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Empirical Analysis of the Impact of Digital Trade Barriers on the Development of China's Cross-Border E-Commerce Industry



Abstract: - The economy of China has been in a progressive and prosperous condition for a while. The traditional industrial sector of China is a major strength of the Chinese economy. In the current times, the upgradation of this sector, with the advent of newer options such as digitization, is becoming more and more popular, innovative and developed. Due to such introductions, newer economic possibilities, such as electronic commercial activities across borders, are emerging out. Depending on the consumers' choice and demand, a newer export pattern is being developed, in which both the electronic commercial activities across the borders and the conventional foreign trade are evolving, while being intertwined with each other. In this study, it is empirically investigated whether changes in the digitally created trade barriers have an impact on the e-commerce transacted across the borders, taking into consideration some of the influencing factors such as GDP, labor productivity, geographical distance etc. The empirical analysis finds that cross-border e-commerce is negatively correlated with digital trade barriers. Also, an econometric model has been developed to quantify this relationship including the effects of control variables.

Keywords: Cross-border e-commerce, Digital trade barriers, Export Scale, Gross Domestic Product, National Effective Distance, Productivity of labor

1. INTRODUCTION

Cross-border electronics commerce or e-commerce is observed as a relatively new model of trade throughout the world. The main aspect behind the popularity of this model is that it is not only capable of mitigating the barriers and issues of the old traditional international trade model, but it can also meet the different types of needs of people throughout the world. The main barriers of the traditional trade model include less effectiveness in meeting the lead time, extensively complex processes and issues in meeting the satisfaction level of the

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customers. Contrasting to this, e-commerce platforms in contemporary times have matured relatively in management. In China, the most well-known and famous e-commerce platform is Alibaba, and the higher quality of the manufacturers throughout the world is associated with showing products through the mentioned cross-border e-commerce (CBEC) platforms. Therefore, the growth of e-commerce platforms is observed as extensively higher throughout the world. The research center of e-commerce in China mentioned that the volume of transactions of CBEC in China increased from 0.7 trillion yuan to 10.5 trillion yuan from 2008 to 2019. Hence, the annual rate of growth in this sector is found as 20% (Yin & Choi, 2023). Therefore, the CBEC of China makes a significant positive contribution towards the GDP of the country.

The digital trading system has initiated changes in the system of traditional trade in services, intellectual property rights and goods. This factor creates a new type of digital trade barrier, which is different from the non-tariff and tariff barriers of the traditional system. The existing regulations and rules of the World Trade Organization (WTO) have become outdated for dealing with the new digital trade barriers, and from 2001, Doha Round was settled as a response to digital trade barriers (Abdelrehim Hammad et al., 2021). The issues of digital trade have evolved into a diverse range of “post-border measures” along with the regulations related to the data flow of the cross-border and access of network.

Digital trade barrier is linked with creating a diverse range of issues in the e-commerce sector of China. According to the Chinese customers’ data of 2014-2018 and the data of countries' reactivity towards digital service trade, it is mentioned that total manufacturing export of China dropped by \$30.92 billion due to the increase of the composite digital trade barriers of the destination country from 2014-2018 (Jiang et al., 2022). Similarly, in the e-commerce sector of China, formidable complexities can be seen due to digital trade barriers (dtb). It is observed that digital trade barriers encompass issues related to economic and technological challenges and complicated regulations of the web, and these issues create a negative impact on the seamless flow of digital transactions across borders. However, digital trade barriers consist of diverse negative influences on the development of international trends. Considering the mentioned factors, the main intention of this study is to delve into the complex impact and involvement of the digital barriers of trade in assuring the development and growth of the CBEC of China.

The regulatory environment of China consists of a wide range of legal frameworks including policies of trading at the international level, measures for protecting the business relationships and policies. Challenges related to the technology, need for the data localization, safety and security of the data in cross-border flow are found as the major issues of CBEC in China. However, in the market of China, extensive competition is marked as another difficulty and threat for the CBEC sector (Jiang et al., 2021). The complicated and problematic array of digital trade barriers is observed as a hindering factor in the seamless growth of the CBEC sector of China. The rationale of this study is that it helps in establishing a comprehensive and clear analysis of the influence of digital trade barriers towards the successful development and growth of the CBEC in the Chinese market. The economic impact can be examined based on identifying the effect of digital trade barriers in the CBEC of China.

This paper focuses specifically on examining the effect of dtb on the development of the CBEC sector in China. The objectives are mentioned below:

- To find out the relationship between dtb and CBEC export scale of China.
- To investigate the influencing factors of cross-border e-commerce in China
- To find out the major digital trade barriers that impact the cross-border e-commerce sector of China

This research consists of extensive significance in exploring the complicated difficulties that occur in the digital trade barriers in the CBEC sector of China. Based on shedding light on the digital trade barriers, the ways of ensuring resilience, innovation and sustainable growth through navigating and mitigating the barriers can be understood. Moreover, the findings of this study can be considered beneficial for making practical implications on creating policies to shape the landscape of the CBEC industry, and ways of promoting collaboration across the border can also be examined.

2 LITERATURE REVIEW

2.1 Relationship between digital trade barriers and cross-border e-commerce export sales in China

In the contemporary digital era, digital services in the trading system have brought diverse benefits to the global economy. The crucial drivers for the digital transformation in the trading system include AI and big data analytics. These technologies are observed as significant potential for the emergence of an innovative model of trading systems and business opportunities (Liu et al., 2021). Depending on the rise of digital trading systems, the regulations of cross-border e-commerce are confronted with a diverse range of negative impacts. On this note, the previous studies mentioned that the accessibility of the markets, collection of tariffs, intellectual property and categorization of the products are the major problematic aspects of the cross-border e-commerce that occurred due to digital trade barriers (Zhao, 2023). However, the regulatory environment of China acts as a very influential factor in terms of shaping the CBEC. Regulations associated with cyber security, maintaining the safety of the data, and the flow of the data cross-border create a positive impact on digital transactions. On the other side, changes can be seen in the CBEC including the need for licensing and tariff regulations, and these factors created a negative influence on the CBEC of China. Therefore, digital trade barriers have a complicated relationship with the CBEC export sales in China.

Tariffs and procedures of customs act as another relevant barrier towards the flawless movement of goods in the case of cross-border e-commerce. In the case of less complicated procedures of the goods, chances of boosting the export sales are increased. In most cases, digitalized services and products need to face a diverse range of regulations related to the customs and regulations of tariffs. Previous literature mentioned that, with the continuous growth in the use and importance of the internet, digital trade or electronic commerce has become one of the major concerning areas of the international regulations of trade. The literature also mentioned that the policies of tariff, the flow of data, digital border, credit system and protection of the customers are directly related to the export sales of e-commerce (Gao, 2018). These factors create impacts on the export sales of the e-commerce business of China. Another piece of literature mentioned that the immediate guidelines of WCO are focused on supporting e-commerce, depending on creating less complex clearance procedures for the less valuable consignment. In addition, no taxes or tariffs are collected in these cases (Yu, 2018). Hence, the relationship between the digital trade barriers and export sales of CBEC in China consists of a diverse range of regulatory factors. Besides that, language and cultural differences also created issues in the flawless activities of e-commerce across the border.

2.2 Factors influencing cross-border e-commerce in China

In China, cross-border e-commerce is witnessing unprecedented growth in the past few years. The growth of CBEC is influenced by multifaceted aspects, which include the policies of the government, dynamics of the market, behaviors of the customers, and enhancement of the technological infrastructure. The existing literature suggested that per capita income, groups of consumers, market opportunities, and behaviors of the customers impact the scale of CBEC significantly. The study also mentioned that the geographical obstacle is one of the major difficulties of the size of CBEC transactions. Moreover, the logistics performance index and penetration of the Internet have huge potential in terms of affecting the CBEC of China (Zhao, 2020). Providing extensive focus towards creating a very positive and good environment for the business and encouraging the construction of the infrastructure, are the desirable factors for driving the development of CBEC.

In the current times, significant changes in the global trade environment can be seen. The significant and rapid growth of global e-commerce and cross-border e-commerce in China is associated with experiencing unprecedented opportunities for successful development. CBEC of China plays a conducive role in terms of optimizing the structure of the export and import of diverse range of commodities. Along with that, it is also beneficial for the promotion of exporting higher quality of the products. Previous literature marked that, e-commerce across the border is linked with adjusting the trading structure of the Chinese market. This factor is observed as one of the most beneficial and impactful aspects in terms of affecting the CBEC of the Chinese market (Guo'e & Xueping, 2020). Technological advancement and changing the buying patterns of the customers act as the driving forces for the rapid development and growth of CBEC in the Chinese market.

CBEC is different as compared with domestic e-commerce and traditional international trade. Despite having a huge growth opportunity for CBEC, the complexities can be seen from diverse perspectives including types of payments and cultural backgrounds. However, the existing studies indicated some of the factors that are associated with forcing the development of CBEC. On this note, competitiveness, scale of the transaction, online demand for shopping across borders and GDP were mentioned as the key factors that influence the CBEC in China (Xi et al., 2023). Inter-firm competition is identified as the root factor for influencing the stability of the CBEC eco-system, and competitiveness also plays a critical role in influencing the other factors of CBEC.

2.3 Major digital trade barriers that impact the cross-border e-commerce sector of China

A significant growth in the use of the Internet can be seen in the past few years, and cross-border data flows are becoming one of the most influential factors for trade as a consequence of this. The main reason behind this is that a lot of products are traded based on the integration of the web, and reliance on digital connectivity is increasing effectively. Even though diverse benefits of digital trade are there, some challenges are also present in this context. On this note, the international trade regime is mentioned as the key challenge that created debates in the digital trade arena (Azmeah et al., 2020). The shift of the digitalization process is challenging for both the existing rules of trade along the demands of new rules of trading. Addressing the changes in the technologies is also found as another concern in this context.

After the fourth industrial revolution, the use of digital technologies has become one of the core features due to having the potential to reduce the time and cost of trading. According to the findings of the existing literature, information cost, cost of the contract execution, tariff and non-tariff barriers of policy, logistics and transportation costs are the main challenges of digital trade barriers. In addition, the income share of the labor and the effect of digital service trade's income distribution consists of heterogeneity for differentiating the trade barriers of the national digital service trading system (Yeerken & Deng, 2023). These factors impact negatively on the growth and development of CBEC in China.

2.4 Trade Facilitation Theory

Trade facilitation indicates the full spectrum of the procedures of borders ranging from the electronic exchange of the data on the shipment to and simplification of the documents for trading. Possibilities of appealing administrative decisions by the border agencies are adopted as a result of this. A piece of literature was constructed previously for calculating the provincial Trade Facilitation Index of China and the performance index of cross-border e-commerce. The study showed that a significant positive impact is there on improving the performance of the CBEC of China. However, regional differences can also be seen in this context (Zou, 2022). Hence, the level of trade facilitation consists of opportunities to improve the CBEC operations in China.

Despite having different literature regarding the factors influencing CBEC and digital trading in China, a few pieces of literature can be seen which are intended to identify and evaluate the specific relationship between CBEC and digital trade barriers in China. A very small number of quantitative studies can also be seen in the existing database. This can be considered as the main gap of the previous literature.

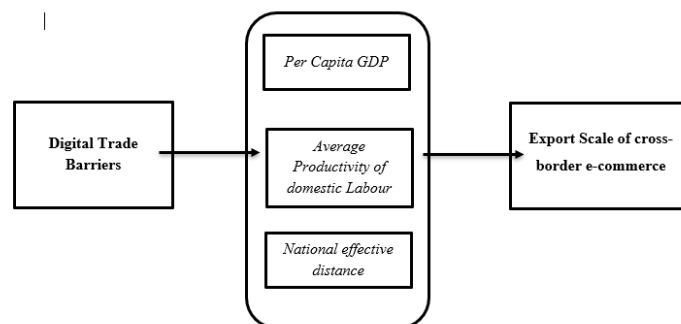


Figure 1 Conceptual Framework (Source: Self-developed)

Based on the research objectives of this paper, the research framework is shown above.

3 METHODOLOGY

3.1 Data collection

This research is moved with the adoption of an empirical data analysis process, and publicly available secondary quantitative data is collected. A quantitative approach is observed as a formal, rigorous and systematic approach in terms of generating refining knowledge for solving the problems of research (Mohajan, 2020). The collection of data related to the OECD countries and the per capita GDP of China are gathered for the empirical analysis. The total number of observations was 296, and data was collected from the OECD database, National Bureau of Statistics of China. Besides that, the spatial distance was adopted from the Google map, and the average distance was calculated.

3.2 Variables and Measurements

3.2.1 Dependent variables

Export scale is observed as another most intuitive indicator or the dependent variable of this study in terms of measuring the scale of the cross-border e-commerce industry of China. The export scale and capabilities of export of a country can be increased based on increasing international electronic e-commerce activities (Wang et al., 2021). Hence, e-commerce is found as one of the major factors for improving export scale. At the time of selecting the index, the hypothesis is made as “The digital trade barrier of China will have a significant negative correlation with the export scale of CBEC of China.” Data in this context is gathered through the National Bureau of China.

3.2.2 Independent variables

The core independent variable of this research is found as a digital trade barrier, and the digital trade barrier index is collected from the database of OECD. Trade openness is marked as one of the leading factors for the growth of gross GDP (Fatima et al., 2020). Along with the trade barrier index of OECD, the digital trade barrier index of China is also taken for the empirical analysis of this study. It is found that the OECD is focused on measuring the trade barrier index from the year 2014, of all the OECD member countries and some non-member countries, year by year. The system of evaluation is constructed depending on the five different dimensions including the system of payment, transaction through electronic processes, the digital barrier of trade, intellectual rights of property and technical facilities. Binary methods are used for the case of scoring, and the score is given between 0 to 1. If the value is closer to 1, deeper restrictions can be seen in digital trade barriers.

3.2.3 Control variables

Per Capita GDP- China’s per capita GDP and the per capita GDP of OECD countries are considered the most important control variables for this research. In this case, also, OECD databases are used for collecting the corresponding data. Per capita GDP is indicated as another significant variable for this research.

The average productivity of domestic labor- Domestic productivity of labor is another important variable for this research. Usually, relatively higher productivity of the labor is associated with concentrating on the domestic production of products with higher technological and scientific content. In this research, domestic productivity of labor is observed as another variable, and data in this context is gathered from the OECD database.

National effective distance- National effective distance can be indicated as another core variable of this research. This factor is indicated as the control variable. This variable is chosen as the logistics cost must be considered as one of the core operators for the cross-border e-commerce of China. In the case of price advantage, transportation distance has a direct impact. The national transportation system is capable of overcoming the cost of distance to some extent (Halaszovich & Kinra, 2020). For gathering data corresponding to this, the effective distance of the country is selected as the control variable. Google map calculation is used in terms of gathering data corresponding to this. In terms of the calculation method, ten random locations are selected in the territory of China, Beijing and other countries of the OECD. For avoiding special distance, empirical analysis is chosen in this research. The close relationship between the cost of transportation and e-commerce operations cross-border is selected in this research. This index is demonstrated depending on the

products of the spatial distance and the crude oil price of WTI of the current year for forming the data of time series. The heteroscedasticity of the data set was reduced through the application of the logarithmic process, and the impact of the order of magnitude of the original data was also eliminated effectively through this.

3.3 Construction of the Basic Regression Model

This study used empirical data to explore the impact of digital trade barriers on the development and growth of the CBEC of China. The econometric model is created, and the basic model used is identified as the Gravity or Space Interaction Model. This model is considered a very commonly used model in international trade research. The mentioned model, which is used in this research is identified as the Space Interaction Model or Gravity Model, and initially, the model was proposed by William Reilly. After that, the model was revised through many parties. Two different aspects are there in the innovation of this model, which includes interaction between the customers and shops, and influence of the location of stores and competitors.

The mentioned model indicates that the choices of the customers regarding shops are evaluated depending on two factors including price and convenience. Besides these two initial factors, other factors include traffic, distance and so on. The model assumed that, in an extremely attractive condition, customers are usually willing to choose a store that has better accessibility. Analysis through the application of this model is indicated as beneficial in terms of making decisions about locations effectively. The cross-border export market of China is concentrated usually in Europe, North America and countries which are members of the OECD. In this research, the main explanatory variable is settled as the digital service trade barrier index. In this research, export scale, investment in R&D and other indicators of the cross-border e-commerce of China were mentioned as the major dependent variables. On the other hand, in countries which are members of the OECD, digital trade barriers are found as the explanatory variables. Moreover, the level of tariff, population, GDP and other indicators of the OECD countries are considered as control variables of that study, and all of these variables influence the development of cross-border e-commerce in China. Finally, the following model is developed:

In this model, $\ln export_{it}$ is identified as the cross-border industry of China in the e-commerce sector. βdt_{ijt} indicates the digital trade barrier index and the OECD listed countries' trade barrier index in the T year. Besides that, $pgdpc_{it}$ and $pgdpc_{jt}$ are considered as the per capita GDP of China in the T year and the per capita GDP of OECD countries in that year's GDP. $dist_{ijt}$ indicates the physical distance of space between the countries and China. $Prod_{jt}$ can be considered as the domestic productivity of OECD countries in T year. The last three factors of the equation are individual, including μ_i , ν_t , δ_{ijt} , and these factors are observed as fixed effect terms, time fixed effect terms and random interference terms respectively.

4 ANALYSIS OF EMPIRICAL RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Before performing the regression analysis, this research proceeds by applying descriptive statistics. The mean, median, mode and SD are calculated on this note. The main scope of descriptive statistics is to measure the central tendency and dispersion of the data set (Nusantara et al., 2021).

Table 1 Descriptive Statistics

	$\ln export$	dbt	$\ln pgdp$	$\ln pgdpc$	$prod$	$\ln dist$
Observation	296	296	296	296	296	296
Mean	13.776	0.129	10.401	9.145	0.215	13.517
Median	13.595	0.122	10.542	9.146	0.584	13.494

Min	9.219	0.000	8.578	8.943	-23.169	11.341
SD	1.617	0.000	0.656	0.158	4.137	0.599

The above table demonstrated that the total number of observations is identified as 296, and the SD value indicated some differences in the total number of samples for each variable. However, the distribution of the data set is found as efficient enough in terms of moving to the next analysis with this empirical dataset.

4.2 Pearson’s Correlation Analysis

In addition to descriptive statistics, Pearson's correlation is also done to evaluate the empirical data. In most cases, Pearson's correlation coefficient is observed as the de facto standard, but from construction, it can work only for the interval variables. A Pearson's correlation value of 0 is linked with indicating no correlation, while +1 and -1 are linked with indicating complete positive and negative correlations respectively (Baak et al., 2020). The result of Pearson’s correlation for this study is as follows:

Table 2 Pearson Correlation Test

	lnexport	dtb	lnpgdp	lnpgdpc	Indist
lnexport	1				
dtb	-0.205***	1			
lnpgdp	0.0500	-0.312***	1		
lnpgdpc	0.0390	0.173***	0.108*	1	
Indist	-0.0450	0.0490	-0.0450	-0.0610	1

It can be seen in the above table that a significant negative correlation is there between the core explanatory variables which include dbt and lnexport. However, this outcome is similar to the expected assumption. The coefficient matrix is only capable of establishing the relationship between two variables. Along with that, the interference between the control variables and potential variables cannot be excluded. Therefore, these findings can be used only for references, and further regression analysis is needed to evaluate the specific correlation.

4.3 Evaluation of Variance Inflation Factor

For examining further the presence of multicollinearity among the variables of this study, the Variance Inflation Factor or (VIF) test is employed. The result of this study is demonstrated in Table 4.3. Multiple collinearities can be evaluated through the mentioned test.

Table 3 Variance Inflation Factor

	VIF	1/VIF
<i>dtb</i>	1.176	.85
<i>lnpgdp</i>	1.146	.873
<i>lnpgdpc</i>	1.072	.933
<i>prod</i>	1.011	.989
<i>Indist</i>	1.008	.992

Mean VIF	1.083
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Depending on calculating the VIF between the independent and dependent variable, a multicollinearity test can be performed, and the variables which are associated with causing multicollinearity of a model can be reduced in terms of minimizing the collinearity between independent variables (Cheng et al., 2022). Formally, VIF is identified as the ratio of different variances when there is a diverse range of collineation between the dependent and independent variables. If the tolerance reciprocal is higher than the VIF, the chances of presenting collinearity are serious. From the empirical judgment, it can be stated that no multicollinearity is there if $0 < \text{VIF} < 10$, and severe multicollinearity can be seen if $\text{VIF} \geq 100$. However, the determinant of the strong multicollinearity is $10 \leq \text{VIF} < 100$. It can be seen from the above table that, for each of the variables, the values of VIF is less than 10. This factor establishes that the collinearity is not present in this paper.

4.4 Hausman Test and BPLM Test

In terms of the panel data, it is considerably beneficial and important to judge the most suitable model for analysis. Three different types of models are situated in the panel data including fixed-effect, mixed-effect and random-effect models. In terms of testing the model fit, the usage of the Hausman test is seen as very popular and common (Ranger & Much, 2020). It is important to choose whether the mixed-effect or random-effect model is the best fit for analysis, and the Hausman model helps in determining the best-fit model. BPLM test is usually carried out to examine the heteroscedasticity of the linear regression model (Martin, 2023). Besides that, in terms of identifying the most effective model between mixed-effect or fixed-effect models, BPLM analysis is performed. Considering these factors, it is important to perform BPLM analysis and the Hausman test before performing the regression analysis. In Table 4.4.1 and 4.4.2, the results of the Hausman test and BPLM test are demonstrated respectively:

Table 4 Hausman Test

	Coef.
Chi-square test value	1.54
P-value	0.8192

From the above value, it can be mentioned that a random effect model is required to be accepted for adopting the original hypothesis of this study. The value of the Hausman test is seen as $s = 1.54$, $p = 0.82 > 0.05$.

Table 5 BPLM Test

Var(u)	0
chibar2(01)	974.01
Prob > chibar2	0.0000

For understanding the best-fit model between the random-effect model and the mixed-effect model, this paper performed a BPLM test. In this context, the value of the BPLM test is seen as 974.01, $p = 0.00 < 0.05$. Hence, it can be stated from the value that, the original hypothesis of the research is rejected, while the random effect model is selected.

4.5 Empirical analysis of the regression result

Regression analysis is observed as one of the most popularly used statistical methods, and the key concern of this analysis is to examine the linear relationship between the metric-scale DV and metric-scale IV. The effect

of explanatory variables on the response variable can be examined through regression analysis (De Menezes et al., 2021). The result of regression analysis is discussed briefly as follows:

Table 6 Result of regression analysis

VARIABLES	(1)	(2)	(3)	(4)	(5)
dtb	-4.865*** (1.025)	-4.979*** (1.198)	-5.421*** (1.167)	-5.483*** (1.138)	-5.444*** (1.156)
lnpgdp		-0.038 (0.064)	-0.074 (0.062)	-0.078 (0.061)	-0.079 (0.061)
lnpgdpc			0.835*** (0.183)	0.853*** (0.167)	0.832*** (0.167)
prod				-0.010 (0.019)	-0.010 (0.019)
Indist					-0.083*** (0.010)
Constant	14.403*** (0.130)	14.812*** (0.806)	7.610*** (1.360)	7.488*** (1.181)	8.812*** (1.201)
Observations	296	296	296	296	296
R-squared	0.042	0.042	0.049	0.049	0.050
Number of id	37	37	37	37	37
wald	22.55	65.91	69.24	72.29	447.3

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Dtb is observed as the main explanatory variable in this research, and from the stepwise result of the regression, it is found that dtb remained significant at 0.001 level at the time of adding the associated control variables. A negative relationship and influence is found in this context. However, a positive impact and relationship is demonstrated, when the per capita GDP of OECD countries and the per capita GDP of China were added as the indicator. The significance level of the per capita GDP variable of China is significant at 0.001 level. After that, the productivity of the labor and spatial distance indicators of the OECD countries are also added to the stepwise regression. The level of significance in this context is seen as 0.001, which is associated with indicating a negative relationship.

Depending on adding the control variables, it is found that the increase in the digital trade barriers of the OECD countries to the trade index will inhibit significantly the CBEC export of China. The conjecture is confirmed before the test through the empirical result. From the side of the control variables, when put into the method of GDP indicators per capita on both sides, a significant positive impact on the GDP of China is seen. This factor to some extent confirmed that the overall national economic development of China is capable of promoting the CBEC export to a certain level. Hence, it can be stated that the CBEC export of China will continue to rise.

However, OECD productivity of the labor and spatial indicators of the distance are incorporated as the indicators in the stepwise regression analysis. The findings of this test showed a negative correlation between cross-border e-commerce export scale in China and spatial distance. From the findings, it can also be stated that the cost of logistics is mainly affected by the physical spatial distance, and it will harm the CBEC export scale

of China. This factor can be considered consistent with the development of the laws and traditional international trade system. The overall findings and empirical results can be considered consistent with the expected assumptions. In the previous literature, the researchers believed that in the trading system, the digital barrier will affect mainly the development of the international trade in the technical services. Depending on the result of the CBEC process of trade in the export scale, the flow of electronic information, and flow of goods are found as supportive. The digital trade barrier is found as a hidden barrier of trade, and to some extent, it is associated with inhibiting the development of the CBEC exports of China.

Considering such a scenario, from a national perspective, a discussion needs to be developed on the safeguards and countermeasures with the main cooperative countries through the commercial and diplomatic departments. Besides that, initiatives also need to be developed in terms of maintaining the principles of “mutual benefits and reciprocity”. Moreover, investment in R&D is also needed to be increased from the perspectives of the enterprises. Focus is also given to digital technology for decreasing the impact of digital trade barriers on major business operations.

In terms of further verifying and objectifying the scientific (is something missing? Or did you intend to write just ‘scientific’?) of the empirical process, another analysis was performed in this research. A lag analysis of the time series was done, and from the result, it can be stated that it was consistent with the prominent conclusion of the evaluation of regression. In the following table, the result is demonstrated:

Table 7 Hysteresis Analysis

VARIABLES	(1) L.lnexport	(2) L2.lnexport
dtb	-5.188*** (1.312)	-5.056*** (1.392)
lnpgdp	-0.040 (0.062)	-0.097 (0.073)
lnpgdpc	0.679* (0.383)	1.061*** (0.312)
prod	-0.040** (0.019)	-0.163*** (0.060)
Indist	-0.074*** (0.013)	-0.058*** (0.017)
Constant	9.654*** (3.431)	6.696** (2.638)
Observations	259	222
R-squared	0.050	0.054
Number of id	37	37
wald	135.3	149.7

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

A robustness test is performed in this study. The results of the Robustness test are demonstrated as follows:

Table 8 Robustness Test

VARIABLES	(1)	(2)
dtb	-4.304*** (1.238)	-5.157*** (1.366)
lnpgdp		-0.111 (0.084)
lnpgdpc		0.494* (0.273)
prod		-0.185*** (0.059)
Indist		-0.082*** (0.019)
Constant	14.274*** (0.151)	12.291*** (2.235)
Observations	222	222
R-squared	0.032	0.060
Number of id	37	37
wald	12.09	97.12

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robustness Test also demonstrated that dtb has a significantly positive correlation with lnexport after considering all the influential factors for 222 observations. Hence, the outcome of the Robustness Test showed consistency with the previous findings.

5 CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Conclusions

The present study is carried out to investigate whether CBEC is impacted by the factor namely dtb, considering various other factors which may control the relation between CBEC and dtb. dtb and CBEC, here, are considered as the independent and dependent factors respectively. The data, which were used in this study, were collected from several sources. Some of these sources are Chinese NBS (National Bureau of Statistics), a database of countries tied under the Organisation for Economic Co-operation and Development (OECD), and internet sources like Google Maps. The influencing factors which may control the aforementioned relationship are considered as follows: average gross domestic product of China and countries which are associated with e-commerce, average productivity of domestic labor, and effective distance value across borders. The data binary score is evaluated based on five considerations such as facility which provides technical support, digital transaction, system for the economic transaction, patent system and various impedances related to dtb. The dependent variable, for example, CBEC, is scaled, associated with export volume made from China to other recipient countries.

Initially, descriptive statistics, Pearson's correlations analysis, VIF test, Hausman test and BPLM analysis were done. The VIF test indicated that there were no multicollinear relations between the independent variables. The result of Pearson's correlation analysis stated that dtb and lnexport have a statistically significant correlation. From the result of the Hausman test, the random-effect model was chosen as the original hypothesis to be

accepted. Moreover, the application of the BPLM test helped to confirm the result of the Hausman test. In terms of quantifying the relationship between CBEC and dtb, a multiple linear regression model was developed, and from the regression analysis it was found that export scale decreased if dtb increased and vice-versa. Besides that, it was also observed from the evaluation of this study that, the more the average gross domestic product results, the more the volume of exports. The volume of exports is negatively correlated with the productivity of the labor at the domestic level. Moreover, the findings of this study revealed that if the distance between China and the countries, which are in electronic commercial relationships with China, increases, then the CBEC can be decreased. It has been found in the regression analysis that if the control variables are added one by one, the coefficient value of dtb changes to a certain extent. However, the statistical significance remains undisturbed. For checking whether the results found empirically are objective and scientific, Hysteresis analysis is carried out. It also reaffirmed the earlier findings.

In a nutshell, from this study, it can be concluded that:

- 1) The development of CBEC in China is significantly influenced by the increased dtb measures taken by other countries.
- 2) Focus should be given on a diplomatic level to the countries which are in a good commercial relationship with China to protect the prospect of CBEC through mutually beneficial and reciprocal projects.
- 3) Enterprises that depend on the facet of e-commerce heavily should increase their 'research and development' fund and develop the technologies which are technologically viable to reduce the influence of increasing dtb.

5.2 Policy Recommendations

China must adopt a multifaceted approach to mitigating the impact of dtb from the CBEC of China. Technological approaches, diplomatic aspects and regulatory factors should be considered in this context. Policy recommendations for China to mitigate the impact of dtb from CBEC are as follows:

Harmonizing the international standards: Focus should be given more prominently on adopting the international standards for CBEC for creating opportunities to deal with every country, and collaboration should be created with the international organization including WTO in terms of promoting fair trading and open trading.

Maintaining transparency on the regulatory aspects: China must maintain transparency in the regulatory aspects of e-commerce depending on identifying clear regulations and rules. Regulatory changes must be circulated periodically in terms of allowing businesses to adapt easily to the new requirements.

Data privacy and protection: Focus must be given to ensuring the privacy and protection of the data to increase the trust between the trading partners. Secure data flow in cross-border can be managed effectively as a consequence of this.

Increasing diplomatic engagement: It is considerably important for China to increase its diplomatic engagement. For instance, collaboration with the trading partner should be increased, and joint programs with the trading partners of the other countries should be fostered in terms of ensuring the knowledge sharing and understanding level. Mutual solutions should be encouraged for mitigating the conflicts between two parties considering the benefits of both.

Increasing investment in innovation: Encouragement should be done on the R&D in the development of digital trade technologies for fostering innovation to mitigate the dtb. The focus must be given to the effectiveness and efficiency of the CBEC.

Implementation of the mentioned policies requires collaboration between the international government, private sector and international organizations. Therefore, focus should be given in these contexts also.

5.3 Implications, Limitations and Outlook

This research has enriched the analysis of CBEC exports in China at a certain level. Impact of digital technology in the development of cross-border e-commerce in China along with gathering data from the authoritative

departments (incomplete). Hence, from the side of the realistic contribution, the outcome of this research is capable of making a positive contribution to the CBEC export of China to macroeconomic growth along with the potential of future development. As empirical data is used, decision-making can be done more potentially by the policymakers, investors and operators of business.

In the case of analyzing the impact of dtb on the export scale of CBEC in China, this study adopted a short-section data set from the year 2014-2021. The dtb index of OECD came from the database of OECD. Due to the huge workload of the calculation, the panel data was designed only in the year in which the results of the measurements were published. Besides that, the onset of the COVID-19 pandemic in 2020 created a huge negative disruption in the CBEC. As the data included this year, it affects the empirical analysis to some extent. These are considered as the main limitations of this research.

Based on performing quantitative analysis, this research has focused on identifying the major digital trade barriers along with assessing the economic implications of dtb. Through providing the policy recommendations, this research helps to foster a more conducive business environment for the seamless development and growth of the CBEC sector of China. This can be considered as the main outlook of this research.

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References

- [1] Abdelrehim Hammad, A. A., Khan, A., & Soomro, N. E. (2021). Digital Economy Barriers to Trade Regulation Status, Challenges, and China's Response. *International Journal of Social Sciences Perspectives*, 8(2), 41-49. [10.33094/7.2017.2021.82.41.49](https://doi.org/10.33094/7.2017.2021.82.41.49).
- [2] Azmeh, S., Foster, C., & Echavarrri, J. (2020). The international trade regime and the quest for free digital trade. *International Studies Review*, 22(3), 671-692. <https://doi.org/10.1093/isr/viz033>.
- [3] Baak, M., Koopman, R., Snoek, H., & Klous, S. (2020). A new correlation coefficient between categorical, ordinal and interval variables with Pearson characteristics. *Computational Statistics & Data Analysis*, 152, 107043. <https://doi.org/10.1016/j.csda.2020.107043>.
- [4] Cheng, J., Sun, J., Yao, K., Xu, M., & Cao, Y. (2022). A variable selection method based on mutual information and variance inflation factor. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, 268, 120652. <https://doi.org/10.1016/j.saa.2021.120652>.
- [5] De Menezes, D. Q. F., Prata, D. M., Secchi, A. R., & Pinto, J. C. (2021). A review on robust M-estimators for regression analysis. *Computers & Chemical Engineering*, 147, 107254. <https://doi.org/10.1016/j.compchemeng.2021.107254>.
- [6] Fatima, S., Chen, B., Ramzan, M., & Abbas, Q. (2020). The nexus between trade openness and GDP growth: Analyzing the role of human capital accumulation. *Sage Open*, 10(4), 2158244020967377. <https://doi.org/10.1177/2158244020967377>.
- [7] Gao, H. (2018). Digital or trade? The contrasting approaches of China and US to digital trade. *Journal of International Economic Law*, 21(2), 297-321. <http://doi.org/10.1093/jiel/jgy015>.

- [8] Guo'e, X., & Xueping, L. (2020). China's Cross-Border E-Commerce: Evolution Pattern and Influencing Factors. *China Economist*, 15(2), 64-76. [10.19602/j.chinaeconomist.2020.03.05](https://doi.org/10.19602/j.chinaeconomist.2020.03.05).
- [9] Halaszovich, T. F., & Kinra, A. (2020). The impact of distance, national transportation systems and logistics performance on FDI and international trade patterns: Results from Asian global value chains. *Transport Policy*, 98, 35-47. <https://doi.org/10.1016/j.tranpol.2018.09.003>.
- [10] Jiang, L., Liu, S., & Zhang, G. (2022). Digital trade barriers and export performance: Evidence from China. *Southern Economic Journal*, 88(4), 1401-1430. <https://doi.org/10.1002/soej.12572>.
- [11] Jiang, Y., Zhang, L., & Jin, Y. (2021). China's e-commerce development and policy relevance. M. Smeets, *Adapting to the digital trade era: Challenges and opportunities*, WTO Chairs Programme, 140-157. https://www.wto.org/english/res_e/booksp_e/10_ader_a_chapter_06_e.pdf.
- [12] Liu, A., Osewe, M., Shi, Y., Zhen, X., & Wu, Y. (2021). Cross-border e-commerce development and challenges in China: A systematic literature review. *Journal of Theoretical and Applied Electronic Commerce Research*, 17(1), 69-88. <https://doi.org/10.3390/su151914547>.
- [13] Martin, N. (2023). Robust and efficient Breusch-Pagan test-statistic: an application of the beta-score Lagrange multipliers test for non-identically distributed individuals. *ArXiv Preprint arXiv:2301.07245*, 1. <https://doi.org/10.48550/arXiv.2301.07245>.
- [14] Mohajan, H. K. (2020). Quantitative research: A successful investigation in natural and social sciences. *Journal of Economic Development, Environment and People*, 9(4), 50-79. <https://www.ceeol.com/search/article-detail?id=939590>.
- [15] Nusantara, T., Rahmatina, D., & Purnomo, H. (2021). The Statistical Creative Framework in Descriptive Statistics Activities. *International Journal of Instruction*, 14(2), 591-608. <https://doi.org/10.29333/iji.2021.14233a>.
- [16] Ranger, J., & Much, S. (2020). Analyzing the fit of IRT models with the Hausman test. *Frontiers in Psychology*, 11, 149. <https://doi.org/10.3389/fpsyg.2020.00149>.
- [17] Wang, C., Liu, T., Wen, D., Li, D., Vladislav, G., & Zhu, Y. (2021). The impact of international electronic commerce on export trade: Evidence from China. *Journal of Theoretical and Applied Electronic Commerce Research*, 16(7), 2579-2593. <https://doi.org/10.3390/jtaer16070142>.
- [18] Xi, X., Wei, M., & Teo, B. S. X. (2023). Analysis of the key influencing factors of China's cross-border e-commerce ecosystem based on the DEMATEL-ISM method. *PLoS one*, 18(8), e0287401. <https://doi.org/10.1371/journal.pone.0287401>.
- [19] Yeerken, A., & Deng, F. (2023). Digital Service Trade and Labor Income Share—Empirical Research on 48 Countries. *Sustainability*, 15(6), 5468. <https://doi.org/10.3390/su15065468>.
- [20] Yin, Z. H., & Choi, C. H. (2023). The effects of China's cross-border e-commerce on its exports: a comparative analysis of goods and services trade. *Electronic Commerce Research*, 23(1), 443-474. <https://doi.org/10.1007/s10660-021-09483-y>.
- [21] Yu, T. (2018). A case study of B2C cross-border e-commerce challenges in China from Customs to consumers. *World Customs Journal*, 12(2), 122. [https://worldcustomsjournal.org/Archives/Volume%2012,%20Number%202%20\(Sep%202018\)/1855%2000%20WCJ%20v12n2%20COMPLETE.pdf#page=128](https://worldcustomsjournal.org/Archives/Volume%2012,%20Number%202%20(Sep%202018)/1855%2000%20WCJ%20v12n2%20COMPLETE.pdf#page=128).
- [22] Zhao, L. (2023). Cross-Border E-Commerce and Digital Trade Rules. In *Modern China and International Rules: Reconstruction and Innovation*, 141-163. https://doi.org/10.1007/978-981-19-7576-9_6.
- [23] Zhao, Y. (2020). Influencing factors of cross-border e-commerce trade between China and "Belt and Road" coastal and inland countries. *Journal of Coastal Research*, 103(SI), 70-73. <https://doi.org/10.2112/SI103-015.1>.
- [24] Zou, M. (2022). The Impact of Trade Facilitation on China's Provincial Cross-border E-commerce Operational Performance under the "Dual Circulation" Development Pattern. *Frontiers in Business, Economics and Management*, 4(1), 145-152. <http://drpress.org/ojs/index.php/fbem/article/view/543>.