

Study on the Impact of the Development of Digital Economy in RCEP Member Countries on China's Export Trade

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Abstract: With the rise of the global wave of digitisation, the digital economy has become an important driver of international trade. This study aims to deeply explore the impact of the development of digital economy in RCEP member countries on China's trade. On the basis of the panel model which comprehensively analyses three kinds of digital economy development status measurement indicators such as digital economy development status, digital information industry and digital cultural resources input of RCEP countries, it assigns values to the digital economy development status of each country by means of the fixed effect model and empirically proves the relationship between the digital economy development level of member countries and the development of China's export trade. The results show that the digital economy development capacity of RCEP member countries will have a positive promotion effect on the overall improvement of China's foreign trade and export volume, and the conclusions drawn from the empirical results provide suggestions and countermeasures for the high-quality development of China's digital economy to promote foreign trade and export.

Keywords: Digital Economy; Export Growth; Entropy Method; Fixed Effects.

1. Introduction

With the continuous advancement of Internet technology, the digital economy has emerged as the dominant economic form after the agricultural and industrial economies, providing a key impetus for the reorganisation of global resources and economies. With the entry into force of the Regional Comprehensive Economic Partnership (RCEP), member countries have demonstrated their determination to further promote economic integration and trade liberalisation in the Asia-Pacific region. In the new wave of globalisation driven by digital technology and the digital economy, digital economy cooperation in the RCEP region has become a key factor in shaping the economic future of member countries, and accelerating digital transformation will inject new vitality into regional integration and global economic development [1]. As a key driver of the global digital economy, China's export trade interacts with the level of digital economy in other member countries, and the level of digital economy development in member countries plays an increasingly important role in the growth of China's trade volume and the enhancement of its international competitiveness. The study of the correlation between the development of digital economy in member countries and China's export trade as well as the related mechanism will help China better grasp the opportunities brought by the development of RCEP digital trade [2].

2. Current Status of Digital Economy Development in RCEP Member Countries

As the largest economy among the member countries of the Regional Comprehensive Economic Partnership (RCEP), China has demonstrated remarkable strength in the digital economy. With the world's largest Internet user base, China

has spawned a number of innovative companies with international influence, such as Alibaba, Tencent and Huawei. In areas such as e-commerce, artificial intelligence and digital payments, China has consistently led the way as a global leader in the digital economy [3]. According to the Digital China Development Report 2022, the scale of China's digital economy has reached a new breakthrough, more than tripling from the early stage of the 13th Five-Year Plan to a staggering 50.2 trillion yuan, ranking second in the world. The digital economy accounted for 41.5 per cent of China's GDP, a nominal increase of 10.3 per cent year-on-year. This result demonstrates the dynamic growth of China's digital economy, which is not only having a profound impact on the domestic economy, but is also playing an increasingly important role in the global digital economy [4]. India has a strong presence in the software and information technology sector and has achieved significant results in the digital economy. The rise of mobile payments, e-commerce and digital financial services is gradually changing India's business models and financial ecosystems. In 2019, the size of India's digital economy reached US\$585.6 billion in value-added, ranking eighth globally and making it one of only two developing countries among the top eight economies. Japan and South Korea have exceptional strengths in technology and manufacturing, while making breakthroughs in the digital economy. Globally renowned technology and electronics companies, such as Samsung, Sony and Toshiba, have brought substantial economic contributions to both countries [5]. Southeast Asian countries, such as Singapore, Malaysia, Indonesia, the Philippines and Vietnam, have shown a unique pattern of development in the digital economy. Singapore, in particular, as one of the most competitive digital economy centres in Asia, has attracted a large number of domestic and foreign investments. Vietnam has made remarkable progress in manufacturing and outsourcing services.

E-commerce has become an important engine driving the

prosperity of Southeast Asia's digital economy. According to the Southeast Asia Digital Economy Report 2021, six countries - Singapore, Malaysia, Indonesia, the Philippines, Thailand, and Vietnam - have achieved significant growth in terms of Internet users [6]. The data shows that these six countries have added 40 million new internet users, a 10 per cent increase year-on-year, to reach a total of 440 million users, which means that 75 per cent of the population in these six countries already have access to the internet. Australia and New Zealand have also made progress in the digital economy, especially in e-commerce and digital payments. These two countries are actively exploring the potential of the digital economy to drive economic growth [7]. Today, the world is in the midst of a wave of digital economy, and digital trade has become an important engine for driving the development of international trade. In this era, the development of digital economy has a significant role in promoting the development of various fields of the economy, and the high-quality development of digital economy is expected to lead to the high-quality development of various industries and economic development directions [8]. This paper will analyse the impact of the economic development level of Regional Comprehensive Economic Partnership Agreement (RCEP) countries on China's export trade from nine dimensions through the entropy method, so as to validate the role of the digital economy development of RCEP countries in the promotion of China's export trade from the measurement point of view, and to put forward practical suggestions for the improvement of China's export trade in the future [9].

3. Construction of Digital Economy Indicators and Level of Development of RCEP Member Countries

3.1. Construction of the Indicator System

The digital economy takes data resources as the main component, digital technology as the core driving force, and modern information network as the important carrier of the new economic form, through the deep integration of digital technology and the real economy, covering a number of industries and geographic scopes, and overlapping with the traditional economy's statistical methodology and industrial classification to a certain extent, which makes it a difficult task to accurately measure the scale and impact of the digital economy [10]. To establish the indicator framework of the International Competitiveness Index for Digital Trade, three first-level indicators are selected, namely, the use of digital economy to reflect the actual use of ICT in the society, the economic industry to reflect the situation of the internal environment for the development of the country's ICT industry, and the input of digital economy resources to measure the in-depth impact of the development of ICT in the country; the coverage rate of fixed-line telephones, the coverage rate of mobile telephones, the percentage of individuals using the Internet, the number of mobile cellular subscribers, and the percentage of high-tech exports to the real economy. cellular subscribers, the share of high-tech exports, the share of information and communication technology (ICT) service exports, the number of scientific and technical journal articles, the number of resident patent applications, and the urban population are nine level 2 indicators, and the weights of the results measured by the entropy method are shown in Table 1 below:

Table 1. Indicator weights for the level of development of the digital economy

Tier 1 indicators	Secondary indicators	Unit	Weighting	Indicator Attributes	Data source
Use of the digital economy	Fixed-line coverage	%	2.13%	+	WDI database
	Mobile phone coverage	%	4.09%	+	
	Percentage of individuals using the Internet	%	5.86%	+	
	Mobile cellular subscribers	people	8.03%	+	
Digital Industries	Share of high-tech exports	%	23.19%	+	
	Percentage of exports of information technology (ICT) services	%	17.31%	+	
Digital economy resource inputs	Number of scientific and technical journal articles	sheet	12.39%	+	
	Number of resident patent applications	item	10.85%	+	
	Urban population	people	16.16%	+	

3.2. Entropy Weight Method Weight Measurement and Description

Entropy weight method, as a common indicator weight allocation method, calculates the entropy value of the relationship between indicators, and then determines the weight of the indicators according to the size of the entropy value. Firstly, the data of the selected secondary indicator indicators are normalized, and then the entropy value of each indicator is calculated, and the larger the entropy value is, the more informative the indicator is, and the smaller the weight is. Subsequently, by calculating the information entropy and information gain of each indicator, the weight of each indicator is derived [11].

If the value of a single economic indicator shows a positive

relationship with the development of the institutional system, a positive indicator calculation method is used, and the indicators selected in this paper are all positive indicators. As shown in equation (1):

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

All the individual indicator values selected in this paper show a positive relationship with the institutional system, and the larger the indicator value, the more favourable it is to the development of the institutional system, so they are measured. Where x_j^{max} is the maximum value of the indicator value in all years, and x_j^{min} is the minimum value of the indicator value in all years.

$$x''_{ij} = H + x_{ij} \quad (2)$$

where H is the parallel magnitude of the indicator,

generally taken as 1.

The data were normalized using the weighting method:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n y_{ij} \ln y_{ij} \quad (3)$$

Measure the entropy of the j th metric:

$$g_j = 1 - e_j \quad (4)$$

The weight of the j th indicator is:

$$w_j = \frac{g_j}{\sum_{j=1}^p g_j} \quad (5)$$

where $j = 1, 2, \dots, p$.

After obtaining the weight of each indicator in the total score, then the score of individual system indicator in year i can be obtained by multiplying the product of weight w_j and the regularised value of indicator j to get the score of j indicator in year i . The formatted value is multiplied with the weight to get the integration score:

$$Z_i = \sum_{j=1}^p w_j x_{ij} \quad (6)$$

Table 2. Measurement results of the level of digital economy development of RCEP countries in 2010-2020

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	Ranking
Japan	0.140	0.141	0.141	0.138	0.136	0.133	0.134	0.137	0.136	0.136	0.137	0.137	1
South Korea	0.073	0.078	0.082	0.087	0.089	0.089	0.087	0.094	0.103	0.099	0.104	0.090	2
Singapore	0.048	0.052	0.053	0.053	0.054	0.053	0.057	0.063	0.062	0.067	0.072	0.058	3
Australia	0.025	0.035	0.036	0.046	0.037	0.047	0.038	0.048	0.049	0.049	0.052	0.042	4
China	0.034	0.038	0.040	0.042	0.041	0.039	0.039	0.043	0.046	0.006	0.047	0.038	5
Malaysia	0.026	0.028	0.029	0.029	0.030	0.028	0.028	0.031	0.034	0.017	0.037	0.029	6
Philippines	0.024	0.027	0.027	0.029	0.029	0.027	0.028	0.029	0.031	0.033	0.035	0.029	7
Thailand	0.022	0.022	0.023	0.023	0.024	0.024	0.026	0.029	0.029	0.022	0.030	0.025	8
New Zealand	0.020	0.020	0.022	0.023	0.024	0.026	0.027	0.030	0.033	0.021	0.028	0.025	9
Indonesia	0.019	0.020	0.022	0.022	0.023	0.023	0.025	0.026	0.028	0.025	0.030	0.024	10
Brunei	0.003	0.003	0.003	0.003	0.005	0.005	0.006	0.006	0.007	0.008	0.008	0.005	11
Vietnam	0.004	0.004	0.004	0.005	0.005	0.004	0.005	0.005	0.004	0.004	0.005	0.004	12
Cambodia	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	13
Myanmar	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.002	0.0015	14
Laos	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	15

According to Table 2, it can be seen that in the ranking of the fifteen RCEP countries, the top five in the level of development of digital economy are Japan, South Korea, Singapore, Australia and China, while the level of development of digital economy in Indonesia, Brunei, Vietnam, Cambodia and Laos is lower and ranked in the last five. It is not difficult to conclude that the level of digital economic development and the overall level of regional development also has a greater relationship between the Asia-Pacific region, Australia, Singapore and other countries focus on the cultivation of high-tech industries, information technology research in the infrastructure is relatively perfect, the results are relatively outstanding, so the ranking results are more advanced, while the countries of Southeast Asia region are affected by the lack of a stable innovation and research and development of material security, the momentum of the development of the digital transaction and the relatively backward infrastructure development and other factors, are at a lower level, the overall ranking is relatively backward [12]. Measurement results and the reality of empirical judgement is also more consistent, therefore, the index system designed in this paper has a certain degree of scientific, can reflect the overall development of the level of the digital economy of the countries, and on the basis of empirical evidence to further test the level of development of the digital economy of the member states of the impact of China's export trade.

4. Econometric Model Design and Empirical Analysis

4.1. Measurement Model Setting

This paper adopts the entropy value method to comprehensively measure the weights of nine secondary indicators in the three dimensions of digital economy usage, digital industry and digital economy resource inputs, and constructs the following basic empirical model according to

the selected indicators:

$$LnEXP_{cit} = \beta_0 + \beta_1 digital_{it} + \gamma_X + \mu_{it} + v_{it} + \varepsilon_{it} \quad (7)$$

In the regression equation, i represents the trading country, c represents China, and t represents the year. As the explanatory variable $LnEXP_{cit}$ denotes the total size of China's exports to country i at time t and the total domestic exports to other countries in the RCEP in year t , reflecting the quality level of export trade. The core explanatory variable $digital_{it}$ is designed to depict the development trend of country i 's digital economy in time period t ; X represents a collection of variables consisting of several control variables affecting the trade between the two countries; β_0 represents a constant term, β_1 is the coefficient used to explain the main variable, and γ is the coefficient used to control the variable; v_{it} is the unobservable error term in the time series, and μ_{it} is the panel data model the unobservable error term on the cross-section in the panel data model, ε_{it} is the random error term in the panel data model, and the rest are explanatory variables [13]. There are many factors affecting export trade, this paper mainly selects four indicator factors to be included in the model, namely: per capita consumption level (CONSUME), total population of the countries along the route (POP), weighted average tariff rate (TAR), and the trade freedom index (OPEN), which can be obtained by collation:

$$LnEXP_{cit} = \beta_0 + \beta_1 LnDIG_{it} + \gamma_2 LnCON_{it} + \gamma_3 LnPOP_{it} + \gamma_4 OPEN_{it} + \gamma_5 TAR_{it} + \mu_{it} + v_{it} + \varepsilon_{it} \quad (8)$$

4.2. Sample Selection and Data Description

4.2.1. Explained Variables

Export trade level (EXP). This paper adopts the total trade volume of the country's exports to RCEP member countries from 2010 to 2020 as a measure of export trade indicators, which can more accurately reflect the degree of development of a country's exports, and the data come from the World Bank's public data.

4.2.2. Core Explanatory Variables

Digital economy development level (DIGITAL). The panel data of the member countries along the RCEP selected in this paper has both time span and inter-country span, and the comprehensive score is measured by using the entropy method to assign the level of digital economic development of each member country, and the data are measured by the authors themselves.

4.2.3. Control Variables

In order to control other influencing factors that may cause changes in the volume of service trade between China and other countries, this study sets four control variables.

Per capita consumption level (CONSUME). The annual per capita consumption level of RCEP countries is used to express it. This variable is used to measure the overall economic well-being and standard of living of a country or region.

Total population of countries along the route (POP). Digital trade is a high value-added good, while the GDP and population size of the trading country reflect the demand capacity for services trade there.

Weighted Average Tariff Rate (TAR). Represents the tariff

barriers to China's exports to RCEP member countries. It is generally theorized that higher tariff barriers hinder trade between the two countries, which in turn reduces the efficiency of export trade.

Trade Freedom Index (OPEN), representing the level of market openness of member countries. The higher the level of trade freedom, indicates that the member states have less restrictions on imports, the more favourable to the export of China's goods.

4.3. Empirical Analysis

4.3.1. Descriptive Statistics

As shown in Table 3, the content is the descriptive statistics analysis of the sample data. The object of inquiry in this paper is the descriptive statistics of the sample that affects the growth of imports of 14 RCEP countries from 2010 to 2020. In this paper, the corresponding variables are adjusted to the scale and standard logarithmic processing, the linear transformation of the original data to reduce the existence of heteroskedasticity and autocorrelation brought about by the impact. The paper compares the minimum value, maximum value, mean and standard deviation of each sample indicator.

Table 3. Descriptive statistics of variables

	Unit	Minimum value	Maximum value	Mean value	standard deviation	N
LnEXP	USD	8.565	11.181	10.24	0.685	154
LnDIG	None	1.002	2.883	2.148	0.387	154
lnCON	US Dollars	2.690	4.515	3.658	0.560	154
LnPOP	Billions	5.598	8.434	7.405	0.715	154
OPEN	None	56.60	94.800	78.51	7.640	154
TAR	%	0.021	9.770	3.047	2.301	154

4.3.2. Correlation Analysis

In order to detect whether there is a correlation between the calculated selected variables, the correlation coefficient matrix is analysed through Table 4 before regression analysis. The correlation coefficients between variables show that the correlation coefficients between LnEXP and all variables are less than 0.8, so it is reliable for this paper to select the

indicators of RCEP member countries that can promote the growth of the digital economy and China's exports of trade volume of the RCEP member countries to explore. Meanwhile, the correlation coefficients of per capita consumption level, total population of countries along the route, weighted average tariff rate and trade freedom index are high, so it is feasible for this paper to select the above control variables for regression analysis.

Table 4. Correlation analysis

	LnEXP	LnDIG	lnCON	LnPOP	OPEN	TAR
LnEXP	1					
LnDIG	0.748**	1				
lnCON	0.365**	0.660**	1			
LnPOP	0.717**	0.396**	0.243**	1		
OPEN	0.320**	0.389**	0.691**	-0.194*	1	
TAR	0.272**	0.190*	-0.294**	0.596**	-0.380**	1

4.3.3. Multicollinearity Test

Table 5. Multicollinearity test

Variable Name	VIF Value	1/VIF
LnDIG	4.45	0.224786
lnCON	5.31	0.188452
LnPOP	2.86	0.350158
OPEN	2.11	0.474152
TAR	1.80	0.555620
MeanVIF	3.30	

In order to ensure the accuracy and stability of the empirical results, as well as to prevent the high correlation

between the variables from influencing the results, this paper conducted a multicollinearity test on the selected variables. The VIF (Variance Inflation Factor) is used through stata to test whether there is multicollinearity in the model. Generally, if the VIF value exceeds 10, multicollinearity is considered to exist. In this model MeanVIF is 3.3 and the VIF value of each variable is less than 10, it can be concluded that this model passes the multicollinearity test.

4.3.4. Underlying Model Testing

Panel data has two dimensions, time series and cross-section, which can overcome the interference of multicollinearity and improve the estimation and research efficiency. In terms of model selection, since the individual

effects model not only takes into account the commonality but also the heterogeneity of individuals, this paper chooses the individual effects model, but such models are divided into random effects models and fixed effects models, so it is necessary to use the Hausman test to further determine which way to take for data processing. The results of the Hausman test are shown in Figure 1, and the individual fixed effects model is used.

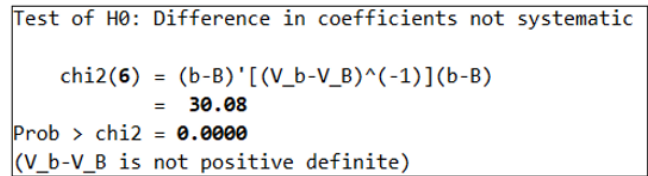


Figure 1. Hausmann test results

4.3.5. Benchmark Model Back

Table 6. Model estimation results

variable	FE LnEXP	FE LnEXP	FE LnEXP	FE LnEXP	FE LnEXP
Constant term	7.402** (0.221)	7.849** (0.234)	2.130** (0.377)	1.984** (0.389)	1.495** (0.391)
LnDIG	1.322** (0.091)	1.587** (0.121)	0.230** (0.097)	0.304** (0.106)	0.345** (0.105)
lnCON		0.278** (0.073)	0.573** (0.079)	0.506** (0.082)	0.355** (0.092)
LnPOP			0.746** (0.043)	0.794** (0.046)	0.763** (0.047)
TAR				-0.040** (0.013)	-0.028** (0.013)
OPEN					0.015** (0.004)
NUM	154	154	154	154	154
\bar{R}^2	0.556	0.582	0.823	0.833	0.844

Dependent variable: LnEXP*p<0.05**p<0.01

In terms of the regression results of the fixed-effects benchmark model in Table 6, whether there is only one core explanatory variable of the level of digital economic development or the control variables are added to the model sequentially, the digital economic development of the RCEP countries is significant at the 1% significance level and the coefficients of the core variables are positive, which indicates that the impact on the level of China's exports and trade is effective and significant, i.e., for every one percentage point increase in the level of the indicator of the level of digital economic development by one percentage point, the average trade volume of China's exports to member countries will increase by 0.345 percentage points. This means that the expansion of the level of digital economy in member countries on the new forms of trade not only includes online publicity, trading, settlement, etc. based on information and communication technology, through the effective collection, differentiation, preservation, dissemination and transformation and use of data and information resources through digital technology to build a new regional industrial chain system, the formation of a new form of export industry; it also includes digital services transmitted through the information and communication network, such as data, Digital products, digital services and other digital industries and traditional industries integration is conducive to transforming the mode of trade growth, based on the international digital trade and thus promote the intermingling of international organizations, services and technological innovation, to promote the single value chain to the value system or the value network to leap, to achieve the economies of scale effect and the digital economy driven by the new mechanism, to create new business models, and thus increase China's exports to it.

Meanwhile, the coefficients of other control variables are also basically in line with expectations. The per capita consumption level and population of the importing country

have a significant role in promoting China's exports, with a high per capita consumption level and a larger population base representing a larger market size in that country, and demand will increase accordingly; the weighted tariff rate of all commodities of the member countries has a negative impact on China's trade and export volume. Higher tariffs in member countries increase the cost of China's exports, which in turn reduces the volume of export trade to the host country; higher trade openness in importing countries usually means lower tariff barriers, fewer trade restrictions and simplified import procedures, such an environment provides a broader market space for Chinese commodities, which makes it easier for China's exports to enter its market.

4.3.6. Robustness Analysis

Addition of omitted variables. This paper chooses several control variables in the benchmark regression model, involving the per capita consumption level of residents, the total population of the countries along the route, the weighted average tariff rate, and the trade freedom index in many aspects, but in reality, there may still be some variables that have an impact on the empirical results. As the official exchange rate (RATE) of each member country affects the volume of China's export trade, the stability of the external exchange rate, which contributes to the stable development of trade, and the magnitude of change in exchange rate level is an important factor in a country's trade, this section adds the official exchange rate control variable in the robustness test, that is, it adopts the average annual exchange rate of the member country's local currency to the U.S. dollar to express the solution to the problem of omitted variable deviation.

According to the regression results in the table, we can see that after adding the new control variables, the sign and significance of the coefficients of the variables are not significantly different from the baseline regression, and the coefficient of the core explanatory variable DIGITAL is still

significantly positive on the 1% confidence interval, which further verifies that the level of digital economic development of the RCEP member countries has a significant positive impact on China's export trade. At the same time the regression results show that the official exchange rate of the

importing country has a reverse inhibitory effect, and the depreciation of the currency of the destination country will increase its import costs, thus reducing the volume of imports to China.

Table 7. Adding variables

Variable	constant	LnDIG	LnCON	LnPOP	TAR	OPEN	LnRATE	R ²	Adjusting R ²
Regression coefficient	1.297** (0.501)	0.322** (0.111)	0.383** (0.097)	0.761** (0.048)	-0.029** (0.014)	0.016** (0.005)	-0.016* (0.026)	0.85	0.844

5. Conclusion and Recommendations

Using cross-country panel data from 2010 to 2020, this study empirically analyses the impact of the rise of digital economy in RCEP member countries and China's export trade. The empirical results show that the level of digital economy development of member countries has a positive promotion effect on China's exports to them. At the same time, the per capita consumption level, population size and trade freedom of member countries are positively correlated with China's export trade volume to that country.

Based on the above conclusions, the following suggestions are provided for the high-quality development of China's digital economy to promote foreign trade and exports:

First, improve the level of China's digital infrastructure in all aspects. The government should increase investment in digital infrastructure and promote the construction and upgrading of digital infrastructure in order to provide stronger infrastructure support for the development of digital trade. In addition, China needs to strengthen the synergistic development of digital infrastructure, such as communications, cloud computing, big data and the Internet of Things, in order to improve the overall effectiveness of digital infrastructure.

Second, accelerate cross-border cooperation in digital technology and innovation. China should actively advocate and promote cross-border cooperation in research and development projects related to the digital economy, jointly build new types of infrastructure to enhance international connectivity, jointly promote digital transformation to facilitate the integrated development of industries, and jointly deepen digital trade to accelerate the international flow of goods and services, in order to address common challenges such as digital inequality and the digital divide. Second, simplifying and accelerating the process of digital trade will help improve trade efficiency for member countries, accelerate the customs clearance process of goods and the flow of funds to reduce trade barriers, and add new momentum to the development of trade in the digital economy.

Third, create a digital platform with global influence and cultivate new modes and new business forms to gain competitive dominance. Give full play to its advantages in terms of market scale and other aspects to explore new models and new business forms. In particular, we should encourage capable companies to build digital platforms, actively join world commerce, acquire data-based strategic resources, develop cross-region and transnational digital commerce ecosystems, and gain leadership in future international commerce competitions through the advantages of platforms.

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