilitation in APEC countries is gradually improving, but the gap between countries is large and the development trend is unbalanced.

Keywords

Trade Facilitation; APEC Countries; Principal Component Analysis.

1. Introduction

Under the background of economic globalization and regional economic integration, the development of international trade is increasingly affecting the economic development of various countries. The level of trade facilitation is directly related to a country's openness to the outside world and its international trade competitiveness. There are also increasing amount of studies on trade facilitation. However, it is worth noting that the economic system between countries, the infrastructure quality and customs policies have caused a series of barriers to trade. "Non-facilitation of trade" has become an important factor affecting the normal activities of international trade.

Most scholars use subjective valuation method, simple average method, multi-field scoring method, analytic hierarchy process and other methods to measure the level of trade facilitation. As for the evaluation criteria of trade facilitation, Wilson, Mann and Otsuki (2003)[1] introduced four indicators to the evaluation of the trade facilitation level of APEC countries, namely port efficiency, regulatory environment, e-commerce and customs environment. Yang Qinglong (2018) [2] pointed out that port efficiency has the greatest impact on the level of trade facilitation, regulatory environment has the second largest impact on the level of trade facilitation, e-commerce environment and customs environment have relatively small impact on the level of trade facilitation, and pointed out that China is a relatively convenient country. Li Fusheng (2022) [3] introduced an additional first-level indicator of cultural environment and 20 second-level indicators to measure the level of trade facilitation in 22 countries, and found that there was a large gap in the level of trade facilitation among countries.

Based on the data from 2013 to 2019, this paper constructs an index system of trade facilitation level, uses the global principal component analysis method to measure the trade facilitation level index of APEC countries, and analyzes its temporal and spatial changes.

2.　Establishment of Trade Facilitation Level Index System

This paper selects four first-level indicators, including infrastructure perfection, customs clearance convenience, regulation effectiveness and technology advanced, and 13 second-level indicators, including highway infrastructure quality, transparency of policy making, prevalence of non-tariff barriers and individual Internet users, to build a trade facilitation level indicator system, as shown in Table 1 below.

Table 1. Index system of trade facilitation level

Primary indicator	Secondary indicator	Value	Resource	Weight
Infrastructure Integrity (I)	Highway Infrastructure Quality (I1)	1-7	GCR	0.0459
	Railway Infrastructure Quality (I2)	1-7	GCR	0.0005
	Port Infrastructure Quality (I3)	1-7	GCR	0.0740
	Aviation Infrastructure Quality (I4)	1-7	GCR	0.0754
Customs Clearance (C)	Prevalence of non-tariff barriers (C1)	1-7	GCR	0.1128
	Customs Process Burden (C2)	1-7	GCR	0.1024
Regulatory Effectiveness (R)	Agricultural Policy Costs (R1)	1-7	GCR	0.1123
	Policy making Transparency (R2)	1-7	GCR	0.0973
	Judicial Independence (R3)	1-7	GCR	0.0951
	Efficiency of legal dispute resolution (R4)	1-7	GCR	0.0851
Technological Sophistication (T)	Individual Internet Users (T1)	1-	GCR	0.0664
	Enterprise-level technology Uptake (T2)	1-7	GCR	0.0627
	Power Supply Quality (T3)	1-7	GCR	0.0700

Infrastructure Integrity. This index is used to measure the quality of infrastructure construction in APEC countries, and measure the efficiency and quality of transportation in APEC countries, including the quality of infrastructure construction such as roads, railways, ports and aviation.

Customs Clearance. This index mainly evaluates the degree of corruption and customs efficiency of a country to reflect the level of customs management of a country. Among them, the prevalence of non-tariff barriers is used to reflect the severity and quantity of national non-tariff barriers. The burden of customs procedures is used to reflect the complexity of national customs procedures and procedures.

Regulation Effectiveness. This index mainly evaluates the level of national government management and transparency, so as to reflect the impact of the improvement of national institutional environment on the improvement of national trade facilitation. Among them, agricultural policy costs are used to reflect the impact of agricultural policies of APEC countries on national agricultural trade. Transparency in policymaking is used to reflect the ease with which companies within a country can access trade information. Judicial independence refers to the ability of national laws and judicial institutions to maintain their independence and impartiality when dealing with transactional disputes. The efficiency of legal dispute resolution is used to measure the degree of perfection of a country's laws, and it is also the ability to use laws to resolve and deal with disputes.

Technological Sophistication. This indicator mainly assesses the penetration and utilization rate of e-commerce adopted by countries in carrying out foreign trade activities. Among them, individual Internet users are used to reflect the Internet penetration of a country and the level of technical infrastructure construction of the country. Enterprise-level technology uptake is used to reflect the ability of enterprises to utilize new technologies.

The quality of power supply is used to reflect the development degree of the national power industry and the difficulty of using electricity, and the country's technical infrastructure construction status.

3. Measurement of Trade Facilitation Level of APEC Countries

This paper selected 13 major APEC economies as research objectives, including the United States, Canada, Mexico, Australia, New Zealand, Peru, Chile, South Korea, Japan, Hong Kong, China, Vietnam, Thailand, Indonesia, etc. The study period was 2013-2019, and most of the variable data came from the Global Competitiveness Report. Since the value range of "individual Internet user" is 1-100, in order to eliminate the impact of data dimension on the result, it is normalized by linear transformation. After processing, the range of this variable is between [0,1], which is comparable with other variables.

Table 2. Total variance interpretation of principal component analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.600	73.843	73.843	9.600	73.843	73.843
2	1.602	12.325	86.168	1.602	12.325	86.168
3	0.492	3.787	89.955			
4	0.468	3.603	93.558			
5	0.296	2.277	95.835			
6	0.240	1.844	97.679			
7	0.126	0.972	98.652			
8	0.092	0.705	99.356			
9	0.058	0.447	99.803			
10	0.018	0.137	99.940			
11	0.004	0.031	99.971			
12	0.002	0.018	99.989			
13	0.001	0.011	100.000			

Table 3. Component score coefficient matrix

Secondary indicator	$COMP_1$	$COMP_2$
Highway Infrastructure Quality (I1)	0.091	-0.222
Railway Infrastructure Quality (I2)	0.067	-0.398
Port Infrastructure Quality (I3)	0.101	-0.084
Aviation Infrastructure Quality (I4)	0.100	-0.068
Prevalence of non-tariff barriers (C1)	0.072	0.363
Customs Process Burden (C2)	0.100	0.122
Agricultural Policy Costs (R1)	0.057	0.449
Policy making Transparency (R2)	0.089	0.152
Judicial Independence (R3)	0.097	0.088
Efficiency of legal dispute resolution (R4)	0.098	0.012
Individual Internet Users (T1)	0.090	-0.072
Enterprise-level technology Uptake (T2)	0.091	-0.104
Power Supply Quality (T3)	0.098	-0.094

Considering that there may be collinearity among indicators of trade facilitation level, the global principal component analysis method is adopted in this study, which can not only retain the information of the original data as much as possible, but also effectively reduce the degree of

collinearity of the original data, and the results obtained can be used for spatial and temporal comparison.

KMO and Bartlett tests were performed on the variable data of the index system, and the results showed that KMO=0.705. The Bartlett test value is 241.78, and its P-value is close to 0. This indicates that the variables are highly correlated and suitable for principal component analysis. The results of variance analysis of principal component analysis are shown in Table 2 below. The results show that the eigenvalues of principal component 1 and principal component 2 are greater than 1, and their cumulative variance contribution rate reaches 86.17%. Therefore, two principal components are selected, and the principal component score coefficient matrix is shown in Table 3.

The 13 secondary indexes in Table 3 are multiplied by the corresponding principal component score coefficient and the standardized secondary index data, and then added together to obtain the expressions of the two principal components. Then multiply the coefficient of each index in these two expressions by the corresponding variance contribution rate, the evaluation model of APEC countries' trade facilitation level can be obtained as follows.

$$C = 0.0462I_1 + 0.0005I_2 + 0.0745I_3 + 0.0760I_4 + 0.1136C_1 + 0.1031C_2 +$$
$$0.1131R_1 + 0.0980R_2 + 0.0957R_3 + 0.0857R_4 + 0.0668T_1 + 0.0631T_2 + 0.0705T_3$$

Table 4. Comprehensive score of trade facilitation of APEC countries from 2013 to 2019

Area	Countries (Area)	Year							Area average
		2013	2014	2015	2016	2017	2018	2019	
North America	America	0.7258	0.7358	0.7559	0.7665	0.7982	0.7884	0.7834	0.6952
	Canada	0.7574	0.7575	0.7588	0.7625	0.7793	0.7196	0.7382	
	Mexico	0.5667	0.5555	0.5562	0.5677	0.5681	0.5615	0.5960	
	average	0.6833	0.6829	0.6903	0.6989	0.7152	0.6898	0.7059	
South America	Peru	0.5406	0.5289	0.5209	0.5340	0.5253	0.5242	0.5390	0.6096
	Chile	0.7063	0.7014	0.6989	0.6936	0.6988	0.6262	0.6958	
	average	0.6235	0.6152	0.6099	0.6138	0.6121	0.5752	0.6174	
Oceania	Australia	0.7343	0.7302	0.7533	0.7504	0.7483	0.7297	0.7534	0.7876
	New Zealand	0.8469	0.8424	0.8315	0.8289	0.8358	0.8362	0.8051	
	average	0.7906	0.7863	0.7924	0.7897	0.7921	0.7830	0.7793	
Asia	Hong Kong	0.8452	0.8010	0.8346	0.8414	0.8389	0.8249	0.8245	0.6507
	Indonesia	0.5684	0.5673	0.5529	0.5746	0.5918	0.5997	0.6017	
	Korea	0.6501	0.6479	0.6504	0.6658	0.6725	0.6691	0.6860	
	Japan	0.7120	0.7377	0.7481	0.7512	0.7569	0.7527	0.7546	
	Thailand	0.5877	0.5770	0.5813	0.5868	0.6048	0.6132	0.6138	
	Vietnam	0.5220	0.5302	0.5446	0.5479	0.5350	0.5423	0.5626	
	average	0.6476	0.6435	0.6520	0.6613	0.6667	0.6670	0.6739	
Europe	Russia	0.5054	0.5284	0.5132	0.5585	0.5837	0.5756	0.6016	0.5983
Total average		0.6621	0.6601	0.6643	0.6736	0.6812	0.6688	0.6826	0.6704

After the index coefficient in the above formula is normalized, the weight value of each secondary index can be obtained, as shown in the last column in Table 1. The results show that the prevalence of non-tariff barriers (0.1128) has the highest weight, followed by the two secondary indicators agricultural policy cost (0.1123) and customs procedure burden (0.1024). This indicates that agricultural policy costs, the prevalence of non-tariff barriers and the burden

of customs procedures have a significant impact on trade facilitation. The weights of the four first-level indicators in descending order are: infrastructure integrity (0.1958), customs clearance convenience (0.2152), regulatory effectiveness (0.3898) and technological advance (0.1991). Finally, the weight of each secondary indicator and the corresponding standardized secondary indicator data are brought into this formula to obtain the comprehensive score of the facilitation level of APEC countries, as shown in Table 4.

4. Analysis of Trade Facilitation Level in APEC Countries

The level of trade facilitation is divided into four levels. If a country's level of trade facilitation falls within the range of [0,0.6], it is considered to be not trade facilitation. If it is within the range (0.6,0.7), it is general convenience. If it is in the range (0.7,0.8), it is classified as more convenient. When the level of trade facilitation is within the range (0.8,1), it indicates that trade is very convenient.

As can be seen from Table 4, in the APEC region as a whole, the average level of trade facilitation of major APEC economies in each year of the study period is [0.66,0.69], indicating that the region as a whole is at the general level of trade facilitation. By continent, Oceania has the highest average level of trade facilitation in the more convenient range, followed by North America and Europe at the bottom. Among them, the average level of trade facilitation in Oceania is [0.78,0.80], indicating that the region is at a relatively convenient level of trade, and the average value is stable in a slight fluctuation, that is, the regional trade is relatively convenient and stable. The average level of trade facilitation in North America is [0.68,0.72], indicating that the region has improved from general trade facilitation to relatively convenient level, and the average is stable in a slight fluctuation, that is, the regional trade is relatively convenient and stable. The average level of trade facilitation in Asia is [0.64,0.68], indicating that the region is at the general level of trade facilitation, and the average continues to rise. The average level of trade facilitation in South America is [0.57,0.63], indicating that the region is between the level of trade disfacilitation and general facilitation, and the average is basically stable. Russia's average level of trade facilitation is basically lower than 0.60, but its level of trade facilitation continues to improve during the study period.

In addition, as can be seen from Table 4, the level of trade facilitation of major APEC economies varies greatly, and there is great room for improvement in trade facilitation. The trade facilitation level of New Zealand and Hong Kong has been above 0.8, indicating that their trade is very convenient. The trade facilitation level index of the United States, Canada, Australia and Japan has been between 0.7 and 0.8, which is stable in the ranks of more convenient. Mexico, Peru, Vietnam level index is low, has been in the ranks of trade inconvenience. Indonesia and Russia had been in a trade facilitation status until 2018, but moved into a general facilitation status in 2019.

5. Conclusion

On the whole, the level of trade facilitation of APEC countries has been improving, but the gap between countries (or regions) is large, showing the characteristics of imbalance. Regionally, Oceania has the highest level of trade facilitation, followed by North America, then Asia and South America, with Europe at the bottom. From the perspective of each country, the level of trade facilitation is closely related to its economic level, and the higher the level of economic development, the higher the level of trade facilitation.

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