

The Chinese Experience of Developing Cross-Border E-Commerce Under the “Belt and Road” Framework: Factors, Challenges, and Solutions

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ABSTRACT

Cross-border e-commerce is becoming the driver of digital globalization and is of strategic importance in the growth of world trade. Under the framework of the Belt and Road Initiative, China has released a number of guidelines to accelerate the process of development regarding the cross-border e-commerce industry, including the Digital Silk Road project. However, the boosting of cross-border e-commerce is followed by challenges. This article investigates the main factors affecting the current situation with cross-border e-commerce within the 51 countries along route. Based on empirical analysis, it is concluded that logistics infrastructure has so far been the key factor for cross-border e-commerce’s sustainable development. Thus, general suggestions are given, among which the priority belongs to improvement of the existing logistics infrastructure and construction of the new one. Several directions for future research in this area are recommended, such as exploration of new logistics mechanisms and schemes, based on digitalization and innovations.

KEYWORDS

Belt and Road Initiative Countries, China, Country’s Gross Domestic Product, Digital Silk Road, Information and Communication Technologies, Transport and Logistics Infrastructure

1. INTRODUCTION

In the digital era, modern technologies are changing the world at exponential speed. As an upgraded version of traditional trade, e-commerce is considered to be one of the tools for improving efficiency and increasing the scale of domestic trade, while cross-border e-commerce (CBEC) is becoming the driver of digital globalization and is of strategic importance, causing major changes in world trade. The average annual growth rate of e-commerce is about 20%, but in the period from 2017 to 2020, the volume of e-commerce grew by astonishingly 76%. Despite the enormous progress of CBEC, currently, many developing countries among which there are also WTO members are still weakly involved in CBEC.

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In the digital era, the interdependence of the economies of different countries from each other and the vulnerability of the global economic system in the context of disruption of regional economic ties is more obvious than ever. Regional cooperation between countries is a fundamental component of the global economy's mechanism. In this aspect, the Chinese initiative Belt and Road (BRI) is a good example of regional cooperation between BRI countries, united by common interest of prosperity of nations and expansion of goods and services export possibilities.

Looking back to the roots of the BRI, it has been firstly put forward by President Xi in 2013 as an ambitious attempt towards the development of economic cooperation of the Eurasian continent. The BRI is truly meant to revive and improve the essence of the historic Silk Road. Due to its nature of building the historic Silk Road, it focuses primarily on countries in Asia, East Africa, Eastern Europe, and the Middle East, which forms a region composed primarily of emerging markets. Through the implementation of the Initiative, new prospects for the development of cross-border cooperation between European and Asian countries are evolving. In 2021, the volume of e-trade in goods between China and other BRI countries reached 11.6 trillion CNY (approx. \$1.7 trillion), a 23.6% increase over the previous year, constituting 29.7% of national total foreign trade (China's Ministry of Commerce, 2021). In Chinese national top plans, the importance of accelerating the development of CBEC is repeatedly mentioned. Since the second decade of the 21st century, the relevant policies of China's CBEC have entered a period of explosion that shows the strategic height given by the Chinese government. Within integration of soft and hard power China as the initiator of BRI has taken the lead in the global e-commerce market. The further expansion of comprehensive CBEC pilot zones, improvements in tax reduction policies, and construction of transport and logistics infrastructure connecting China with countries located along the historic route played a great role in the advancement of CBEC. As an emerging market, China demonstrates unprecedented flourishing of e-commerce. BRI countries are beneficiaries from Chinese policy not only in the sphere of infrastructure projects and Chinese foreign direct investment (FDI) flows, but also in integrating into regional economic processes, via participating in regional foreign trade, since e-commerce has a quite large potential for the development in these countries.

Despite the big potential and current achievements in the field of e-commerce made by developing countries, their contribution to the world's economy via participating in e-commerce and empirical verification of the factors affecting the state of CBEC are rarely investigated by scholars and even by international organizations and agencies, due to a widespread preconceived opinion about their minor role and weightless contribution to e-commerce before. On the contrary, there are a number of studies devoted to CBEC in developed countries, such as in the USA and EU, which have a long history dating back to the 1960s when e-commerce appeared (Burt & Sparks, 2003; Talha & Salim, 1970). Future exploration of potential of developing countries in the field of CBEC is an important direction for understanding modern processes of globalization. The basis of the potential for the development of e-commerce in developing countries is an advantage in the population, which means in the consumer ability of the population and in the workforce. In the nearest future, developing countries will occupy a niche in the global economy and become the engine for its further development.

Consequently, there is a need to investigate factors affecting the development of CBEC in BRI countries, to identify challenges, and discuss appropriate solutions. This study conducted the evaluation of factors currently affecting the development of CBEC in BRI countries. It was found that logistics and transport infrastructure, GDP level of the host country, as well as level of technological and informatization development are most impactful factors. Based on results of empirical analysis the study predicts challenges which BRI countries face or possibly face, among which are under-developed logistics and transport infrastructure, heterogeneity in economic development, and technological gaps and informatization holes. Finally, the authors provide appropriate solutions, considering the specifics of the BRI countries.

The use of a combination of quantitative and qualitative approaches in the study contributes to the theory of the regional economy and enriches the theory of CBEC. Several important directions

for further research in this area are suggested, such as construction of new theoretical models and mechanisms of cross-border logistics, as well as exploration of innovative transport and logistics schemes for CBEC, with making full use of the advantages brought by digitalization. The conclusion of this article can provide an important reference for BRI and non-BRI countries to further develop their cross-border e-commerce trade activities and also can provide information for policymakers engaged in regional and global management, and for organizations like WTO in the sphere of strengthen of multilateral connections in the world's trade mechanism in the digital era.

2. BACKGROUND

2.1 CBEC

CBEC is a new type of trade interaction that combines elements of electronic commerce and cross-border trade (Sibanda & Yin, 2020). CBEC refers to international business activities based on the use of advanced information network technologies in which transaction entities from different countries conduct transactions through online e-commerce platforms and deliver goods using cross-border logistics. It exists with strategic importance of contributing to international trade and economic openness based on Internet plus technologies. CBEC as a new form of trade has obvious advantages, reducing the distance between the consumer and the seller, reducing trade costs, and facilitating the development of international trade (Alyoubi, 2015), and is the main manifestation of the digital transformation of international trade (Spartak, 2018).

2.2 CBEC Development Influencing Factors

Recent research has focused attention on the factors influencing the development of CBEC. According to literature review, scholars prefer the classification of factors made by Li et al. (2018), who divided factors into macro, meso, and micro perspectives.

The macro perspective is related to the analysis of factors at the national level. In macro studies of the drivers of CBEC, the PEST method is common (Sibanda & Yin, 2020). The PEST method distinguishes between four groups of factors, including political, economic, social, and technological. A macro-perspective study of the development of CBEC also highlights factors such as Internet penetration and information infrastructure, economic freedom, market environment, customs agreements and customs fees, transport costs, and logistics infrastructure. The meso-level factor analysis focuses on business and industry factors. Some of the factors, such as transport costs, are taken into account at the macro and meso-levels, but if the macro perspective refers to the overall economic level of transport costs, then the meso-perspective takes into account the average level of transport costs for logistics operations in the e-commerce of the country. The micro-perspective is in regards to consumer behavior and includes customer responsibility (Ding, 2017), trust, and e-commerce service quality (Feng & Chen, 2019).

2.3 CBEC in Developing Countries

Global e-commerce is moving to emerging regional markets. Currently, increase in customer demand and rapid penetration of the mobile Internet contributes to growth of CBEC in many developing countries (Molla & Heeks, 2007). The progressive development of CBEC is an important growth driver for the economies of developing countries (Koval & Evdokimova, 2020). CBEC has different rates of development in macro regions, among which the Asia-Pacific region with its many developing countries occupies a leading position, and China is expected to continue to play the role of an engine of the global e-commerce market going forward (Kulik & Pazdnikov, 2018).

Shugurov & Shugurova (2021) put forward a theoretical concept of the disproportionate development of CBEC, which is based on the idea of a "digital divide" (Genus & Noor, 2005) between developed and developing countries. Different groups of countries, mainly developed and developing,

have different infrastructure capabilities for the development of electronic commerce, which leads to differences in economic development. Inadequate infrastructure is a major barrier to CBEC in developing countries. The development of CBEC in developing countries is also constrained by access to technology, poor telecommunications infrastructure and unreliable power supply (Lawrence & Tar, 2010). Economic, sociopolitical, and cognitive barriers are also highlighted (Molla & Heeks, 2007). In general, former studies on CBEC in developing countries are descriptive, and empirical analyses is a needed.

2.4 CBEC Development in China and BRI Countries

The sustainable development of developing countries requires external incentives (Tagarov, 2021), and participation in regional projects like the BRI is such an incentive.

Since the BRI was proposed, academia has made detailed studies on the trade relations, types, structural characteristics, and business potential of BRI countries. Research in China has highlighted the immense importance of BRI in the development of CBEC, pointing out advantages of the Initiative. It has concluded that BRI has provided a lot of convenience for CBEC customs, inspection, tax, foreign exchange, and other regulatory policies, and organizing of supporting services such as warehousing, logistics and payment (He & Xu, 2018). At the same time, scholars have unanimously agreed that problems in development of CBEC between countries along BRI and in China particularly still have been continuous (Chernova, 2021; Wang & Liu, 2021).

Review of the existing literature about BRI has shown that the previous researchers made attempts to survey the state of e-commerce and to explore the factors affecting the development of CBEC in BRI countries. Nevertheless, most studies were based on qualitative analysis, while few of them explored the issue using empirical methods. Therefore, previous academic content has covered an increasing number of topics, rather than delving into topics more in-depth (Blanchard, 2021).

To sum up, literature analysis has proved that the “Belt and Road” framework is more competitive in BRI countries due to the policy support of regional cooperation. However, there is a lack of empirical studies on major factors influencing the current development of CBEC in BRI until now. Thus, there is a need to close the literature gap through the determination of the most impactful factors, using statistical analysis. In this study, a macro perspective was the most appropriate way to analyze factors at the national and regional level, and the authors adhered to this theoretical approach to develop hypotheses and determine factors affecting the development of CBEC in the BRI. To fulfill this study, the authors discuss the challenges for CBEC in BRI countries and provide appropriate suggestions.

3. THEORETICAL MECHANISM ANALYSIS AND HYPOTHESES

Based on the previous authors’ research results, CBEC has a high potential for further development that could make international trade cooperation between China and countries along the BRI route more efficient. One of the main trends in the development of international trade is the intensification of CBEC processes. Thus, factors affecting CBEC development must be empirically investigated. For this purpose, the authors have used macro-level factor approach in developing the theoretical mechanism and hypotheses, based on classification of factors, suggested by Li et al. (2018), by macro-, meso-, and micro levels. The macro perspective is related to the analysis of factors at the national level, which combines with the research object – BRI as a form of regional cooperation between countries. Based on the PEST method from the perspective of macro-level factors, affecting factors were studied regarding logistics and infrastructure, and economic, information and technological situations in BRI.

Despite bright prospects, CBEC within the BRI countries faces high risks due to market complexity, heterogeneous development of e-commerce infrastructure, different socio-cultural environments, and political risks associated with international conflicts on the Eurasian continent. In the opinion of Wang et al. (2017), China’s CBEC alone is not powerful enough to dampen the current shock of contraction in international trade. The positive effect of CBEC does not compensate

for the negative impact of other factors, so CBEC cannot be considered as a new or additional source of growth in international trade, without existence of an appropriate level of logistics infrastructure and customs efficiency. An empirical study by Wang and Liu (2021), through the survey of logistics employees, marketing, and infrastructure companies working within the BRI, found that logistics is a key link in CBEC. Informational and capital flows in transactions for CBEC are created online, while logistics is carried out offline, and logistics factors determines the amount of costs of CBEC.

The state of transport and logistics infrastructure (Figure 1) is a key issue in the development of CBEC for the countries with high index of LPI and the major bottleneck for the countries with the opposite (Yu, 2022). Lack of robust logistical networks is the main obstacle for developing countries (Alyoubi, 2015, p. 481). In this turn, the improvement of infrastructure is positively affecting the development of trade (Limao & Venables, 2001; Vijil & Wagner, 2012).

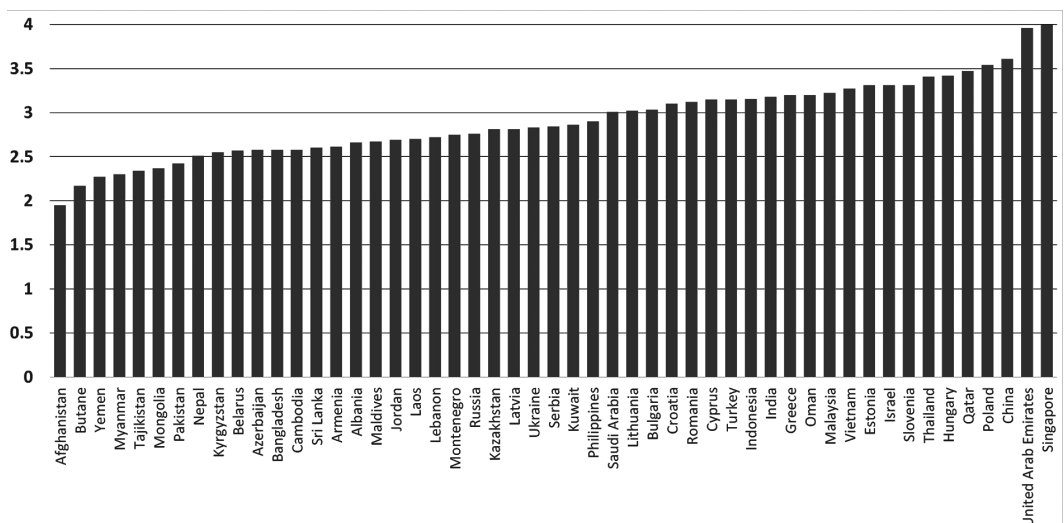
Based on the importance of the logistics in the development of CBEC between BRI countries, the following hypothesis was proposed:

H1: The state of cross-border transport and logistics infrastructure determines CBEC development level in the BRI countries.

According to Pang (2015), the development of e-commerce is based on the economic development of the country. A country’s GDP determines the level of its economic development and a country’s potential market demand. In this regard, Wu and Cao (2021) used the value of GDP as a factor influencing the state of e-commerce. Zhao (2020) used a linear regression model in the study of the potential of China’s CBEC, which included factors of the country’s export and import volume, GDP, and the cost of transporting goods through e-commerce operations.

Sahu et al. (2021) and Zhou and Yu (2021) claimed that FDI inflows have significant positive effect on economic growth of the recipient countries. FDI can be attracted by the development of infrastructure according to Asiedu (2002), Bellak et al. (2009) as well as by the macroeconomic stability of the host country. Therefore, ensuring a continuous and stable inflow of FDI is one of the factors for the development of e-commerce. The development of e-commerce based on application of scientific and technological components, and the modernization of industry leads

Figure 1. Development of the Transport and Logistics Infrastructure of E-Commerce in the 51 Countries of the BRI (Note: Compiled by the authors based on LPI UNCTAD data)



to an increase in FDI. High-tech industries, including e-commerce, have a higher return on investment, which greatly increases FDI inflows into the country. Currently, investments into high technology, finance, and agribusiness have become preferable target sectors of Chinese enterprises in BRI countries. Furthermore, high-level political cooperation promoted by BRI as well as policy coordination and governmental support, can reduce host country policy uncertainty and political risks for foreign investors and attract FDI inflows (Du & Zhang, 2018). According to the theory of the relationship between international trade and FDI, FDI may have a substitution or additional effect in international trade, so the FDI variable and the trade facilitation-FDI interaction condition should be considered when studying the state of e-commerce in BRI countries. Thus, the authors proposed the following hypothesis:

H2: Economic development of the country and the intensity of FDI flow form macroeconomic stability and determine the state of e-commerce in the BRI countries.

In the 21st century, with the progress of information and communication technologies, public and government officials have discovered that the use of new technologies in the process of making trade transactions has some advantages, including remoteness. The Internet has significantly expanded the opportunities for the development of CBEC. With the development of global integration and Internet technologies, more consumers carry out cross-border consumption via the Internet and participate in international trade, which makes CBEC available for B2C and C2C, besides B2B.

BRI countries have different levels of informatization. Singhal (2019) highlighted the heterogeneity of informatization in BRI countries, as well as low degree of informatization in Central Asian countries. This is reflected in the imperfection of the information infrastructure and the insufficient development of information services. The high Internet penetration level, as well as widespread access to digital services and mobile devices affects the national e-commerce development and increases the activity of e-commerce processes between countries (Łukomska-Szarek et al., 2021). ICT adoption and innovation positively drives financial development (Ejemeyovwi et al., 2021). In addition, technical innovations in e-commerce enhance competitiveness by integrating value-added services with logistics and supply chain (He and Xu, 2018). Thus, the authors proposed the following hypothesis:

H3: The information and communication technologies (ICT) in the BRI countries have an impact on the e-commerce development level.

4. RESEARCH METHODOLOGY

4.1 Research Context and Study Design

According to the principles of completeness, representativeness, and availability of primary data in official databases, there was chosen a sample of 51 countries from different BRI regions for trial bases instead of 65. To maximize the coverage of countries located in different parts of the BRI, the authors have chosen countries along the BRI belonging to one of five geographic regions including (a) East and Southeast Asia, (b) Western Asia, (c) South Asia, (d) Central Asia, and (e) Central and Eastern Europe (Table 1).

Countries data were collected from the official databases of UNCTAD, World Bank, World Economic Forum, and national sources of statistics. During the collection of data on e-commerce, it was found out that there is no common database of CBEC, which led to certain difficulties in determining the degree of a country's activity in the processes of cross-border trade interaction. Primary data was processed using MS Excel applications and the statistical analysis program StatPlus (Build 8.0.3 / Core v7.8.11) and SPSS PRO.

Table 1. Study sample

Region	Countries	Share in the Sample, %
East and Southeast Asia	China, Mongolia, Singapore, Malaysia, Philippines, Indonesia, Cambodia, Thailand, Laos, Myanmar, Vietnam	21.6
Western Asia	Israel, Turkey, Saudi Arabia, Jordan, Cyprus, Yemen, United Arab Emirates, Qatar, Kuwait, Oman, Lebanon	21.6
South Asia	India, Pakistan, Bhutan, Maldives, Bangladesh, Afghanistan, Sri Lanka, Nepal	15.7
Central Asia	Kazakhstan, Kyrgyzstan, Tajikistan, Armenia, Azerbaijan	9.8
Central and Eastern Europe	Russia, Ukraine, Belarus, Serbia, Estonia, Romania, Bulgaria, Croatia, Albania, Latvia, Slovenia, Hungary, Lithuania, Poland, Montenegro, Greece	31.4

The authors used multiple regression analysis to create a model to study the factors influencing the development of CBEC in China and the BRI countries. For confirming the hypotheses, it would be necessary to use different-sized values, so a logarithm was taken, and the model is:

$$\ln e - commerce\ index_i = a + \ln LPI_i + \ln GDP_i + \ln FDI_i + \ln ME_i + \ln TR_i + \varepsilon_i \quad (1)$$

where $\ln e - commerce\ index_i$ is logarithm of e-commerce index of i BRI country and represents the e-commerce development level; $\ln LPI_i$ is logistic performance index of i country, which generalizes country performance in six logistics dimensions (includes efficiency of the customs clearance process, the quality of trade and transport infrastructure, ease of organizing supplies at competitive prices, competence and quality of logistics services, the ability to track and trace shipments, and the frequency with which shipments reach the consignee during the scheduled or expected time) (Arvis et al., 2014); $\ln GDP_i$ is gross domestic product of i country (in current US\$) logarithm; $\ln FDI_i$ is logarithm of foreign direct investment in i country and represents investment status of BRI country; $\ln ME_i$ is logarithm of Macroeconomic environment index of i country and generalize macroeconomic stability (includes government budget balance, gross national savings, inflation, government debt, and country credit rating indicators); $\ln TR_i$ is ICT adaptation index of i country or technological readiness and represents tech development level. The results of descriptive statistics are presented in Table 2.

The independent variables according to the model (1), included the natural logarithms of LPI, GDP, FDI, ME, and TR, while the e-commerce index is treated as the dependent variable. The choice of LPI as an independent variable was due to the importance of transportation and logistics infrastructure for e-commerce development. Since the object of study in the article is CBEC, the use of LPI to express the state of the transport and logistics infrastructure of each BRI country was the most appropriate, since LPI also includes assessments of the effectiveness of customs procedures, which is important for cross-border trade operations in e-commerce. The choice of GDP as an independent variable was justified by the fact that the BRI countries have a heterogeneous level of economic development. The choice of FDI as an independent variable was due to the fact that foreign direct investment contributes to the digitalization of the economies of developing countries, and the volume of FDI inflow can influence the state of e-commerce in the country. The choice of ME was due to the fact that the state of the country's macroeconomic environment is able to express the stability of its

Table 2. Statistical Description of Main Variables

Variables	Sample size	Mean	Standard deviation	25% quantile	75% quantile
ln <i>E-commerce Index</i>	306	4.055	0.401	3.878	4.357
ln <i>LPI</i>	204	1.059	0.163	0.947	1.182
ln <i>GDP</i>	306	11.377	1.729	10.141	12.619
ln <i>FDI</i>	306	7.743	1.867	6.800	8.980
ln <i>ME</i>	255	2.666	1.408	1.530	4.303
ln <i>TR</i>	255	2.440	1.315	1.404	4.009

economic development which is important for CBEC. Among the independent variables the authors used the country's ICT adaptation index or technological readiness index, which reflects the level of technological development of the country and its readiness for the development of e-commerce.

Statistical significance of regression model was tested using ADF-test, basic regression test, heterogeneity tests, robust regression analysis, quantile regression, and two-stage regression.

4.2 Empirical Analysis and Results

4.2.1 Time Series Analysis

The authors used the Augmented Dickey-Fuller test (ADF-test) to measure the significance of the most important coefficient singularly, which in this study is the e-commerce index. The results of the ADF test for the E-commerce index are presented in Table 3.

The results of the time series analysis show that, based on the field E-commerce index 2015-2020, when the difference order is 0, the significant P value is 0.000***, and the level is significant, rejecting the null hypothesis, the series is a stationary time sequence.

4.2.2 Basic Regression Results

Based on Equation (1), this article conducted an empirical analysis of the impact of logistics infrastructure factors, economic development, investment, macroeconomic environment, technological development on the state of e-commerce in BRI countries. The regression results for 2015-2020 are presented in columns (1)-(6) of Table 4 respectively.

The results of the baseline regression show that there is a positive relationship between the e-commerce index and the level of development of logistics infrastructure in the BRI countries. At the same time, the relationship of the LPI factor with the e-commerce index is closer than with the other factors, including the level of economic development (ln GDP), the state of FDI (ln FDI), the macroeconomic situation in the country (ln ME), the state of technology development, and the technological readiness of countries to the promotion of e-commerce (ln TR). There is a direct positive

Table 3. Time Series Analysis Results

Variables	Differential order	t	P	AIC	Critical Value		
					1%	5%	10%
ln <i>E-commerce Index</i>	0	-6.183	0.000***	147.517	-3.466	-2.877	-2.575
	1	-6.681	0.000***	173.077	-3.468	-2.878	-2.576
	2	-8.042	0.000***	199.923	-3.468	-2.878	-2.576

Table 4. Basic Regression Results

Variables	(1)	(2)	(3)	(4)	(5)	(6)
ln <i>LPI</i>	0.689 (0.000***)	0.568 (0.000***)	0.597 (0.000***)	0.600 (0.000***)		
ln <i>GDP</i>	0.246 (0.103)	0.186 (0.239)	0.228 (0.147)	0.155 (0.012**)	0.025 (0.594)	0.032 (0.003***)
ln <i>FDI</i>	0.192 (0.207)	0.151 (0.340)	0.195 (0.216)	0.091 (0.573)	0.003 (0.330)	0.004 (0.659)
ln <i>ME</i>	0.179 (0.239)	0.152 (0.337)	0.237 (0.131)	0.429 (0.005***)	0.214 (0.002***)	
ln <i>TR</i>	0.864 (0.000***)	0.121 (0.444)	0.160 (0.313)	0.050 (0.757)	0.117 (0.982)	
Constant	0.264 (0.000***)	0.410 (0.000***)	0.361 (0.000***)	0.978 (0.020*)	0.898 (0.267)	
Observations	51	51	51	51	51	51
R ²	0.768	0.416	0.394	0.410	0.240	0.167
F-test	25.884	4.843	4.686	4.870	2.929	4.602

Note: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. The numbers in parentheses are standard errors.

relationship between these factors and the e-commerce of BRI countries, but weaker than between the LPI and the e-commerce index.

The results of the correlation analysis revealed a strong relationship between the level of LPI and GDP (correlation coefficient 0.608), as well as a very strong relationship between FDI and the Macroeconomic environment (correlation coefficient 0.861). A strong relationship was observed between Technological readiness and the Macroeconomic environment (correlation coefficient 0.743), as well as between Technological readiness and FDI (correlation coefficient 0.667). (Table 5).

The relationship between the variables of statistical models is revealed by analyzing the linear correlation coefficient, the proximity of which to 1 indicates the presence of a close direct linear relationship, and, conversely, the proximity to -1 indicates the presence of a close feedback. The proximity of the correlation coefficient to zero is a sign of the presence of a weak relationship or its absence at all between the variables of the linear regression model. Pearson's correlation

Table 5. Correlation Analysis Results

Variables	(1)	(2)	(3)	(4)	(5)
	LPI	GDP	FDI	Macroeconomic environment	Technological readiness
ln <i>LPI</i>		0.608 (0.000***)	0.085 (0.266)	0.023 (0.760)	0.054 (0.478)
ln <i>GDP</i>			0.187 (0.014**)	0.115 (0.132*)	0.073 (0.336)
ln <i>FDI</i>				0.861 (0.000***)	0.667 (0.000***)
ln <i>ME</i>					0.743 (0.000***)

Note: ***, **, and * represent significance at the 1, 5, and 10 percent levels respectively. The numbers in parentheses are standard errors.

coefficients $r < 0.2$ confirms very weak relationship between two quantitative variables, $0.2 < r < 0.4$ confirms a weak relationship, $0.4 < r < 0.6$ confirms a moderate relationship, $0.6 < r < 0.8$ confirms a strong relationship and $0.8 < r < 1.0$ confirms a very strong relationship (The Pennsylvania State University, 2021).

4.2.3 Heterogeneity Tests

The authors investigated the individual impact of development levels of various factors on e-commerce in BRI countries by constructing a corresponding model with two variables: a variable characterizing the corresponding factor influencing on e-commerce in BRI countries and a dependent variable, which was used as an e-commerce index. Specifically, the study relies on examining the individual impact on e-commerce of the following factors:

- Different logistic infrastructure development levels;
- Different economic development levels;
- Different levels of FDI;
- Different macroeconomic environment development levels; and
- Different levels of technological readiness.

After evaluating the influence of each factor, the results shown in Table 6 were obtained.

Data in Table 6 indicate that the state of e-commerce in BRI countries is most significantly affected by differences in the levels of development of logistics infrastructure.

4.2.4 Robustness Test

To test the reliability of the regression model, two regression models were examined. The first model was based on data for the period from 2015 to 2017, and the second was based on the period

Table 6. Heterogeneity tests of the impacts of factors on e-commerce in bri countries

Variables	(1)	(2)	(3)	(4)	(5)
	Different logistic infrastructure development levels	Different economic development levels	Different levels of FDI	Different macroeconomic environment development levels	Different levels of technological readiness
$\ln LPI$	0.132 (0.000***)				
$\ln GDP$		0.913 (0.000***)			
$\ln FDI$			0.061* (0.303)		
$\ln Macroeconomic environment$				0.075 (0.256)	
$\ln Technological readiness$					0.019 (0.034**)
Constant	0.142 (0.000***)	0.152 (0.000***)	0.043 (0.000***)	0.047 (0.000***)	0.052 (0.000***)
Observations	51	51	51	51	51
R ²	0.432	0.106	0.004	0.006	0.020

Note: ***, **, and * represent significance at the 1, 5, and 10 percent levels respectively. The numbers in parentheses are standard errors.

of 2018-2020. The choice of chronological data frames was due to the official presentation of the Digital Silk Road (DSR) project at the BRI forum in 2017, which became one of the key events in the development of e-commerce in the BRI countries. Trend results before and after the formal launch of the DSR are presented in Table 7.

Regression robustness is an algorithm used to replace least squares when linear regression finds outliers in sample points. At the same time, robust regression can also detect outliers or find those sample points that have the most impact on the model.

Based on the model robustness test results, including model standardization scores, t-value, and p-value, it was concluded that LPI has a significant impact on the e-commerce index, similar to GDP (Table 8). At the same time, FDI, the macroeconomic environment, did not have a significant impact on the e-commerce index, and technological readiness had a significant impact on the e-commerce index at the 5% significance level. The value of the regression coefficients for LPI and GDP suggests that LPI plays a more significant role in the development of e-commerce in BRI countries.

Table 7. variable trends before and after official presentation of the DSR project in 2017

Variables	Before or after DSR	Countries	t-Statistics
ln <i>LPI</i>	Before	1.466	7.765
	After	1.575	7.335
ln <i>GDP</i>	Before	0.048	2.806
	After	0.037	2.554
ln <i>FDI</i>	Before	0.001	1.154
	After	0.000	0.810
ln <i>ME</i>	Before	0.000	0.373
	After	0.142	1.056
ln <i>TR</i>	Before	0.380	3.863
	After	0.066	1.106

Table 8. Robust regression analysis results

Variables	(1) Non-standardized coefficients	(2) Standardized coefficient	(3) t-Statistics	(4) p-Value
ln <i>LPI</i>	1.613 (0.151)	0.716	10.682	0.000***
ln <i>GDP</i>	0.056 (0.014)	0.281	4.118	0.000***
ln <i>FDI</i>	0.001 (0.001)	0.101	0.934	0.350
ln <i>ME</i>	0.000 (0.001)	0.065	0.548	0.584
ln <i>TR</i>	0.048 (0.024)	0.163	2.006	0.045**
Constant	2.902 (0.150)		19.343	0.000***

Notes: *** and ** represent significance at the 1 and 5 percent levels respectively. The numbers in parentheses are standard errors.

4.2.5 Quantile Regression

To eliminate the possible endogeneity of the model the authors used quantile regression, which allows minimizing of the sum of absolute regression residuals. This method is characterized by an efficiency comparable to the ordinary least squares (OLS) method for Gaussian Copula (GC) linear models, and at the same time significantly outperforms the least squares method in a wide class of non-Gaussian error distributions. Regression quantiles are types of statistical data for a linear model that have properties similar to the usual sample quantiles of a location model (Koenker and Bassett, 1978). The results of the quantile regression parameters, including quantile points, variables, and R² are presented in Table 9.

The trend of change in the regression coefficient of independent variables LPI, GDP, FDI, ME, and TR to the dependent variable E-commerce Index in different quantiles demonstrated that at the levels of all quantiles between LPI and E-commerce Index and GDP and E-commerce Index, a high statistical significance remained additive. At the same time, quantile analysis showed that the highest

Table 9. Quantile regression

Variables	(1) Quantile 0.10	(2) Quantile 0.20	(3) Quantile 0.30	(4) Quantile 0.40	(5) Quantile 0.50
ln <i>LPI</i>	2.311 (0.000***)	2.109 (0.000***)	2.093 (0.000***)	1.751 (0.000***)	1.524 (0.000***)
ln <i>GDP</i>	-0.065 (0.015**)	-0.070 (0.002***)	-0.058 (0.010***)	-0.074 (0.000***)	-0.073 (0.000***)
ln <i>FDI</i>	0.000 (0.844)	0.001 (0.534)	0.000 (0.873)	0.001 (0.109)	0.001 (0.135)
ln <i>ME</i>	-0.000 (0.001)	0.002 (0.433)	0.000 (0.933)	0.000 (0.895)	-0.002 (0.115)
ln <i>TR</i>	0.022 (0.644)	0.047 (0.223)	0.054 (0.145)	0.066 (0.045**)	0.039 (0.172)
Constant	1.810 (0.000***)	2.248 (0.000***)	2.224 (0.000***)	2.918 (0.000***)	3.239 (0.000***)
R ²	0.361	0.355	0.311	0.267	0.261
	(6) Quantile 0.60	(7) Quantile 0.70	(8) Quantile 0.80	(9) Quantile 0.90	
ln <i>LPI</i>	1.337 (0.000***)	1.178 (0.000***)	1.054 (0.000***)	0.981 (0.000***)	
ln <i>GDP</i>	-0.066 (0.000***)	-0.058 (0.000***)	-0.054 (0.000***)	-0.034 (0.023**)	
ln <i>FDI</i>	0.000 (0.663)	0.000 (0.596)	0.000 (0.540)	0.000 (0.538)	
ln <i>ME</i>	-0.001 (0.249)	-0.001 (0.354)	0.000 (0.851)	0.000 (0.614)	
ln <i>TR</i>	0.052 (0.028**)	0.026 (0.257)	0.027 (0.194)	0.025 (0.213)	
Constant	3.456 (0.000***)	3.592 (0.000***)	3.727 (0.000***)	3.611 (0.000***)	
R ²	0.264	0.268	0.265	0.232	

Note: ***, **, and * represent significance at the 1, 5, and 10 percent levels respectively. The numbers in parentheses are standard errors.

statistical significance for GDP and E-commerce Index was observed in the range of 0.40-0.80. The remaining variables were characterized by lower statistical significance.

4.2.6 Two-Stage Regression

Using the results of previous tests of variables for endogeneity, the authors created a two-stage regression model based on the dependent variables and independent variables (endogenous variables + exogenous variables) for a more accurate check of the reliability of the model under study. The results of the two-stage regression are presented in Table 10.

Table 10 shows the parameter results and test results of the model under study, including unstandardized and standardized coefficient, statistics, P value, R², adjusted R² value, and Wald value. In particular, the Wald value is used to evaluate the correctness of a two-way regression (if the P-value of the Wald statistic is less than 0.05, the set two-way regression is valid, otherwise the set two-way regression is invalid). From the two-way regression results, the Wald value was 25.485 at P 0.000***, indicating model significance and indicating that at least one variable in the explanatory variables would have a significant effect on the variable being explained. This confirmed that the largest value for the e-commerce index was the LPI value, which in turn was influenced by the level of GDP. Therefore, the development of e-commerce in the country is determined by the state of the transport and logistics infrastructure, which in turn depends on the level of economic development of the country.

4.3 Findings

The results of the empirical analysis allowed the authors to conclude that the development of e-commerce in BRI countries is mainly influenced by the level of logistics infrastructure, as well as the overall level of economic development of the country. In turn, it was found that there is a strong direct relationship between LPI and GDP, therefore, the state of LPI in connection with the level of economic development of the country. This allowed the authors to conclude that the level of development of the logistics infrastructure of the BRI countries creates the prerequisites for active economic growth and the development of e-commerce. Thus, the hypothesis H1 about the dependence of e-commerce on the state of the logistics and transport infrastructure was confirmed, the hypotheses H2 (regarding the impact of GDP on the level of development of e-commerce) also was confirmed at the macroeconomic level. As for H3 which was confirmed too: the impact of the technological development factor has been decreasing. In other words, the other factors began to influence stronger, thus are a priority. Results presented the current increasing of importance of logistics, and it is an important issue for further development of CBEC and economic integration between countries.

Table 10. Two-stage regression results

Variables	Unstandardized coefficients		Standardized coefficient	Z	P	R ²	Adjust R ²	Wald
	B	Standard error	Beta					
ln LPI	0.728	0.248	2.938	0.003	0.728	0.339	0.323	Wald=25.485 P=0.000***
ln FDI	0.001	0.001	0.934	0.351	0.001***			
ln ME	-0.001	0.001	-0.611	0.541	-0.001***			
ln TR	0.059	0.028	2.125	0.034	0.059*			
Constant	3.175	0.268	11.834	0	3.175			

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels respectively. The numbers in parentheses are standard errors.

5. DISCUSSION

5.1 Challenges of CBEC in the BRI Countries

Based on results of empirical analysis three major challenges can be pinpointed.

5.1.1 Logistics and Transport Infrastructure in Most of the BRI Countries is Still Under-Developed

Countries along the route have significant differences in logistics infrastructure. Some developed countries, like Singapore, Malaysia, and Poland have high level of LPI. Nevertheless, most of the BRI countries are lagging, with facilities overuse or even lacking facilities (Figure 1). In this regard, countries with lower levels of logistics infrastructure have high risks of limitation of the e-commerce development in the BRI (countries in Central Asia, some countries in Europe). Moreover, the infrastructure of transport channels for cross-border logistics cooperation of e-commerce BRI is not unified. There are many problems in building logistics channels between BRI countries, which affect the development of regional logistics cooperation. For example, there are differences in railway standards between China and the countries of Central Asia, thus a lack of railway capacity and difficulties in connecting the railway transport infrastructure.

Compared with domestic logistics, international logistics includes more links and more complexed procedures, such as transportation, warehousing, customs declaration, goods inspection, customs clearance, tax refunds, etc. Long work cycles have created intricate barriers to the operation of BRI's CBEC' logistics and negatively affects customer's satisfaction and shopping desire. All this increases the cost of logistics operations, which accounts for about 25% of the total cost of goods in e-commerce for B2B or astonishingly reaches about \$15 per kg. for C2C and B2C in China.

As a part of LPI index, in this study another limiting factor of CBEC along the BRI was the imperfection of the regulatory system and customs clearance system. Although China has set up CBEC integrated logistics pilot zones in some cities in the country, which support online declaration and customs clearance procedures, the whole process is still time consuming. The traditional model of cross-border customs clearance has proved unable to adapt to the growing volume of CBEC.

5.1.2 Difference in GDP Level and Economic Situation

GDP level affects CBEC in BRI countries. The countries along the BRI differ much in economic development. Only few developed countries of BRI have economic advantages which help them to develop CBEC smoothly (for example, Malaysia, Latvia).

Most of the BRI countries are the countries with high and moderate GDP level, but with low actual GDP per capita. This phenomenon concerns countries with economies still based on raw materials and energy supplies (e.g., Russia, Kazakhstan, etc.). From the CBEC aspect, GDP can determine consumers' demands and their buying ability. Actually, distribution of GDP in a developing country does not always mean the population of the country has an equally high level of income and can afford themselves to buy more. As for countries with low level GDP per capita (e.g., African countries, Middle Asian countries), development of CBEC could be only provided by efforts of government between BRI countries in the form of aid (Afghanistan, Syria, Cambodia, etc.) or under framework of mutual memorandums of understanding. For attracting private business it is necessary that the host country has potential in economic development, for example, has potential in agriproducts production and export (countries of East and Southeast Asia); cross-border tourism (seashore and tropical countries or countries with ancient civilization in Western and South Asia); raw materials, hydrocarbons, gas and other natural resources (Central Asia and Europe); or countries that have advantage in others sphere of economic activity, for example in shipping goods (due to geographical positions) or in attracting FDI flows (due to development strategy and tax policy).

5.1.3 Technology Gap and Informatization Holes

Despite that countries along the BRI differ greatly in the level of their economic digitalization and ICT, many of them are characterized by low level of digital infrastructure, which is reflected in low penetration of internet, and high costs of internet and mobile services. Not all populations of BRI countries can afford digital devices, and in some countries use of modern devices is limited (South Asia, Western Asia countries). In addition, an inability of the population in middle and old age to cope with modern technology stands in the way to development of CBEC (almost everywhere except China, Europe, and few developed countries), posing new challenges to market expansion.

Another problem is the difficulty of payment in the process of transaction. The development of CBEC in BRI countries is restricted by incompatible payment systems and high payment risks. Currently, BRI e-commerce uses several types of cross-border payments, including payment by bankcard, advance, and cash on delivery. Both offline and online payment methods are provided. However, when different countries participate in CBEC transactions there are several uncontrollable factors. For example, the lack of mutual understanding of the financial and credit situation of e-commerce participants, the risks of changes in the exchange rate, the risk of banking information leakage in cross-border payments, and the risks of electronic fraud.

5.2 Suggestions for CBEC in BRI Countries

5.2.1 Priority – Logistics and Infrastructure Construction

The main challenges for CBEC are the complexity of the international logistics infrastructure and the heterogeneity between BRI countries. In order to form a CBEC logistics system that can achieve both delivery and cost savings, various factors must be considered, such as local logistics conditions and transportation costs, moreover, multiple groups of interest must collaborate efficiently. In this regard, it is necessary to understand the construction of the logistics system in countries along the route and create a framework for a completed transnational logistics system.

Developing countries have less advanced infrastructure and the optimization of facilities soaks up a large amount of budget. In the long term, removing the backwardness of the infrastructure in these countries will release the potential for more effective integration of them into the international trade process, which would cost-effectively benefit developing countries. Infrastructure projects, which at first sight seem to be unreasonably expensive and unprofitable, in long-term can bring fruitful results. One such example is the project of the China-Europe freight train. Prior to the first quarter of 2022, the transport and logistics infrastructure of the BRI based on the China-Europe railway network has shown rapid growth, although at the beginning of the project the community doubted its economic benefits. According to the current situation in the world, it seems appropriate to develop big infrastructure projects, such as Northern Sea Route to increase transit cargo of trade in Eurasia and to restore logistics supply chains. Afghanistan infrastructure projects of road building are also becoming more significant when Afghanistan becomes a transit country for others, especially under a framework of regional cooperation. Hence, there is a big market and much space for development of CBEC by improvement of infrastructure among BRI countries.

A crucial step to reduce the cost of logistics operations in CBEC is the gradual expansion of the network of overseas warehouses, which can reduce time for consumers to receive goods as well as provide professional after-sales service, eliminating complicated procedures in the case of returned goods. Small and medium-sized enterprises involved in CBEC cannot afford to set up an overseas warehouse. Thus, creation of a warehousing system for SMEs under management of the government of the host country or related entities, as well as implementation of e-commerce trade zones in BRI countries with a high degree of cooperation between participants, could lead to a complete or partial solution to the problem.

CBEC logistics companies should focus on improving quality of service, create a multi-level consumer logistics model with highly differentiated demand, and develop logistics models for different market users. In addition, there is a need to investigate new multimodal transport channels, and seamless logistics mechanisms, especially under the context of instability in supply chains.

5.2.2 Stimulate the National Economic Development of BRI Countries to Expand the Prospects for E-Commerce

There are some paths leading to expansion of CBEC. Certain non-tariff factors, such as the availability of domestic infrastructure for cross-border trade, customs supervision and control, the country's institutional environment, and bilateral and multilateral agreements between countries have non-negligible impacts on international trade. "Trade without barriers" as one of the five bridging concepts of the BRI that coincides with the World Trade Organization's Trade Facilitation Agreement, which states that the formal implementation of it may reduce the total cost of imports and exports of international trade by 14% and 15% year-on-year for low- and middle- income countries and by 13% for high-income countries (Fefer & Jones, 2017). Similarly, the integration of national strategies in BRI countries (e.g., Russian strategy "The Great Eurasia" and Mongolian "Steppe Road") with the main concepts of BRI, regarding to creation of a good environment for e-commerce from different aspects may cause a direct economic effect. In the case of BRI countries, the common construction of DSR and further improvement of digital infrastructure facilities is an opportunity to take a big step towards integration into the world economy through unlocking the potential of e-commerce. Thus, the BRI countries should be more open to each other and make common efforts into integration of national strategies with BRI. This is how they could not only reduce risk of the struggle for regional influence but obtain win-win results in economic development and further development of CBEC.

In theory, another way of developing CBEC through improvement of GDP is modernization of national economics, producing goods with high added value, export of innovation, and technologies. In many developing countries of BRI, it is impossible to make a transition to the new source of budget income in a brief period of time. Hence, it seems more practical to develop their own advantages in traditional trade sectors with the implementation of achievements of the digital age. Thus, this could not only increase the competitiveness of goods and services on the global market and boost the CBEC development, but also create a cumulative effect for further modernization of their economies. In addition, growth of CBEC could bring additional sources of income into budgets that may be directed to the development of science-intensive and innovative-breakthrough sectors of the economy. Moreover, scientific and technological innovation is of great importance in attracting FDI flows.

5.2.3 Technology-Driven Forces

It is important for BRI countries to evaluate correctly the opportunities provided by CBEC platforms. Further implementation of digital trade's platforms is beginning to create a more global labor market for traditional employment and freelance assignments. Employment creates income, which births demands, and activates purchasing power. As the standard of living rises, consumption needs rise too and a scale demand becomes wider while e-commerce develops increasingly actively. As a result, the growth of consumer demand has a profound impact on the economic development of the country. Thus, stimulation of the national economic development in BRI countries for expanding the prospects of e-commerce as well as creation of favorable conditions for the expansion of consumer demand in the field of e-commerce are important in sustainable development of CBEC.

CBEC is determined by the state of development of information and communication infrastructure to ensure the exchange of logistics information, such as fiber optic, satellite, Internet, 5G technologies, etc. Therefore, the creation of an information and communication infrastructure promotes the digital transformation for countries along the BRI.

The implementation of innovations is important in the digital era. The State Council of the People's Republic of China has released a number of guidelines to promote CBEC, and one of the most

important economic restructuring objectives of China is to advance digital industry and innovation. In May 2017, the DSR project was proposed at the BRI Forum for International Cooperation. President Xi emphasized that the BRI should become a “road of innovation”, namely the “Digital Silk Road of the 21st century” (Aries, 2017). The DSR is a multi-level project that aims to turn the BRI into a high-tech and innovative network through the exchange of technology, knowledge, and culture. Actually, the main direction of the DSR is e-commerce promotion. At present, China has signed agreements on the development of the DSR with 22 countries and established an advisory mechanism and problem coordination mechanism. Numerous Chinese e-commerce companies, including Alibaba, Huawei, Tencent, and JD.com, have already confirmed their participation in DSR projects.

Artificial intelligence (AI) technologies and services are coming into reality. In CBEC using smart services can achieve an efficient turnover and form a core competitiveness. Some countries that pay attention to intellectual innovations have already derived their advantage of high-tech, such as China, Singapore, and Israel. It is time for the other countries to proceed with determination. As for the ones that suffer from lack of modern technologies, they should be actively involved in practical construction of DSR. In this view, there is a need for a common information data platform in BRI countries with open access for e-commerce and logistics’ data operation, and statistical information exchange as well as high-tech exchange for management efficiency in development of e-commerce in BRI countries. Such a kind of platform will contribute to infrastructure digital transformation of logistics enterprises, which may create value for them (Li et al., 2022) and for CBEC development. Establishment of a platform requires the formulation and adoption of documents that could clearly define the national institutions competency for information exchange, the types of information to be exchanged between countries, and the procedures for information interaction.

Domestic CBEC enterprises and multinationals pay great attention to expanding their business scale in BRI countries. An effective trade interaction in the BRI requires convenience of payment methods. For privacy protection and fund security, creation of a payment platform for BRI countries, based on the expansion of the Chinese payment system CIPS, is recommended. It will boost internationalization of CNY and simplify the routing of payments, on account of China’s political stability and its central position in the implementation of the BRI.

6. CONCLUSION

Despite all positive trends in CBEC growth in BRI countries, the empirical analysis showed that currently the development of CBEC in the BRI countries is heterogeneous, due to a number of affecting factors. Among them logistics and transport infrastructure, GDP level of host country, as well as level of technological and informatization development are most impactful. It was found that transport and logistics infrastructure play a key role in CBEC development. Releasing the potential of e-commerce between BRI countries requires the construction of transport and logistics infrastructure both at the expense of the countries’ own investment resources and through the implementation of BRI investment projects. Geopolitical and epidemiological factors also create uncertain circumstances for the logistics flows of e-commerce. It can be assumed that the ongoing rapid changes in the world are leading to the beginning of a new cycle of economic development, which in turn creates great uncertainties and challenges in the development of various areas of economic activity. Therefore, it is important for BRI governments to consider all latest trends in a timely manner and act in accordance with the current situation both within the country and in the world, strengthening coordination in the field of CBEC development. BRI serves as a platform for the implementation of this type of coordination. Therefore, within the framework of the Initiative, more attention should be paid to information exchange for efficiency of management decisions on the development path of CBEC in BRI countries.

In this study, the authors focused on China’s experience in finding opportunities for boosting economic development through the prism of developing CBEC in macro region under the benefits of the BRI. The use of project instruments of such a scale as the BRI allows China to expand the horizons

of its economic development, and CBEC in this vein is an important element in the development of the regional economy. The study contributes to the development of the theory of CBEC through an empirical analysis of the affecting factors. Combining the theoretical results of predecessors and their recommendations for the development of e-commerce in BRI countries, the authors empirically verified the specific factors that should be prioritized. Future research directions for scholars in the field of CBEC could be oriented on construction of theoretical models, mechanisms, and advanced schemes in regards to cross-border logistics, based on digitalization and innovations. There will be an urgent need for studies on issues such as the investigation of mechanisms of seamless logistics and prediction of the outcomes, exploration of new transport multimodal logistics channels, and reevaluation of logistics capabilities of existing infrastructure. The study also contributes to the theory of the regional economy, as it reveals the reasons for the different economic activities in BRI countries in the processes of CBEC. In this way, Chinese experience in the field of CBEC can be implemented relative to most developing countries, including those ones where the government's awareness about the growing role of CBEC is in its infancy or where the processes of CBEC development are seriously lagging.

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COMPETING INTERESTS

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