



Faculty of Economics and Business

**Cross-Border E-Commerce Trade Index between China and RCEP
Countries**

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Cross-Border E-Commerce Trade Index between China and RCEP Partner Countries

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

This doctoral thesis investigates the development levels and trade potential of Cross-Border E-Commerce (CBEC) between China and its Regional Comprehensive Economic Partnership (RCEP) partners from 2013 to 2022. Utilizing Principal Component Analysis (PCA), the study identifies key components influencing CBEC development and formulates a scoring method to evaluate these levels among RCEP countries. China consistently leads in CBEC development due to advanced logistics, robust infrastructure, and efficient customs procedures, while Laos lags behind due to significant disparities in infrastructure and economic development.

Building on this foundation, the study employs an extended gravity model and system Generalized Method of Moments (GMM) regression to assess the import, export, and total trade potentials between China and RCEP countries. The results reveal that China's CBEC development significantly boosts import volumes, but this positive impact can be moderated or even reversed in economies with a high Digital Economy Development Index. The import trade potential analysis classifies Singapore as having reconstructive potential, suggesting the need to explore new growth strategies such as cross-border live streaming. Meanwhile, Indonesia, Malaysia, the Philippines, and Vietnam show substantial under-trade potential, indicating significant room for growth.

For export trade, the study finds that China's CBEC development negatively affects export volumes, suggesting that despite optimizing export structures in certain contexts, overall CBEC development has not markedly increased export volumes. Conversely, CBEC development in RCEP partner countries positively influences export volumes,

especially in regions with high internet penetration and developed electronic payment systems. Furthermore, China's per capita GDP positively impacts export volumes, reinforcing the role of domestic market demand and production capabilities in boosting CBEC export supply. Notably, countries like Laos, Indonesia, Japan, South Korea, and the Philippines exhibit insufficient CBEC export trade, indicating untapped export potential.

In terms of total trade volumes, the study finds that CBEC development in RCEP partner countries significantly promotes overall trade growth, particularly in economically advanced regions. While China's per capita GDP positively affects total trade volumes by reducing barriers and costs, its CBEC development has shown limited sustained impact on total trade volumes, potentially even exerting negative effects. The study underscores the significant CBEC trade potential between China, Japan, and South Korea, suggesting that enhancing logistics efficiency and improving consumer experiences could unlock further cooperation potential. Additionally, countries like Australia, New Zealand, and Laos need to improve logistics and infrastructure, with support from initiatives like the Belt and Road Initiative, to enhance their CBEC trade capabilities.

These insights provide a comprehensive understanding of CBEC trade potential within the RCEP framework and offer strategic guidance for policymakers and businesses to foster sustainable economic growth through enhanced regional cooperation.

Keywords: Cross-Border E-Commerce, RCEP, Trade Potential, Gravity Model, Digital Economy, System GMM

Potensi perdagangan e-perdagangan melintasi sempadan antara China dan negara rakan RCEP

ABSTRAK

Tesis kedoktoran ini menyelidiki tahap pembangunan dan potensi perdagangan E-Dagang Rentas Sempadan (CBEC) antara China dan rakan kongsi Perkongsian Ekonomi Komprehensif Serantau (RCEP) dari tahun 2013 hingga 2022. Menggunakan Analisis Komponen Utama (PCA), kajian ini mengenal pasti komponen utama yang mempengaruhi pembangunan CBEC dan merumuskan kaedah pemarkahan untuk menilai tahap ini di kalangan negara-negara RCEP. Penemuan menunjukkan bahawa China sentiasa berada di kedudukan teratas dalam pembangunan CBEC, terutamanya disebabkan oleh logistik yang maju, infrastruktur rangkaian yang kukuh, dan prosedur kastam yang cekap, manakala negara seperti Laos tertinggal, mencerminkan perbezaan ketara dalam infrastruktur dan pembangunan ekonomi di kalangan negara-negara anggota RCEP.

Berdasarkan asas ini, kajian ini menggunakan model graviti lanjutan dan regresi kaedah momen generik sistem (GMM) untuk menilai potensi import, eksport, dan jumlah perdagangan antara China dan negara-negara RCEP. Hasil kajian mendedahkan bahawa pembangunan CBEC China dengan ketara meningkatkan jumlah import, tetapi kesan positif ini boleh dimoderasi atau bahkan diterbalikkan di dalam ekonomi dengan Indeks Pembangunan Ekonomi Digital yang tinggi. Analisis potensi perdagangan import mengklasifikasikan Singapura sebagai mempunyai potensi rekonstruktif, mencadangkan keperluan untuk meneroka strategi pertumbuhan baharu seperti penstriman langsung rentas sempadan. Sementara itu, Indonesia, Malaysia, Filipina, dan Vietnam menunjukkan

potensi perdagangan import yang ketara dan diklasifikasikan sebagai "kurang perdagangan."

Bagi perdagangan eksport, Kajian mendapati bahawa pembangunan CBEC China kurang memberi impak positif terhadap jumlah eksport, mencadangkan bahawa walaupun CBEC dapat mengoptimumkan struktur eksport dalam konteks tertentu, pembangunan keseluruhan tidak secara ketara meningkatkan jumlah eksport. Sebaliknya, pembangunan CBEC di negara-negara RCEP memberi kesan positif terhadap jumlah eksport, terutamanya di kawasan dengan penembusan internet yang tinggi dan sistem pembayaran elektronik yang maju. Tambahan pula, KDNK per kapita China berkorelasi positif dengan jumlah eksport, menunjukkan bahawa apabila KDNK per kapita meningkat, permintaan pasaran domestik yang meningkat dan keupayaan pengeluaran dan eksport yang dipertingkatkan mempengaruhi penawaran eksport CBEC secara positif. Negara-negara seperti Laos, Indonesia, Jepun, Korea Selatan, dan Filipina dikenal pasti mempunyai perdagangan eksport CBEC yang tidak mencukupi.

Dari segi jumlah perdagangan keseluruhan, kajian mendapati bahawa pembangunan CBEC di negara-negara RCEP secara signifikan memacu pertumbuhan perdagangan keseluruhan, terutamanya di kawasan dengan tahap pembangunan ekonomi yang lebih tinggi. Walaupun KDNK per kapita China memberi kesan positif terhadap jumlah perdagangan keseluruhan dengan mengurangkan halangan dan kos perdagangan, pembangunan CBECnya menunjukkan kesan berterusan yang terhad terhadap jumlah perdagangan keseluruhan dan mungkin mempunyai kesan negatif. Kajian ini menekankan potensi perdagangan CBEC yang ketara antara China, Jepun, dan Korea Selatan, mencadangkan bahawa meningkatkan kecekapan logistik dan memperbaiki pengalaman

pengguna boleh membuka lebih banyak potensi kerjasama. Selain itu, negara-negara seperti Australia, New Zealand, dan Laos perlu menumpukan perhatian untuk memperbaiki logistik dan infrastruktur, dengan sokongan dari inisiatif seperti Belt and Road Initiative, untuk meningkatkan keupayaan perdagangan CBEC mereka.

Penemuan ini memberikan pemahaman yang komprehensif tentang potensi perdagangan CBEC dalam rangka kerja RCEP dan menawarkan panduan strategik kepada penggubal dasar dan perniagaan untuk memupuk pertumbuhan ekonomi yang mampan melalui peningkatan kerjasama serantau.

Kata kunci: *E E-Dagang Rentas Sempadan, RCEP, Potensi Perdagangan, Model Graviti, Ekonomi Digital, PCA, Sistem GMM*

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LIST OF ABBREVIATIONS

AfCFTA	African Continental Free Trade Area
AFTA	ASEAN Free Trade Area
AI	Artificial Intelligence
APEC	Asia-Pacific Economic Cooperation
AQSIQ	Administration of Quality Supervision, Inspection and Quarantine
ASEAN	Association of Southeast Asian Nations
AUS	Australia
B2B	Business-to-Business
B2C	Business-to-Consumer
BRI	Belt and Road Initiative
C2C	Consumer -to-Consumer
CBEC	Cross-Border E-Commerce
CHN	China
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
DTC	Direct-to-Consumer
EU	European Union
FBA	Fulfilment by Amazon
FTA	Free Trade Area
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
GMV	Gross Merchandise Value

HHI	Hirschman-Herfindahl Index
IDN	Indonesia
IoT	Internet of Things
ITC	International Trade Centre
JPN	Japan
KHM	Cambodia
KMO	Kaiser-Meyer-Olkin
KOR	South Korea
LAO	Laos
MYS	Malaysia
NAFTA	North American Free Trade Agreement
NZL	New Zealand
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
PHL	Philippines
RCEP	Regional Comprehensive Economic Partnership
RTA	Regional Trade Agreements
SAFE	State Administration of Foreign Exchange
SGP	Singapore
SMEs	Small and Midsize Enterprises
TOE	Technology-Organization-Environment
VIF	Variance Inflation Factor

VNM

Vietnam

WPIIS

Working Party on Indicators for the Information Society

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

1.1.1 Definition and Global Trends of Cross-Border E-Commerce

1.1.1.1 Definition of Cross-Border E-Commerce

Cross-Border E-Commerce (CBEC) broadly refers to international commercial activities where individuals or enterprises from different countries or customs territories conduct transactions through digital platforms. It encompasses key trade processes such as product display, payment settlement, customs clearance, and international logistics, and is mainly categorized into B2B (Business-to-Business), B2C (Business-to-Consumer), and C2C (Consumer-to-Consumer) models.

In practice, CBEC integrates traditional trade with digital technologies, effectively reducing transaction costs and shortening delivery cycles, while enabling enterprises — especially SMEs (Small and Midsize Enterprises) — to access global markets at lower thresholds. Major platforms such as Amazon, Alibaba's AliExpress, and Shopee have played instrumental roles in expanding the reach of CBEC, facilitating both exports and imports of goods ranging from fashion and electronics to cosmetics and household supplies.

While Chapter 2 provides a more systematic review of definitions from academic, industry, and policy perspectives, this section serves to offer a functional understanding of CBEC and contextualize its global relevance in the trade integration landscape. The next

section further elaborates on the global development and market expansion of CBEC in recent years.

1.1.1.2 Global Expansion and Market Importance of CBEC

CBEC has grown into a critical pillar of global trade, especially in the context of digital transformation and shifting consumer preferences. Although comprehensive time-series data on global CBEC volumes are limited, market forecasts underscore the sector's remarkable expansion potential.

According to Factors (2022), the value of global B2C CBEC transactions reached USD 785 billion in 2021 and is projected to exceed USD 79.38 trillion by 2030, representing a compound annual growth rate of 26.19%. This highlights the increasing importance of CBEC in global commerce (see Figure 1.1).

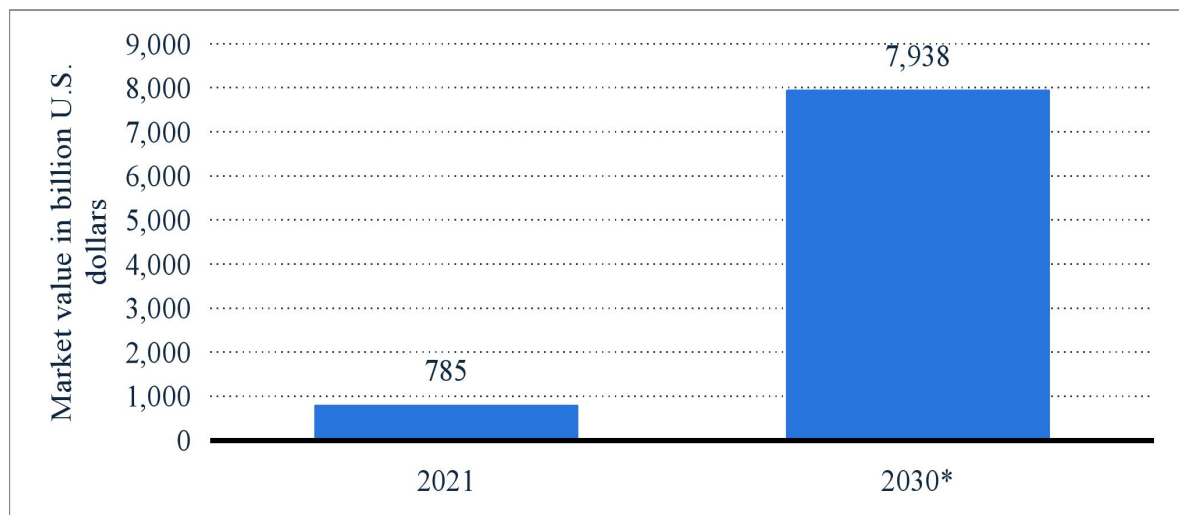


Figure 1.1: Projected Growth of the Global B2C CBEC Market

Note. From *Global B2C Cross-Border E-Commerce Market Size Forecast*, by Facts & Factors & GlobeNewswire, 2022 (<https://www.globenewswire.com/news-release/2022/04/27/2430144/0/en/Global-B2C-Cross-Border-E-Commerce-Market-Size-Share-to-Surpass-USD-7938-Billion-by-2030-Facts-Factors.html>).

Global online retail has witnessed sustained growth over the past decade, driven by increasing internet penetration, mobile adoption, and digital payment innovations. According to Capital One Shopping (2025), global retail e-commerce sales reached approximately USD 5.82 trillion in 2023, accounting for about 20.7% of total retail sales—up from 15% in 2019. This trend highlights the increasing importance of digital commerce within global trade, not only for domestic markets but also for cross-border transactions.

In this context, “global manufacturers and retailers” refer to enterprises that engage in international B2C or B2B transactions via digital platforms. These include large multinational corporations, such as Apple and Nike, as well as export-oriented SMEs that leverage platforms like Amazon, AliExpress, and Shopee to reach consumers abroad.

Against this background, regional participation patterns further illustrate the strategic relevance of CBEC. A global survey conducted by Avalara revealed that over 30% of total online sales in the Asia-Pacific region came from cross-border transactions (Avalara & Reuters, 2023). Similarly, the Latin America and Caribbean region showed a 34% cross-border share, significantly higher than that of Europe and North America. These figures reflect accelerating digital integration across both emerging and mature economies (see Figure 1.2)

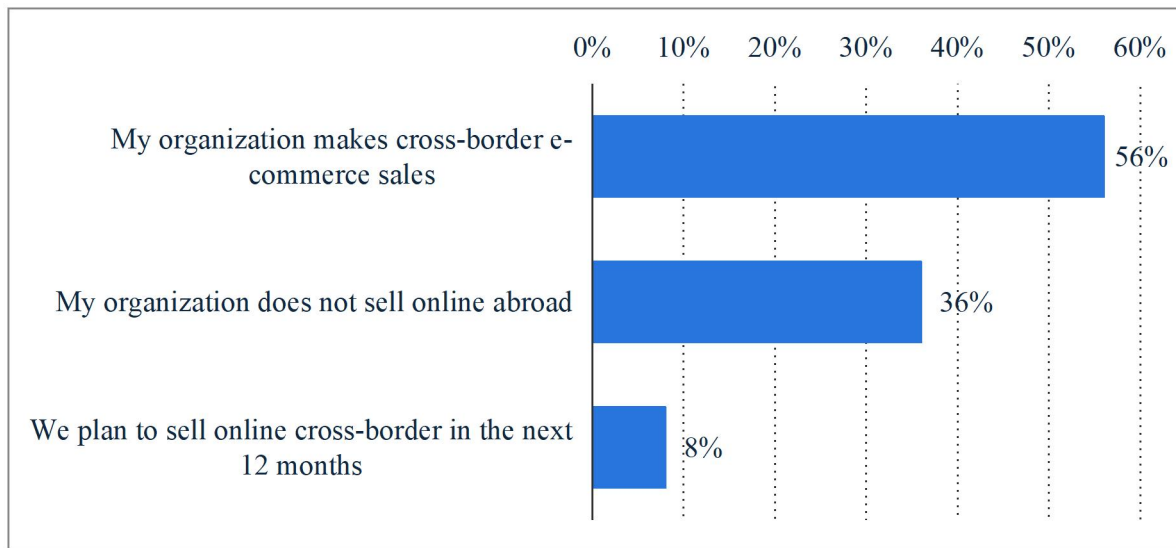


Figure 1.2: Proportion of Global Manufacturers and Retailers Engaging in International Online Sales in 2023

Note. From *Cross-Border E-Commerce Participation of Retail and Manufacturing Companies Worldwide*, by Avalara & Reuters, 2023. Based on a survey conducted from December 16, 2022, to January 26, 2023.

Among all participating countries, China holds the largest share of the global CBEC market, accounting for 37% in 2024 (Ipc, 2025) (see Figure 1.3). This leadership stems from its strong digital infrastructure, policy support, and highly active CBEC platforms such as AliExpress and SHEIN. China's central role in global CBEC will be discussed further in Section 1.1.2.

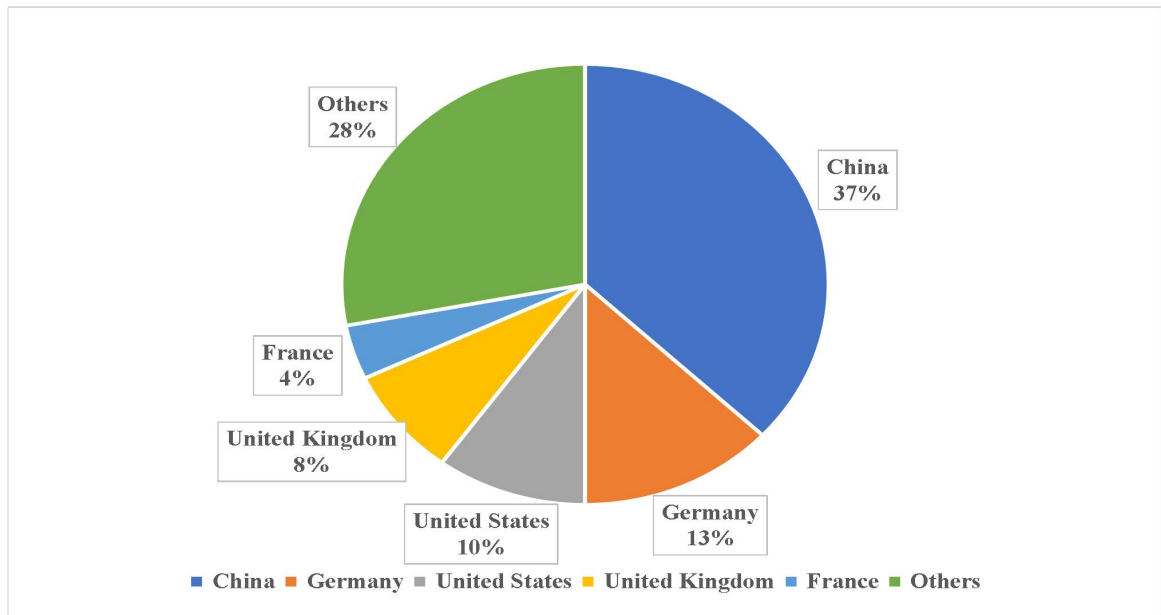


Figure 1.3: Leading Regions in Global Cross-Border Online Purchases in 2023

Note. From *Top Cross-Border Shopping Destinations Based on Most Recent Purchases*, by Dynata & International Post Corporation (IPC), 2023 (<https://www.ipc.be/services/markets-and-regulations/e-commerce/articles/top-cross-border-shopping-destinations-2023>).

In early 2023, survey results indicated that businesses in Asia and Latin America—including manufacturers, retailers, and logistics providers—demonstrated a stronger reliance on CBEC sales than those in other global regions (Jurburg et al., 2023). In the Asia-Pacific region, over 30% of companies' online sales were derived from cross-border transactions, while in Latin America and the Caribbean, the proportion was approximately 34% (Avalara, 2023), as shown in Figure 1.4.

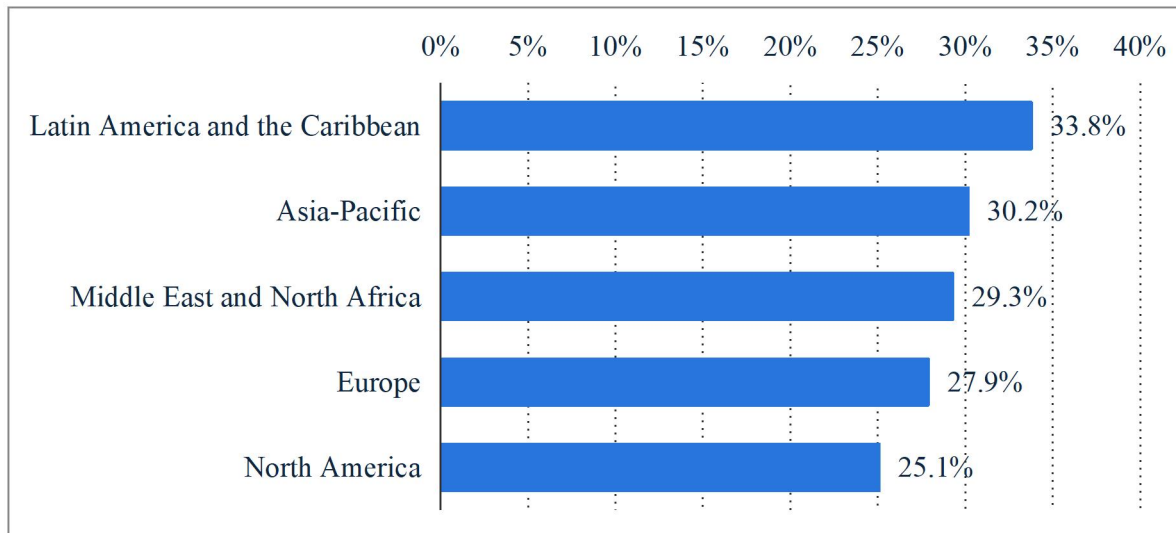


Figure 1.4: Proportion of CBEC Sales in Total E-Commerce Sales within Supply Chain Enterprises Globally in 2023, Categorized by Region

Note. From *Cross-border share of total e-commerce sales among supply chain companies worldwide in 2023, by region*, by Avalara, 2023 (<https://www.statista.com/statistics/1379527/cross-border-e-commerce-sales-share-worldwide-region/>).

These figures illustrate not only the global reach of CBEC, but also its strategic function in promoting trade participation in regions historically challenged by trade barriers. In Latin America, for instance, a high proportion of CBEC sales may reflect how digital platforms are helping overcome infrastructural and institutional limitations, enabling greater market access for SMEs. The increased reliance on CBEC in such regions suggests that digital trade mechanisms are fostering new forms of regional economic integration. This phenomenon aligns with the broader goals of international frameworks like RCEP, which promote reduced trade frictions, digital standardization, and inclusive participation in cross-border commerce.

Together, these indicators reveal the expanding footprint and structural importance of CBEC in both developed and emerging economies. They also provide the empirical

foundation for subsequent discussions on China's leadership and the institutional dynamics of regional digital trade cooperation.

1.1.1.3 Key CBEC Platforms, Product Categories, and Leading Countries

CBEC platforms serve as essential intermediaries in international digital trade by enabling seamless transactions between consumers and sellers across borders. Leading global platforms such as Amazon, Temu, AliExpress, SHEIN, and Shopee have emerged as dominant players. These platforms differ in terms of target markets, business models, and product specialization: Amazon is widely favored in North America and Europe for its comprehensive product range and logistics reliability; Temu, a fast-rising player under PDD Holdings, has rapidly gained popularity in markets like the United States and Europe with its ultra-low pricing strategy; AliExpress distributes “Made in China” goods to over 200 countries and regions; Shopee and Lazada dominate the Southeast Asian market; while SHEIN has become a global leader in cross-border fast fashion, especially among younger consumers.

According to a global survey conducted by Dynata in September 2024, 24% of online shoppers in 37 countries made their most recent cross-border purchase via Amazon, followed by 21% through Temu and 10% through AliExpress (Ipc, 2025) (see Figure 1.5).

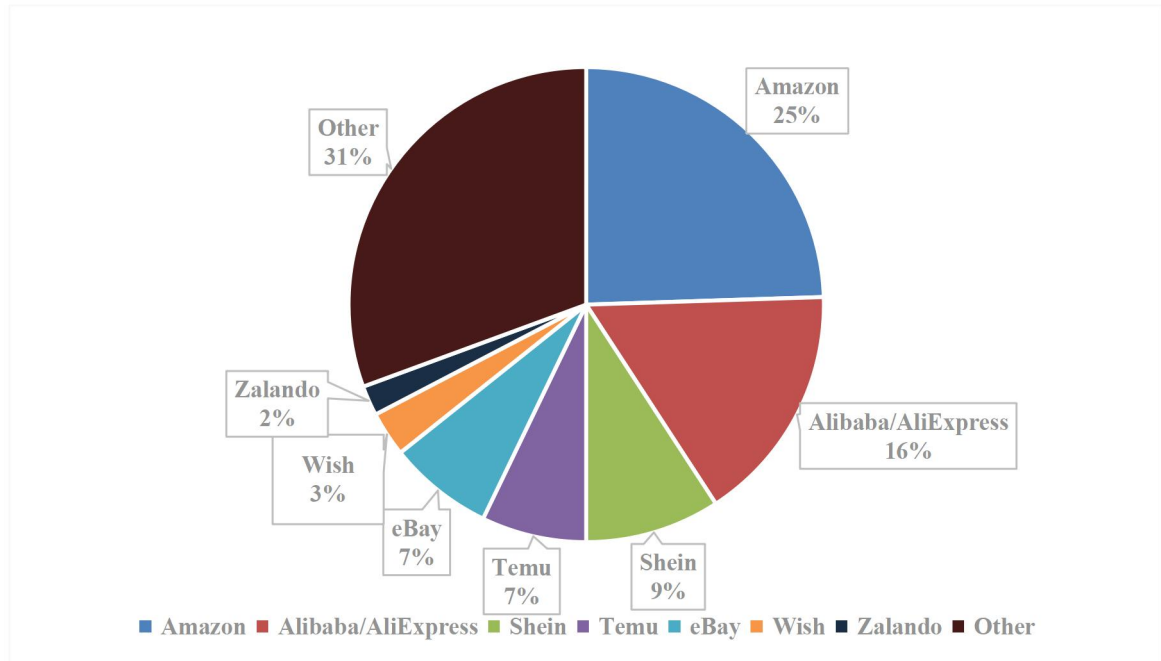


Figure 1.5: Online retailers from which global shoppers made their most recent cross-border purchase in 2024

Note. From *Online retailers from which global shoppers made their most recent cross-border purchase in 2024*, by IPC, 2025 (<https://www.statista.com/statistics/878623/digital-retailers-digital-buyers-cross-border-digital-purchases/>).

In terms of scale, Amazon continues to lead the global e-commerce landscape with a gross merchandise value (GMV) of USD 791.1 billion in 2024. Other top players include Pinduoduo (USD 655.6 billion), Douyin (USD 509 billion), JD.com (USD 504.2 billion), and Taobao (USD 503.5 billion). While Amazon dominates in North America and Europe, the emergence of several Chinese-origin platforms among the top ten illustrates the growing global footprint of China's CBEC ecosystem (ecommerceDb.com, 2025) (see Figure 1.6).

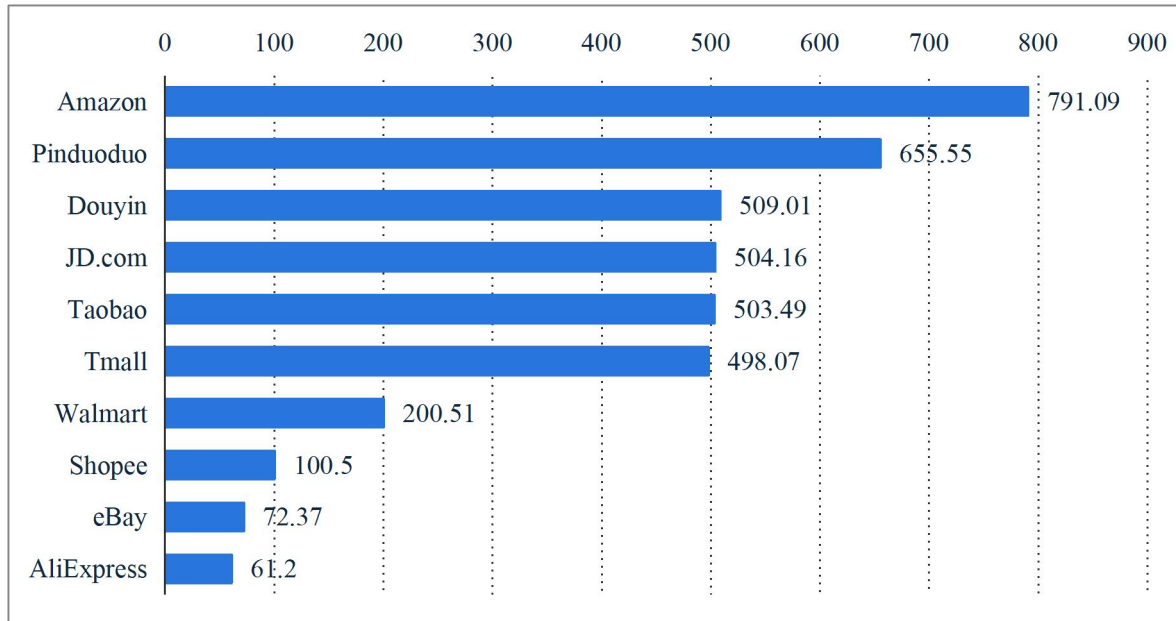


Figure 1.6: Most popular online marketplaces worldwide in 2024, based on gross merchandise value (GMV), in billion U.S. dollars

Note. From *Most popular online marketplaces worldwide in 2024, based on gross merchandise value (GMV), in billion U.S. dollars*, by ecommerceDB.com, 2025 (<https://www.statista.com/statistics/885354/top-global-online-marketplaces-by-gmv/>).

In terms of product categories, apparel, footwear, and accessories represent the most dominant segment in global CBEC, accounting for nearly 39% of total purchases in 2023. This is followed by consumer electronics and related accessories (20%), as well as personal care and beauty products (17%). Other notable categories include sports and leisure goods, home and garden items, luxury products, and mother and baby supplies. These trends reflect global consumer preferences for value, variety, and personalization when shopping across borders (see Figure 1.7).

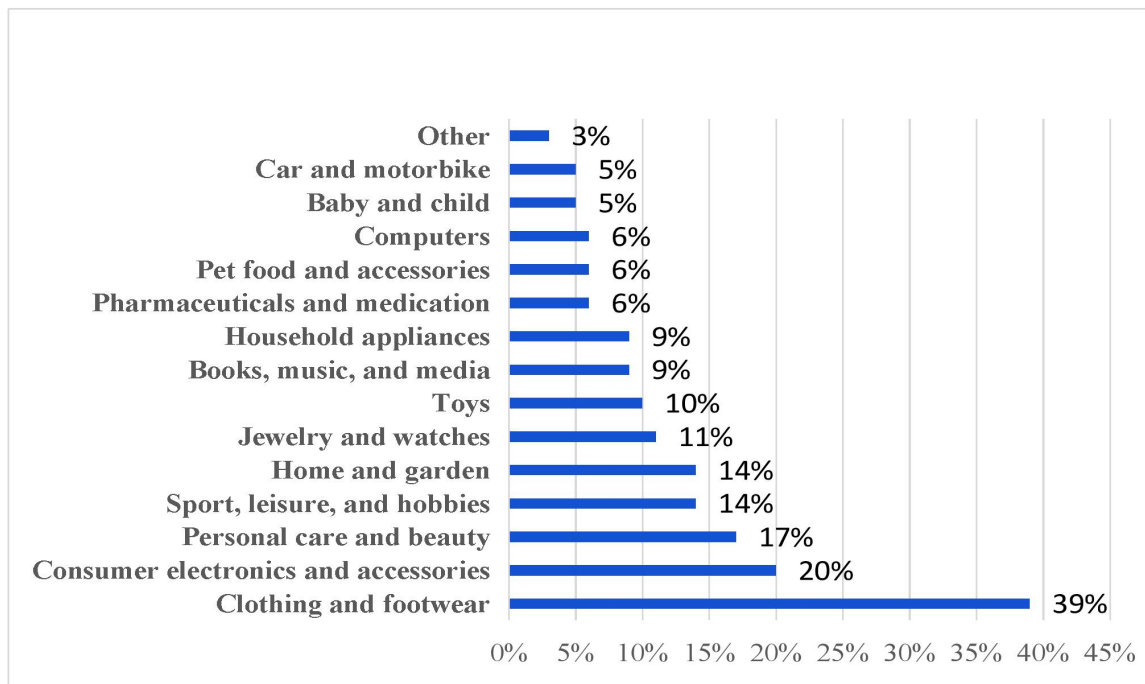


Figure 1. 7: The Prevailing Cross-Border Online Shopping Product Categories on a Global Scale in the Year 2023

Note. From *Most popular product categories for cross-border online purchases worldwide in 2023*, by Dynata & International Post Corporation (IPC), 2023. Based on a survey of 32,510 respondents in 41 countries conducted in September 2023.

Regionally, CBEC penetration varies significantly. In Asia-Pacific, particularly in Singapore, Australia, and China, cross-border online shopping has become mainstream. In 2023, approximately 78% of digital buyers in Singapore engaged in CBEC purchases—the highest rate globally. Australia followed closely with 62%, and the United Kingdom, Germany, and the United States also demonstrated high engagement levels (Ppro, 2024). These figures underscore the broad adoption of CBEC in both developed and emerging digital economies (see Figure 1.8).

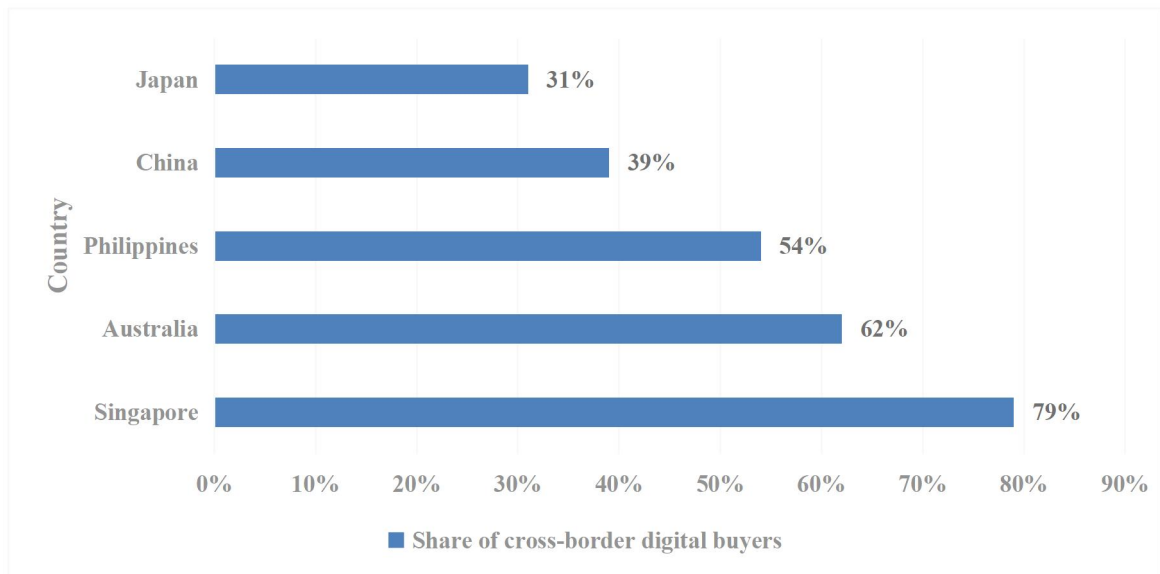


Figure 1.8: Proportion of Cross-Border Online Shoppers in Selected Countries, 2023

Note. Adapted from *Percentage of cross-border online shoppers in selected countries worldwide in 2023*, by PPRO, 2024 (<https://www.statista.com/statistics/1296438/cross-border-ecommerce-users-worldwide-country/>).

Together, these patterns in platform usage, product demand, and geographic distribution highlight the global expansion and diversification of CBEC, providing a foundation for more in-depth analysis of national performance—particularly in the case of China, as discussed in the following sections.

1.1.1.4 Technological Drivers of CBEC Expansion

The expansion of CBEC has been fundamentally driven by rapid technological advancements. Core technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, mobile payment systems, blockchain, and cloud computing have collectively reshaped the landscape of global trade, providing the digital infrastructure that underpins the efficiency, security, and scalability of CBEC.

One of the critical pillars is smart logistics, supported by the widespread adoption of cellular IoT technology. IoT facilitates real-time tracking, inventory monitoring, and

intelligent warehousing, thereby enhancing delivery precision and cross-border supply chain integration. As shown in Figure 1.9, the number of cellular IoT connections is forecast to exceed 4.1 billion by 2029, with a significant shift towards broadband and critical IoT applications. This exponential growth creates a robust infrastructure for global CBEC logistics.

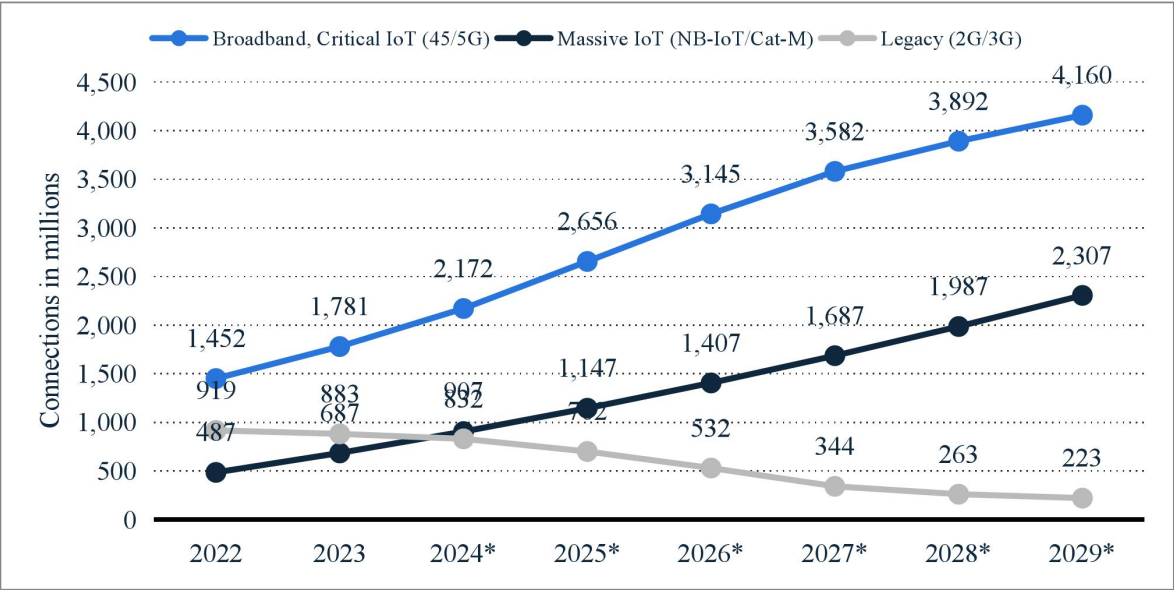


Figure 1.9: Number of cellular IoT connections worldwide from 2022 to 2029, by connection technology (in millions)

Note. From *Number of cellular IoT connections worldwide from 2022 to 2029, by connection technology (in millions)*, by Ericsson, 2024 (<https://www.statista.com/statistics/1388055/cellular-iot-connections-worldwide/>).

Meanwhile, cross-border payment systems have undergone digital transformation, enabling secure and seamless international transactions. The evolution from traditional banking to digital payment platforms—supported by encryption, real-time clearing, and regulatory technologies—has significantly reduced latency and cost in global financial flows. As illustrated in Figure 1.10, the total value of global cross-border payments is projected to grow from 190.1 trillion U.S. dollars in 2024 to 290.2 trillion U.S. dollars by 2032, covering various transaction types such as B2B, B2C, C2B, and wholesale transfers.

This anticipated growth reflects not only increasing trade integration but also digital transformation in international financial infrastructure (Intelligence, 2025).

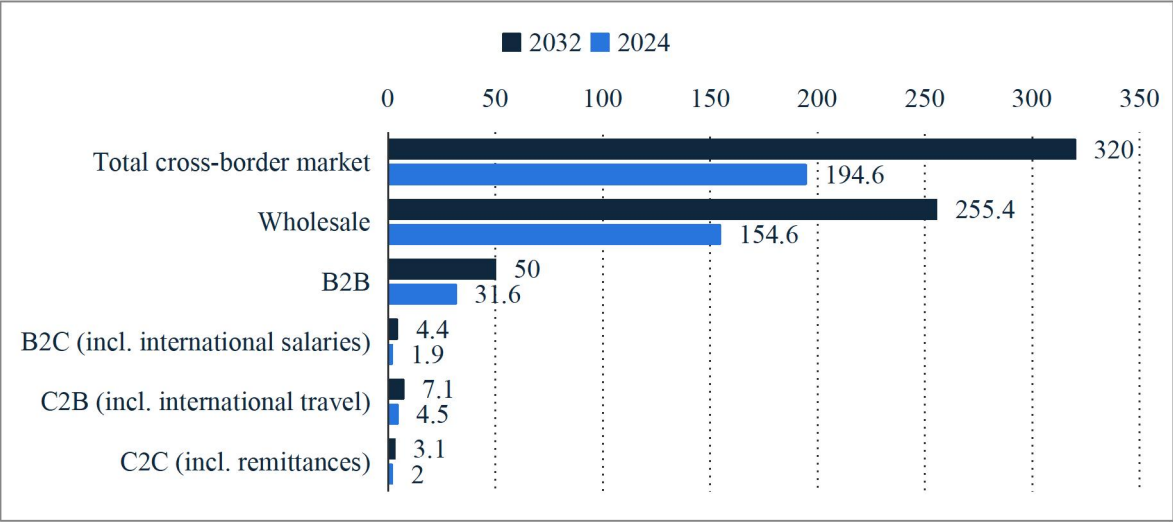


Figure 1.10: Value of total cross-border payments market worldwide in 2024, with a forecast for 2032 (in trillion U.S. dollars)

Note. From *Value of total cross-border payments market worldwide in 2024, with a forecast for 2032 (in trillion U.S. dollars)*, by FXC Intelligence, 2025 (<https://www.statista.com/statistics/1385187/cross-border-payments-value-worldwide-by-segment/>).

These technological advancements not only improve operational efficiency but also foster greater trust among consumers and sellers across borders. With increased automation, data-driven personalization, and digital traceability, technology has become a strategic enabler for the sustained expansion of global CBEC.

1.1.1.5 The Role of COVID-19 in Accelerating CBEC

The COVID-19 pandemic has served as an unexpected accelerator for digital commerce globally, including CBEC. During periods of strict lockdowns and mobility restrictions, consumers across the world turned to online channels for a wide array of products. This shift in consumption behavior fundamentally altered the retail landscape and significantly enhanced the penetration and legitimacy of CBEC as a viable trade mode.

As shown in Figure 1.11, a 2021 survey by iiMedia Research indicated that 65.3% of Chinese CBEC users increased their use of such platforms during the pandemic, while only 21.7% reported a decline in usage. This reflects a strong behavioral shift toward CBEC under the constraints of COVID-19 measures, particularly among digitally active consumers in major economies (iiMedia, 2022) .

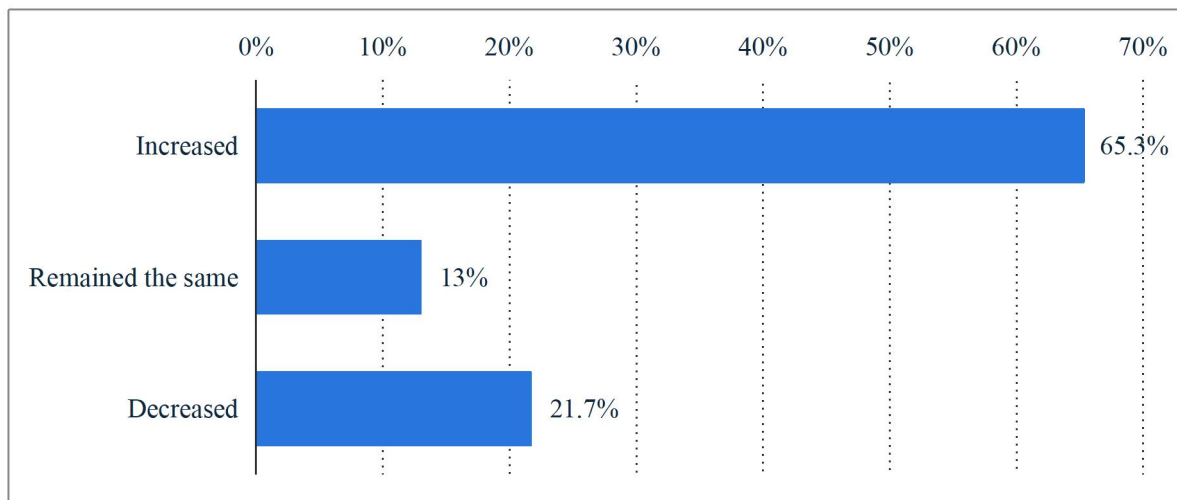


Figure 1.11: Change in the shopping rate of CBEC users during coronavirus COVID-19 outbreak in China in 2021

Note. From *Change in the shopping rate of cross-border e-commerce users during coronavirus COVID-19 outbreak in China in 2021*, by iiMedia Research, 2022 (<https://www.statista.com/statistics/1139433/china-change-in-usage-of-cross-border-e-commerce-platforms-during-covid-19/>).

Beyond China, global consumer behavior also saw substantial reconfiguration. In the United States, a survey by McKinsey revealed that online purchases across most product categories increased during the pandemic (McKinsey & Company, 2021). Although post-COVID expectations indicated moderation, categories such as fitness, personal care, and household supplies maintained elevated e-commerce shares (Figure 1.12).

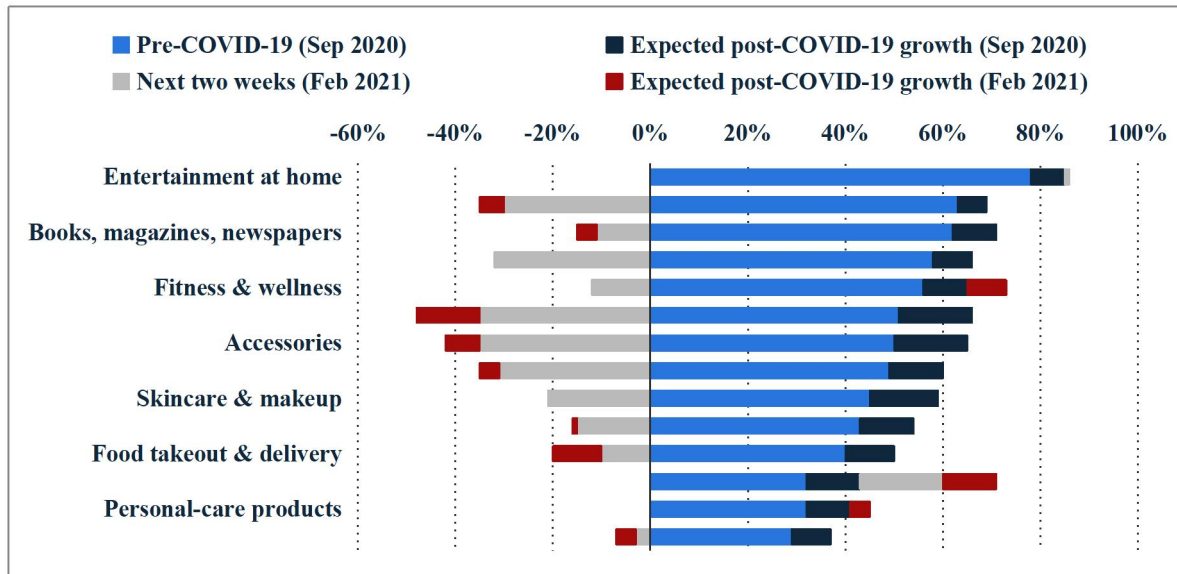


Figure 1.12: Share of U.S. consumers using online shopping before and after COVID-19 by category

Note. From *Share of U.S. consumers using online shopping before and after COVID-19 as of September 2020 and February 2021, by selected categories*, by McKinsey & Company, 2021 (<https://www.statista.com/statistics/1134709/consumers-us-online-purchase-before-after-covid-categories>).

From a broader retail perspective, countries with mature e-commerce infrastructure—such as the United Kingdom, Canada, and the United States—experienced a surge in the share of e-commerce in total retail sales during the pandemic (Mastercard Economics, 2021). Although this share declined slightly post-peak, it remained significantly higher than pre-pandemic levels, reinforcing the role of digital commerce as a permanent fixture in retail economies (Figure 1.13).

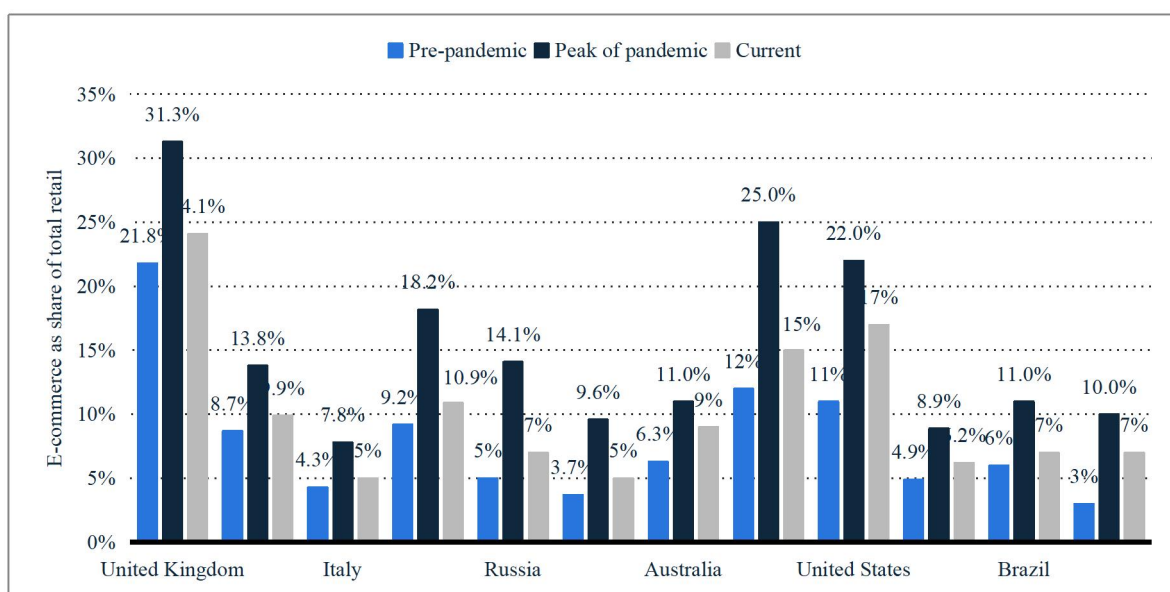


Figure 1.13: Development of e-commerce shares in total retail sales before and after COVID-19

Note. From *Development of e-commerce shares in total retail sales in selected countries before and after the coronavirus (COVID-19) pandemic as of January 2021*, by Mastercard Economics Institute, 2021 (<https://www.statista.com/statistics/1228660/e-commerce-shares-development-during-pandemic/>).

In response to these consumption shifts, governments and enterprises globally accelerated supportive policies and technology adoption. Notably, CBEC platforms rapidly integrated livestreaming, AI-based recommendations, and overseas warehousing to address logistical challenges and simulate real-time shopping experiences. For example, platforms such as Amazon Live, AliExpress Live, and Shopee Live began offering livestream-based product demonstrations in 2020, significantly enhancing consumer engagement and conversion rates.

In conclusion, COVID-19 not only intensified the reliance on digital consumption but also cemented CBEC as a strategic channel in global trade. It catalyzed new consumer behaviors, encouraged regulatory facilitation, and drove innovation in cross-border transaction models—trends likely to persist in the post-pandemic era. Although this study

does not incorporate COVID-19 as an explicit variable in its econometric modeling, the observed shifts in consumer behavior and platform innovations during the pandemic period provide valuable context for understanding the broader dynamics of CBEC expansion.

1.1.1.6 Emerging Models of CBEC

With the development of CBEC, new operational models such as CBEC livestreaming, independent CBEC websites, and cross-border social media marketing have emerged as dominant forces shaping the next phase of global digital trade.

1) CBEC Livestreaming

CBEC livestreaming refers to the real-time demonstration of products on digital platforms, allowing consumers to engage with hosts, evaluate products visually, and make instant purchases. This model gained traction during the COVID-19 pandemic, when traditional in-person retail and trade shows were suspended. In March 2020, Amazon launched Amazon Live for Chinese sellers, enabling them to stream product presentations directly to international consumers (Amazon, 2020). Similarly, Alibaba's B2B platform, Alibaba.com, began hosting livestreaming trade shows for global wholesalers (Alibaba, 2020). Platforms like AliExpress, Lazada, and Shopee also integrated livestreaming functions tailored to localized user habits. A notable case is AliExpress Live, which in 2021 partnered with Chinese factories and influencers to target Russian and Spanish-speaking markets, achieving a reported 600% increase in conversion rates compared to static listings (Sohu, 2021).

2) Independent CBEC Websites (DTC Sites)

As platform commissions rise and sellers seek more autonomy, many enterprises have begun building independent CBEC websites—also known as direct-to-consumer (DTC) or self-hosted stores. These platforms allow for full control over branding, user data, and operations. For example, SHEIN, although often categorized as a marketplace seller, operates an independent website and app that directly connect with global consumers (Shein, 2022). Another successful example is Anker Innovations, a Chinese electronics brand that started on Amazon but expanded into independent site operations to diversify its customer base and improve profit margins (Anker, 2020). According to 2021 data, China had over 200,000 active independent CBEC websites, and their market share is projected to grow from 25% in 2020 to 41% by 2025 (Statista, 2021).

3) Cross-Border Social Media Marketing

Social media platforms have become essential tools for CBEC brands to engage international consumers in a personalized, cost-effective, and data-driven manner. For instance, Perfect Diary, a Chinese cosmetics brand, achieved rapid global growth by collaborating with YouTube beauty influencers and running multilingual TikTok campaigns tailored to Southeast Asian and U.S. markets (Campaign, 2021). Additionally, TikTok's native integration with Shopify and WooCommerce has allowed many SMEs to convert social traffic into cross-border sales (TikTok for Business, 2023)

1.1.2 Development of CBEC in China

Asia plays a dominant role in the global e-commerce landscape. As shown in Figure 1.14, the total retail e-commerce revenue in Asian countries is projected to reach nearly USD 1.97 trillion in 2024, significantly surpassing other regions such as the Americas (USD 1.44 trillion) and Europe (USD 632.7 billion). This overwhelming volume is not only driven by domestic consumption but also reflects the growing importance of cross-border flows—particularly from China, which accounted for over USD 1.4 trillion of Asia's total (Statista Research Department, 2024).

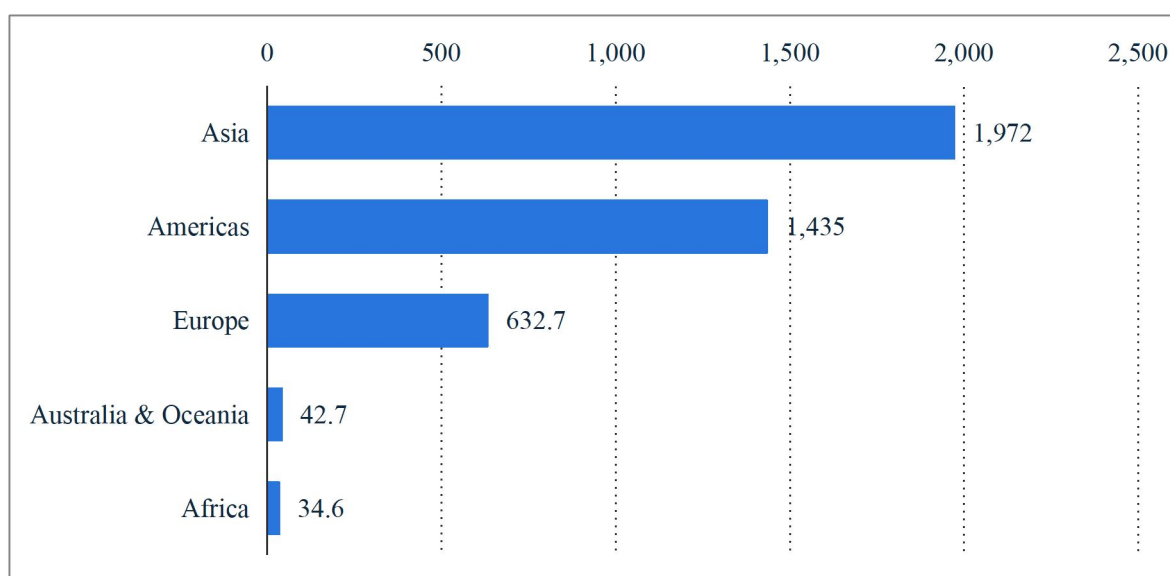


Figure 1.14: Total retail e-commerce revenue worldwide in 2024, by region (in billion U.S. dollars)

Note. From *Total retail e-commerce revenue worldwide in 2024, by region (in billion U.S. dollars)*, by Statista, 2024 (<https://www.statista.com/forecasts/1117851/worldwide-e-commerce-revenue-by-region>).

China has emerged as a global leader in the field of CBEC, showcasing robust development across both import and export sectors. In 2022, China retained its position as

the world's largest exporter and second-largest importer, with CBEC playing an increasingly pivotal role in its foreign trade landscape (Xin Ou, 2024).

To better understand China's leadership in CBEC, it is essential to trace its evolutionary trajectory. Over the past two decades, China's CBEC has undergone four distinct phases, each marking a critical shift in platform function, market players, and business models:

CBEC Phase 1.0 (1999–2003): Focused on information display, platforms served primarily as online yellow pages facilitating offline transactions. Companies like Alibaba International and Global Sources provided suppliers with basic exposure to overseas buyers, with revenue models based on membership fees.

CBEC Phase 2.0 (2004–2012): Marked the transition to online transactions. B2B platforms like DHgate enabled integrated e-commerce functions such as online payments, logistics, and marketing. Service providers diversified revenue through commissions and value-added services.

CBEC Phase 3.0 (2013–2018): Characterized by industrial upgrading, this phase saw factory-based sellers, brand manufacturers, and flexible production models enter the market. The service ecosystem matured, and transactions expanded from small parcels to medium- and large-scale orders. Platform models evolved toward C2C and M2B.

CBEC Phase 4.0 (2019–Present): A phase of regulation, brand elevation, and globalization. In response to regulatory reforms (e.g., E-Commerce Law) and global

disruptions (e.g., US-China trade tensions), Chinese enterprises moved closer to the front-end of the market. Platform capabilities expanded, domestic products increased in quality and brand awareness, and new formats such as livestreaming flourished.

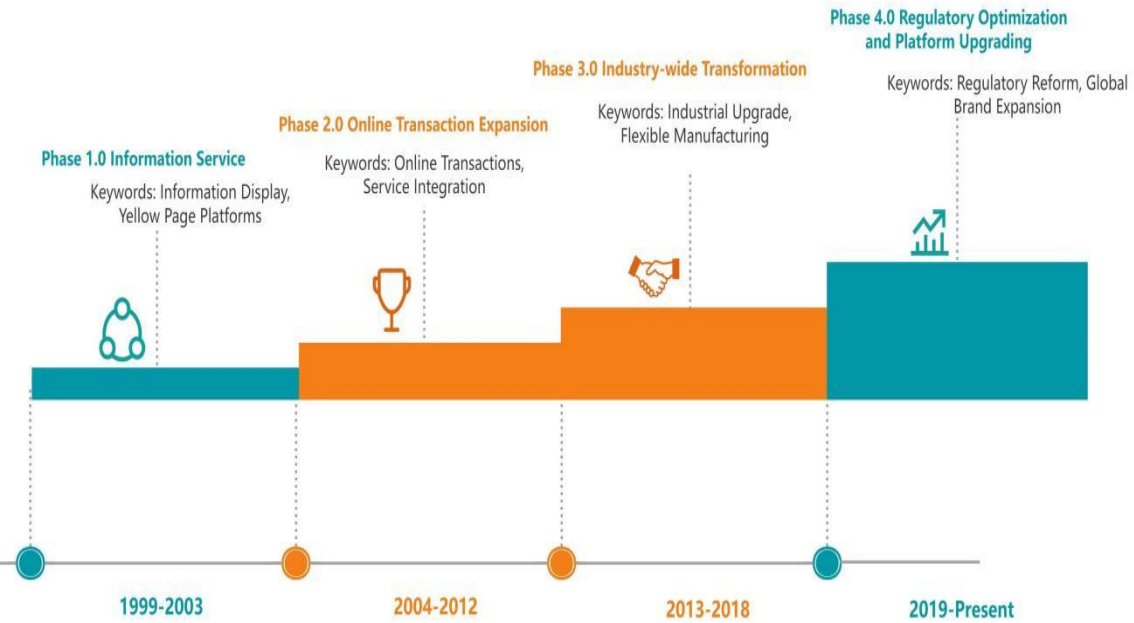


Figure 1. 15: Development Phases of China's CBEC (1999 – Present)

Note. Compiled by the author based on industry literature (1999–present).

This multi-phase evolution laid the foundation for the structural expansion and international competitiveness of China's CBEC sector. As shown in Figure 1.16, the share of CBEC in China's total import-export trade value has grown steadily over the past decade, rising from 15.9% in 2014 to 40.35% in 2023, underscoring the sector's rising prominence (Statista, 2024).

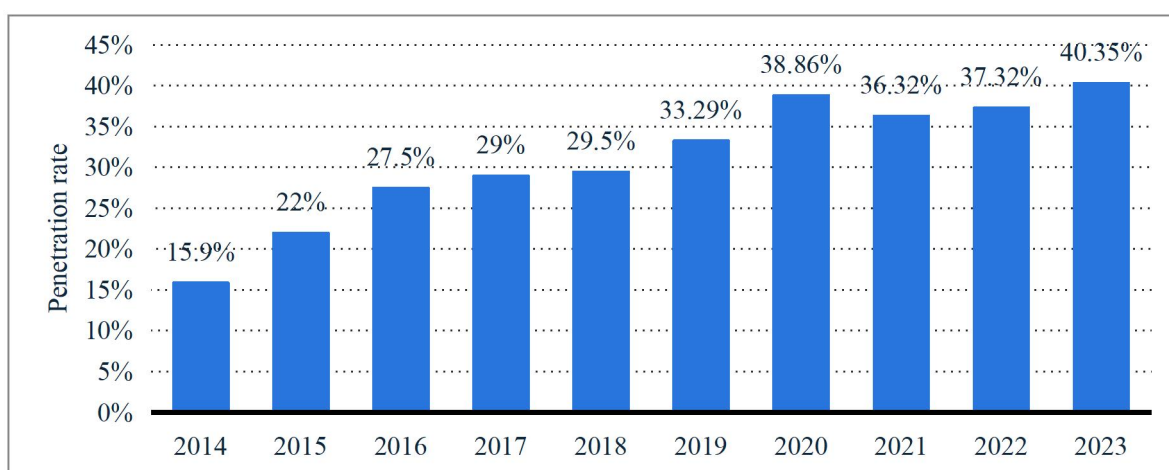


Figure 1.16: Share of China's CBEC Transaction Value in Total Import-Export Trade (2014 – 2023)

Note. From *Share of China's cross-border e-commerce transaction value among total import-export transaction value from 2014 to 2023*, by 100ec.cn, 2024 (<https://www.statista.com/statistics/1139480/china-penetration-rate-of-cross-border-e-commerce/>).

1.1.2.1 Cross-Border Exports

The expansion of CBEC in China is largely driven by the proliferation of SMEs engaging in international online trade. As of August 2023, over 61,000 CBEC companies were registered across the country (iiMedia Research, 2023). Business-to-Business (B2B) transactions have traditionally dominated, accounting for approximately 75.6% of China's CBEC market in 2022. However, Business-to-Consumer (B2C) transactions have been steadily gaining traction, fueled by improved logistics and the rise of mobile shopping and digital payment systems (chinabaogao.com, 2023).

In terms of platform choice, Chinese CBEC sellers demonstrate a clear preference for global and regional e-commerce platforms. A 2021 survey by CBNDData revealed that Amazon was the most utilized online retail platform among Chinese CBEC enterprises, with 59% of respondents indicating it as their primary sales channel. Other frequently used

platforms included eBay (22%), Alibaba International (19%), Wish (19%), and AliExpress (17%) (CBNData, 2021). This distribution underscores Chinese sellers' strategic alignment with platforms that offer broad international reach and advanced logistics infrastructure (see Figure 1.17).

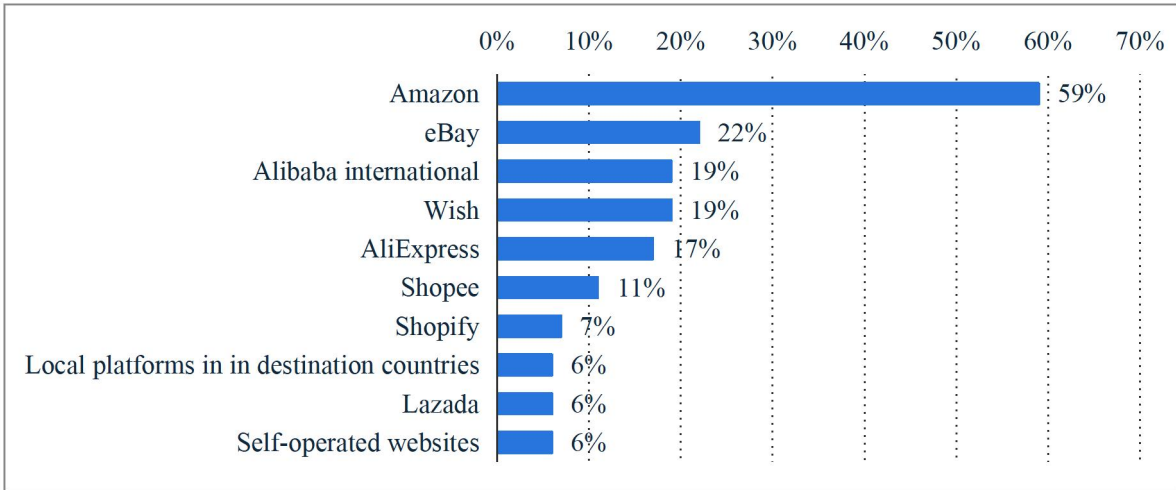


Figure 1.17: The Primary Online Retail Platform Predominantly Utilized by Chinese CBEC Enterprises in the Year 2021

Note. From *Leading online retail platforms used by Chinese cross-border e-commerce companies in 2021*, by CBNData, 2021 (<https://www.statista.com/statistics/1209467/china-platforms-used-by-cross-border-e-commerce-companies/>).

Prominent Chinese CBEC platforms that have successfully expanded their global reach include: AliExpress, owned by Alibaba Group, providing "Made in China" products to global consumers. SHEIN, a fast-fashion retailer that has become one of the top three most preferred cross-border shopping destinations worldwide (Dynata; IPC, 2024). As shown in Figure 1.18, SHEIN leads China's CBEC landscape by a wide margin, with a market valuation of 471.9 billion yuan in 2023. Other notable players include Airwallex, Xingyun Group, KK Group, and Patpat.com, indicating the growing diversity and scale of the CBEC ecosystem in China (Statista, 2024).

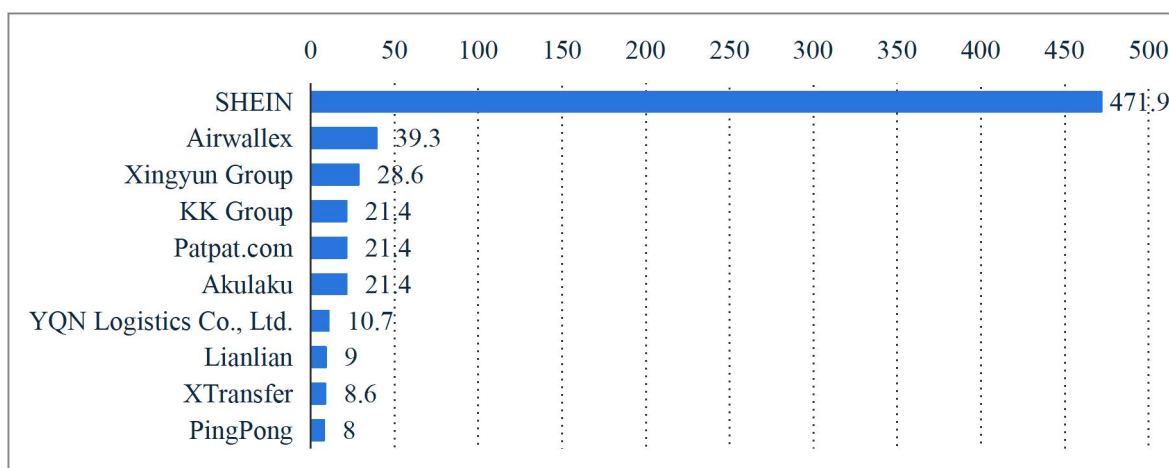


Figure 1.18: Most valuable CBEC players based on market value in China 2023

Note. From *Market capitalization or valuation of China's leading cross-border e-commerce players in 2023 (in billion yuan)*, by 100ec.cn, 2024 (<https://www.statista.com/statistics/1319228/china-market-value-of-major-cross-border-e-commerce-companies/>).

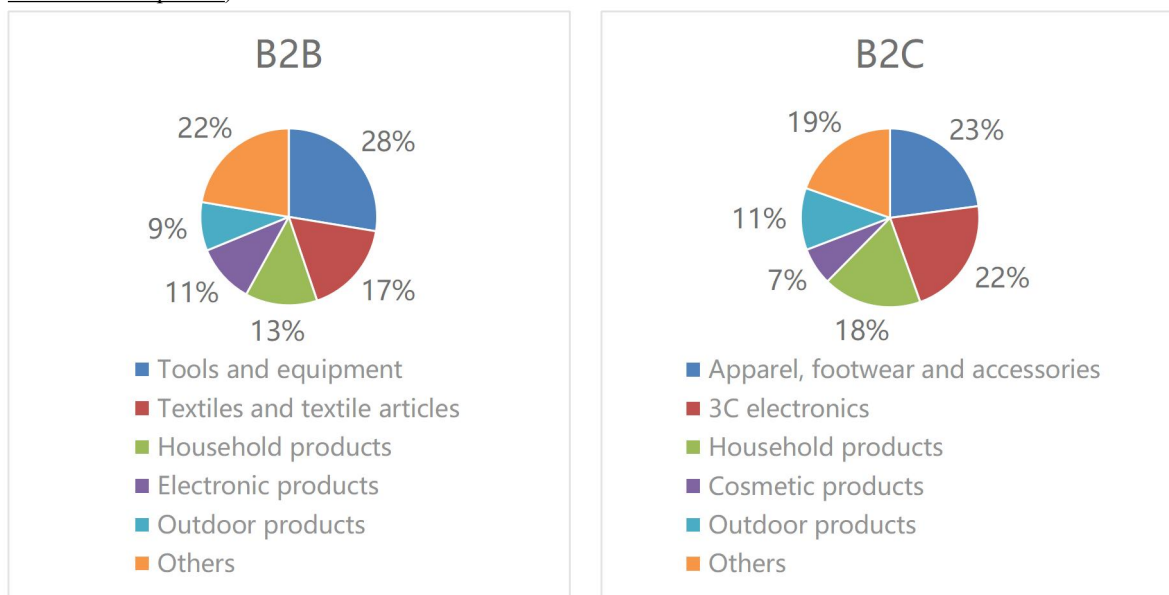


Figure 1.19: Distribution of China's B2B and B2C CBEC Export Categories in 2023

Note. Adapted from *Distribution of B2B cross-border e-commerce exports from China in 2023, by product category* and *Distribution of B2C cross-border e-commerce exports from China in 2023, by product category*, by chinabaogao.com, 2024 (<https://www.statista.com/statistics/1460512/china-b2b-cross-border-e-commerce-export-breakdown-by-category/>); <https://www.statista.com/statistics/1461464/china-b2c-cross-border-e-commerce-export-breakdown-by-category/>).

As illustrated in Figure 1.19, the composition of China's CBEC exports reveals clear distinctions between the B2B and B2C sectors. In B2B exports, tools and equipment dominated with 27.6%, while B2C exports were led by apparel, footwear, and accessories

(22.9%), followed closely by 3C electronics (21.6%). This reflects differentiated consumer demands and logistics strategies across business models (chinabaogao.com, 2024).

1.1.2.2 Cross-Border Imports

On the import side, the rising Chinese middle class has driven a steady growth in demand for high-quality foreign goods. In terms of geographic origin, China's cross-border retail imports are primarily sourced from Asia, North America, and Europe. According to iiMedia Research (2023), Japan was the largest single-country source of imports, followed by the United States, South Korea, Australia, and Germany. Regionally, Asia accounted for 56.7% of total transaction value, followed by North America (21.1%) and Europe (14.6%), as shown in Figure 1.20.

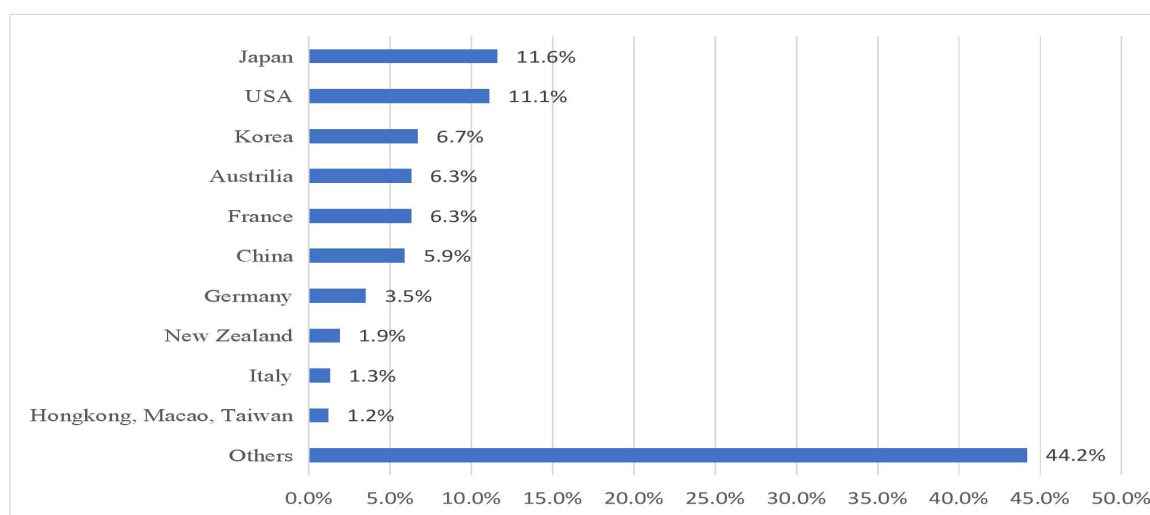


Figure 1.20: Origin and Regional Transaction Volume of Cross-Border Online Retail Imports in China in 2022

Note. Adapted from *E-commerce in China 2022*, by Ministry of Commerce of the People's Republic of China, edited by G. Zhao, 2022 (<http://images.mofcom.gov.cn/dzsws/202306/20230609104929992.pdf>).

The market size for China's cross-border import e-commerce reached approximately 3.61 trillion yuan in 2023 (Statista, 2023). The three most prominent

platforms facilitating these imports were: Tmall Global (Alibaba), JD Worldwide, Douyin EC Global (Analysys, 2023). As illustrated in Figure 1.21, Tmall Global led the market with a share of 37.6%, followed by JD Worldwide (18.7%) and Douyin EC Global (12.3%). These three platforms collectively accounted for over two-thirds of China's cross-border B2C import e-commerce market in 2023, underscoring their dominance in serving the country's rising demand for foreign goods (Analysys, 2024).

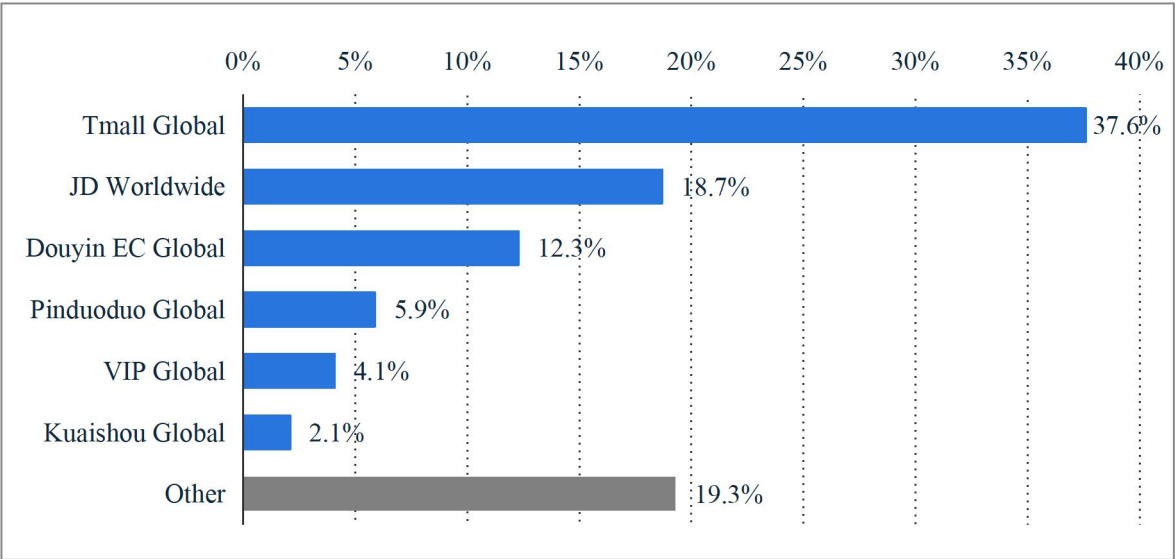


Figure 1.21: Market share of import cross-border B2C e-commerce retailers in China in 2023

Note. From *Market share of import cross-border B2C e-commerce retailers in China in 2023*, by Analysys, 2024 (<https://www.statista.com/statistics/722817/china-import-cross-border-e-commerce-platforms-distribution-by-market-share/>).

As shown in Figure 1.22, the market for China's import-oriented CBEC has experienced consistent growth over the past decade, rising from just 450 billion yuan in 2013 to 3.61 trillion yuan in 2023 (Statista, 2024).

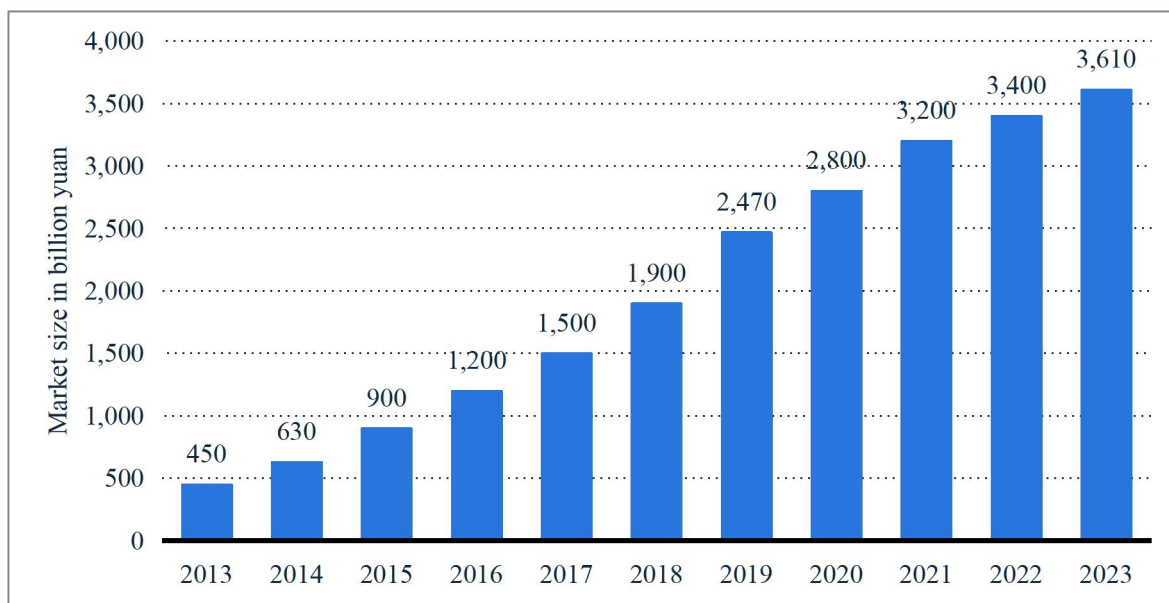


Figure 1.22: Market size of China's import CBEC from 2013 to 2023 (in billion yuan)

Note. From *Market size of China's import cross-border e-commerce from 2013 to 2023 (in billion yuan)*, by 100ec.cn, 2024 (<https://www.statista.com/statistics/722898/china-import-cross-border-e-commerce-players-trading-volume/>).

Together, these platforms accounted for more than two-thirds of China's cross-border B2C import market. Imported goods primarily include categories such as cosmetics, healthcare products, mother and baby supplies, and luxury items.

To ensure product authenticity and enhance consumer trust, Chinese companies have increasingly adopted the overseas warehouse model, allowing faster deliveries and reduced shipping costs. By 2023, more than half of Chinese cross-border sellers utilized overseas distribution centers (Xin Ou, 2024).

1.1.2.3 Overall Market Dynamics

The contribution of CBEC to China's overall trade has been steadily increasing. By 2023, CBEC transactions accounted for approximately 40.35% of China's total import-

export trade value (Statista, 2023). This remarkable growth has been supported by both expanding consumer demand and a robust institutional framework led by the government.

Since the launch of the first CBEC Comprehensive Pilot Zone in Hangzhou in 2015, the State Council has approved eight batches of pilot zones, covering a total of 196 cities or regions, including the entire Hainan Island. These pilot zones serve as testbeds for customs reform, tax incentives, streamlined logistics, and innovations in payment and regulatory supervision.

In parallel, the Chinese government has issued more than 30 national-level policy documents to facilitate CBEC development. These policies cover a wide range of areas including export tax rebates, import retail regulation, overseas warehouse subsidies, cross-border payment controls, and data flow protection.

Table 1.1: Expansion Timeline of National CBEC Pilot Zones in China (2015 – 2025)

Batch	Approval Date	Cities covered
First	Mar 7, 2015	1 city
Second	Jan 12, 2016	12 cities
Third	Jul 24, 2018	22 cities (Haikou withdrawn later)
Fourth	Dec 15, 2019	24 cities
Fifth	Apr 27, 2020	46 cities (Sanya withdrawn later)
Sixth	Jan 22, 2022	27 cities (Alashankou excluded)
Seventh	Nov 14, 2022	33 cities
Eighth	Apr 22, 2025	15 cities + entire Hainan Island
Total		196 (including 9 cities & 10 counties in Hainan)

Note. Adapted from *China (National) Cross-Border E-Commerce Comprehensive Pilot Zone*, by Baidu Baike, n.d.(<https://baike.baidu.com/item/中国跨境电子商务综合试验区/19265634>). Retrieved May 20, 2025.

Table 1. 2: Key National-Level Policies Supporting CBEC in China (2013 – 2023)

Date	Policy Title	Issuing Authority
2013.02.01	Guidelines on the Pilot Program for Foreign Exchange Payment Services by Payment Institutions for CBEC	State Administration of Foreign Exchange (SAFE)
2013.09.16	Approval for Alipay (China) and Zhejiang Beifu to Conduct Pilot CBEC Foreign Exchange Payments	SAFE Comprehensive Dept.
2013.11.11	Guidelines on Supporting CBEC Retail Export	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
2013.12.30	Notice on Tax Policies for CBEC Retail Export	Ministry of Finance, State Taxation Administration
2015.03.07	Approval to Establish China (Hangzhou) Pilot Free Trade Zone for CBEC	State Council
2015.06.16	Guidelines on Promoting the Healthy Development of CBEC	State Council General Office
2015.11.24	Standards for Filing of CBEC Business Entities and Products	AQSIQ
2015.12.18	Tax Policy for Exported Goods in Hangzhou CBEC Pilot Zone	Ministry of Finance, State Taxation Administration
2016.01.12	Approval for the Establishment of Pilot Free Trade Zones in 12 Cities including Tianjin	State Council
2016.03.24	Notice on Tax Policies for CBEC Retail Import	Ministry of Finance, General Administration of Customs, State Taxation Administration
2016.04.06	List of Retail Import Goods under CBEC (1st batch)	Multiple Ministries (MOF, MOFCOM, etc.)
2016.04.15	List of Retail Import Goods under CBEC (2nd batch)	Multiple Ministries (MOF, MOFCOM, etc.)
2017.11	Notice on Promoting the Replication of Successful Experiences from Pilot Zones	14 Ministries including MOFCOM
2018.07	Approval to Establish 22 New CBEC Pilot Zones including Beijing	State Council
2018.09	Notice on Tax Policies for Retail Export in CBEC Pilot Zones	MOF, STA, MOFCOM, GAC
2018.11	Notice on Improving the Tax Policy for CBEC Retail Import	MOF, GAC, STA
2019.03	Two Sessions Government Work Report (CBEC highlighted)	State Council
2020.01	Notice on Expanding the CBEC Retail Import Pilot	MOFCOM and 5 Other Ministries
2020.05	Approval to Establish 46 New CBEC Pilot Zones including Xiong'an	State Council
2020.05	Notice on Supporting the Development of New Trade Formats	SAFE
2021.07	Opinions on Accelerating the Development of New Foreign Trade Models	State Council General Office
2021.09	14th Five-Year Plan for E-Commerce Development	Cyberspace Administration, NDRC
2022.02	Approval to Establish 27 New CBEC Pilot Zones including Ordos	State Council
2023.01	Notice on Tax Policies for Returned Export Goods in CBEC	MOF, GAC, STA

Note. Compiled by the author based on national-level policy documents released by the Chinese government between 2013 and 2023.

To further strengthen its global digital trade network, China has established bilateral e-commerce cooperation mechanisms with 33 countries across five continents as of May 2025. These partnerships, initiated under the “Silk Road E-Commerce” framework, cover both emerging and developed economies, many of which are also members of RCEP or the Belt and Road Initiative (BRI). The growing network illustrates China's expanding influence in shaping global e-commerce standards, logistics connectivity, and policy alignment. Table 1.3 below summarizes the geographic distribution of these bilateral partnerships.

Table 1.3: Countries with Bilateral E-Commerce Cooperation Mechanisms with China (as of May 2025)

Region	Countries
Asia	Indonesia, Philippines, Laos, Thailand, Pakistan, Singapore, Vietnam, Cambodia, Kazakhstan, Tajikistan
Europe	Serbia, Belarus, Italy, Austria, Hungary, Estonia, Iceland, Russia
Africa	Senegal, Rwanda, United Arab Emirates, Kuwait
Oceania	Australia, New Zealand, Samoa, Vanuatu
Latin America	Colombia, Argentina, Panama, Brazil, Chile

Note. Compiled by the author based on data from the Ministry of Commerce of the People's Republic of China (2025), available at https://dzswgf.mofcom.gov.cn/m_slds.html.

In conclusion, the evolution of China's CBEC sector demonstrates not only rapid expansion in scale but also increasing policy sophistication and regional influence. China's domestic reforms, coupled with its multilateral engagement through RCEP, position the country as a key architect of the future digital trade order in the Asia-Pacific.

1.1.3 Regional Integration Enabled by CBEC

CBEC has emerged as a significant driver of regional economic integration. By lowering trade barriers, enhancing digital connectivity, and reducing reliance on traditional trade infrastructure, CBEC enables more SMEs to participate in cross-border trade, serving as a vital tool for the digitalization of Regional Trade Agreements (RTAs).

In Southeast Asia, the e-commerce market has experienced rapid growth. According to statistics, the ASEAN e-commerce market size is projected to increase from USD 6 billion in 2015 to USD 88 billion by 2025 (Business Insider, 2017).

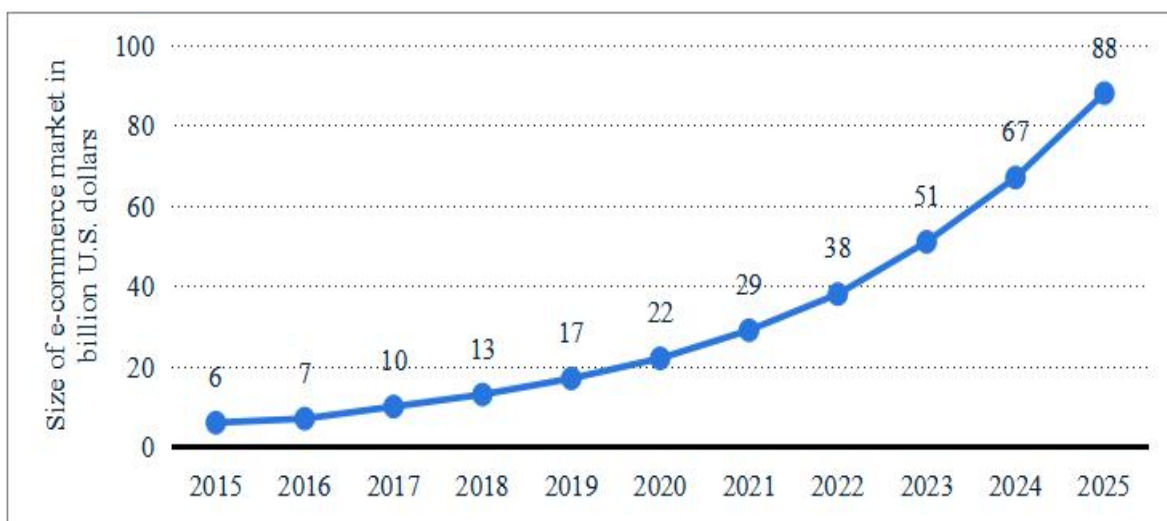


Figure 1.23: Forecasted size of e-commerce market in the ASEAN region from 2015 to 2025 (in billion U.S. dollars)

Note. From *Forecasted size of e-commerce market in the ASEAN region from 2015 to 2025 (in billion U.S. dollars)*, by Business Insider, 2017 (<https://www.statista.com/statistics/763075/forecasted-size-ecommerce-market-asean-region/>).

Additionally, the e-commerce penetration rate in ASEAN is expected to rise from 1.1% in 2014 to 6.5% by 2025, reflecting improvements in digital infrastructure and consumer digital literacy in the region (DBS Group Research, 2020) (see Figure 1.24).

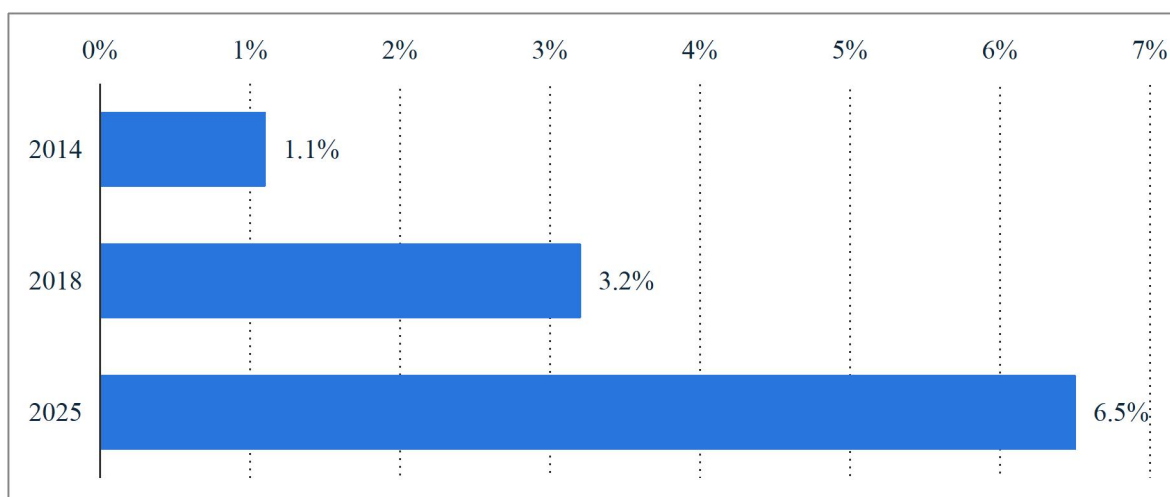


Figure 1.24: E-commerce penetration rate in the ASEAN region in 2014 and 2018 with a forecast for 2025

Note. From *E-commerce penetration rate in the ASEAN region in 2014 and 2018 with a forecast for 2025*, by DBS Group Research, 2020 (<https://www.statista.com/statistics/1177788/asean-e-commerce-penetration-rate/>).

RTAs such as the Regional Comprehensive Economic Partnership (RCEP), the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and the African Continental Free Trade Area (AfCFTA) include provisions related to e-commerce, covering aspects like cross-border data flows, electronic authentication, and paperless customs clearance, providing institutional support for the development of CBEC.

For instance, Chapter 12 of RCEP stipulates that member countries should promote the development of e-commerce, including recognizing the legal validity of electronic signatures, facilitating cross-border data flows, and avoiding the imposition of customs duties on electronic transmissions (RCEP, 2020).

Table 1.4: Comparison of E-commerce Provisions in RCEP, CPTPP, and AfCFTA

Provision	RCEP	CPTPP	AfCFTA
Recognition of Electronic Signatures	Yes – Legally recognizes e-signatures (Chapter 12, Article 12.3)	Yes – Requires non-discrimination of electronic signatures	Yes – Included in Draft Protocol on Digital Trade
Paperless Trading	Yes – Encourages use of paperless trade (Art. 12.6)	Yes – Encourages acceptance of electronic documents	Yes – One of the key pillars in implementation agenda
Cross-Border Data Flow	Encouraged but with exceptions for public policy (Art. 12.14)	Yes – More liberal; prohibits data localization requirements	Not clearly defined; under discussion
Prohibition of Customs Duties on Digital Products	Yes – No duties on electronic transmissions (Art. 12.11)	Yes – Explicit prohibition	Partial – Under negotiation
Online Consumer Protection	General commitment (Art. 12.8)	Strong provisions including redress mechanisms	General reference; details pending
Personal Data Protection	Encouraged with non-binding language	Stronger provisions with legal commitments	General principles recognized
Cooperation on E-Commerce Capacity Building	Yes – Promotes joint activities and exchange of best practices	Yes – Strong emphasis on technical assistance and cooperation	Yes – Emphasized for developing countries
SME Participation Support via E-Commerce	Mentioned in broader cooperation articles	Explicitly addressed in Chapter 24 (SMEs)	Affirmed as a development goal in digital trade negotiations

Note. Compiled by the author based on official texts of the RCEP (2020), CPTPP (2018), and AfCFTA (2021/2024 draft)

CBEC also provides digital platforms that help SMEs access regional markets. Platforms like Shopee and Lazada enable SMEs in Southeast Asia to sell products across borders without establishing physical stores abroad (AppMagic, 2023) (see Figure 1.25).

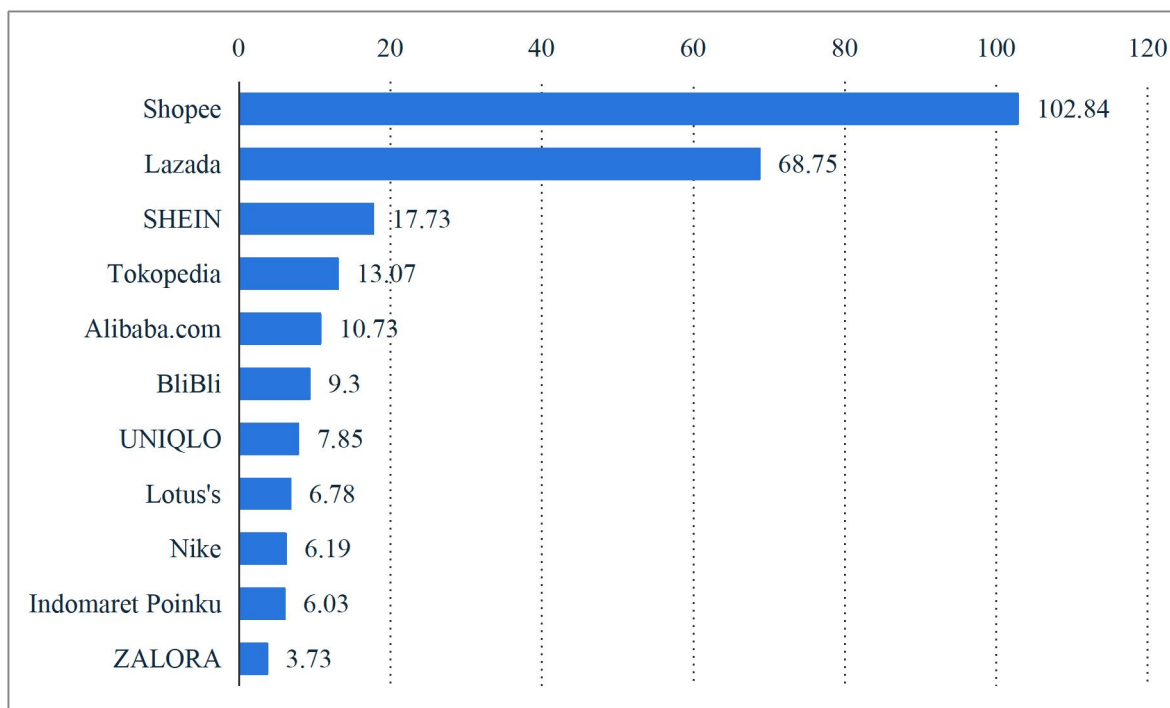


Figure 1.25: Most downloaded free shopping apps in Southeast Asia in 2022, by number of downloads (in millions)

Note. From Most downloaded free shopping apps in Southeast Asia in 2022, by number of downloads (in millions), by AppMagic, 2023 (<https://www.statista.com/statistics/1366796/sea-most-downloaded-shopping-apps/>).

In contrast, Western and Northern Europe have also shown strong trends of regional CBEC integration. Between 2019 and 2023, cross-border B2C e-commerce revenue in these regions increased from € 108 billion to € 237 billion, reflecting the achievements of the EU's unified digital market policies (CBCommerce Europe, 2024) (see Figure 1.26).

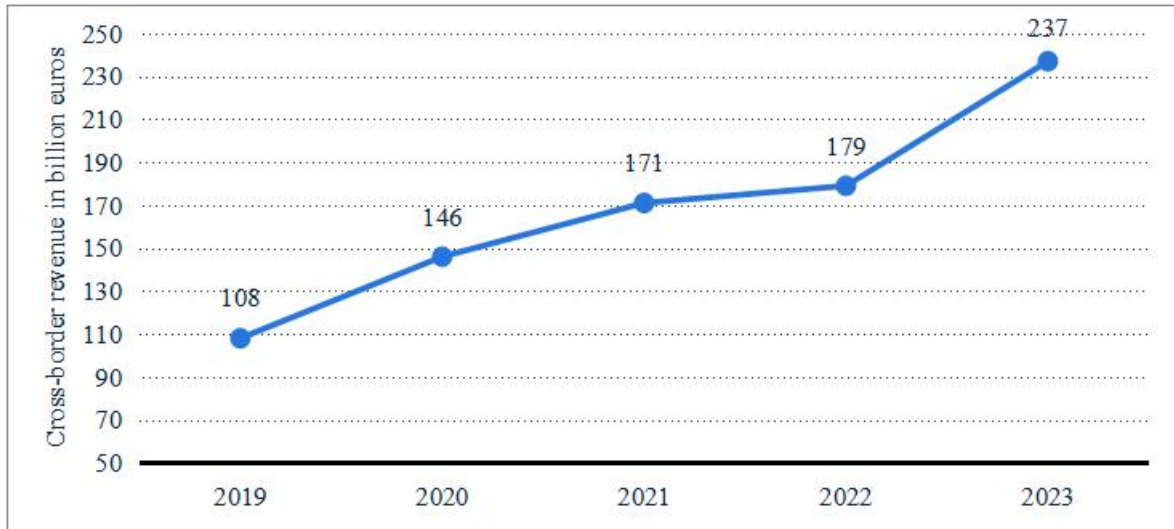


Figure 1.26: Value of cross-border B2C e-commerce revenue in Western Europe and Scandinavian countries from 2019 to 2023 (in billion euros)

Note. From *Value of cross-border B2C e-commerce revenue in Western Europe and Scandinavian countries from 2019 to 2023 (in billion euros)*, by CBCommerce Europe, 2024 (<https://www.statista.com/statistics/1225509/cross-border-b2c-e-commerce-turnover-europe/>).

In summary, CBEC, through digital means and institutional coordination, has substantively advanced the process of regional economic integration. Its low entry barriers and high efficiency make it easier for SMEs to participate, leading to more integrated regional internal markets.

1.1.4 RCEP's Regional Influence and China's Strategic Role

1.1.4.1 Full Implementation of the RCEP

RCEP is the world's largest free trade agreement, covering approximately 30% of the global population, GDP, and trade. Signed in November 2020 and fully implemented by June 2023, it encompasses 15 Asia-Pacific economies: the ten ASEAN member states, plus China, Japan, South Korea, Australia, and New Zealand. While India was initially

involved in negotiations, it withdrew in 2019 due to concerns over market access and trade imbalances.

RCEP was initiated by ASEAN but strategically driven and heavily supported by China, which played a critical role in pushing forward the negotiation, consensus-building, and regional agenda-setting. The agreement integrates previously fragmented trade arrangements into a unified framework and establishes common rules in areas such as trade in goods and services, investment, intellectual property, and digital trade. As such, RCEP reflects the region's growing aspiration for institutionalized cooperation and rules-based trade liberalization.

In order to better contextualize RCEP's positioning in the global trade system, it is useful to compare it with other major Free Trade Agreements (FTAs), namely the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), the European Union (EU), and the United States – Mexico – Canada Agreement (USMCA).

CPTPP, signed in 2018, includes 11 Pacific Rim countries and is known for its high-standard provisions in areas such as digital trade, investment protection, and regulatory alignment.

The EU is a political and economic union of 27 European nations with deep integration through a single market and customs union.

USMCA, which came into force in 2020 to replace NAFTA, represents the modernization of North American trade, especially in terms of e-commerce, labor rights, and environmental commitments.

The comparison in Table 1.2 highlights RCEP's economic weight and strategic role among global FTAs.

Table 1.5: Comparison of RCEP and Major International FTAs

FTA	RCEP	CPTPP	EU	USMCA
Number of Members	15	11	27	3
Population(million)	2262	508	448	493
Share of Global Population	29%	7%	6%	6%
Total GDP (US trillion)	25.8	11.2	15.6	24.4
Share of Global GDP	29%	13%	18%	28%
Total Exports (US trillion)	5.5	2.9	5.8	2.6
Share of Global Exports	28%	15%	30%	13%

Note. Adapted from *Short overview of the Regional Comprehensive Economic Partnership (RCEP)*, by J. Francois & M. Elsig, 2021, European Parliament (<https://doi.org/10.2861/001684>).

In addition to RCEP's macroeconomic weight, its impact on intra-regional trade dynamics is particularly significant. As shown in Table 1.6, the agreement generated an estimated total trade effect of USD 41.8 billion in 2022 across its 15 member countries, comprising USD 25.2 billion in trade diversion and USD 16.6 billion in trade creation (Thailand Business News, 2022). Japan emerged as the largest beneficiary, with a net gain of USD 20.2 billion, followed by China (USD 11.2 billion) and South Korea (USD 6.7 billion), reflecting their strong production capacities and regional supply chain integration.

Table 1.6 also reveals differentiated effects across member economies. Major countries like Japan and China benefited significantly, while several Southeast Asian countries experienced limited or even negative outcomes. These variations reflect not only differences in industrial competitiveness, but also the ability of member states to utilize RCEP's liberalization measures. The data highlight the importance of proactive national strategies—including digital trade readiness and CBEC integration—to fully capitalize on the agreement (Thailand Business News, 2022).

Table 1.6: Economic Effects of RCEP on Member Countries in 2022 (in USD billions)

Country	Overall effects	Trade diversion	Trade creation
RCEP members	41.8	25.2	16.6
Japan	20.2	15.7	4.5
China	11.2	6.9	4.3
South Korea	6.7	4.4	2.3
Australia	4.1	2.8	1.3
New Zealand	1.1	0.8	0.3
Malaysia	0.2	-0.3	0.6
Singapore	0.2	-0.3	0.5
Laos	0.1	0	0.1
Myanmar	0.1	0	0.1
Brunei	0	0	0
Thailand	0	-1.1	1.1
Philippines	-0.1	-0.2	0.2
Cambodia	-0.3	-0.4	0
Indonesia	-0.3	-0.8	0.4
Vietnam	-1.5	-2.3	0.8

Note. From *Economic effects of the Regional Comprehensive Economic Partnership (RCEP) on trade in member countries in the Asia-Pacific region in 2022, by country (in billion U.S. dollars)*, by Thailand Business News, 2022 (<https://www.statista.com/statistics/1284598/apac-economic-effects-rcep-free-trade-agreement-by-country/>).

The shifts in export patterns further confirm these trade effects. As shown in Figure 1.27, Japan's exports to other RCEP countries increased by 5.5% in 2022 compared to 2019 levels, followed by New Zealand (4.5%) and Laos (2.7%). Meanwhile, some countries such as Vietnam, Indonesia, and Cambodia experienced slight declines, reflecting their relatively lower readiness or integration within the RCEP-driven regional value chains (Thailand Business News, 2022).

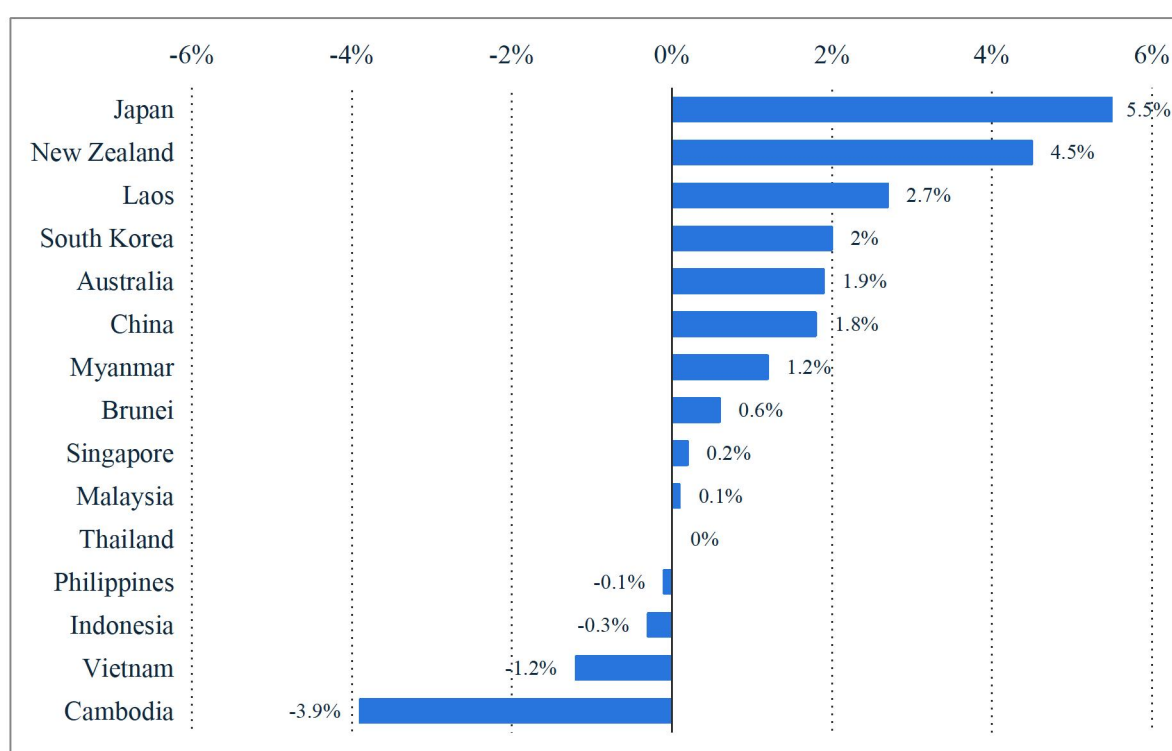


Figure 1.27: Export Change Due to RCEP by Country in 2022 (as % of 2019 baseline)

Note. From *Change in exports due to the Regional Comprehensive Economic Partnership (RCEP) free trade agreement in the Asia-Pacific region in 2022, by country*, by Thailand Business News, 2022 (<https://www.statista.com/statistics/1284629/apac-change-exports-rcep-free-trade-agreement-by-country/>).

These trade and export outcomes illustrate that RCEP is more than just an economic bloc with scale advantages—it is a functioning platform for trade reallocation and integration. By reducing tariffs on more than 90% of goods, simplifying border

procedures, and enabling CBEC cooperation, RCEP strengthens both traditional and digital trade channels. It thus plays a strategic role in facilitating border trade liberalization and regional digital economy transformation.

Following the signing of the RCEP agreement, at least nine ratifications were required for it to come into effect. Each member country completed the approval process in accordance with its domestic procedures. As shown in Table 1.7, the agreement entered into force in stages beginning on January 1, 2022, and by June 2, 2023, all 15 RCEP member countries had officially implemented the agreement (Liu, 2023).

Table 1.7: RCEP's Implementation Timeline for Member Countries

No.	Effective Date	Member Countries
1	January 1, 2022	Brunei, Cambodia, Laos, Singapore, Thailand, Vietnam, China, Japan, New Zealand, Australia, and other 10 countries
2	February 1, 2022	South Korea
3	March 18, 2022	Malaysia
4	May 1, 2022	Myanmar
5	January 2, 2023	Indonesia
6	June 2, 2023	Philippines

Note. From *Today, the RCEP is fully effective for all 15 member countries!*, by M. Liu, 2023 (<http://www.zqrb.cn/finance/hongguanjingji/2023-06-02/A1685633882478.html>).

This progressive implementation process, when viewed alongside comparative FTA data and RCEP's trade-effect figures, reflects both the strategic economic weight of the agreement and the strong commitment of member states to regional integration.

Upon full implementation, RCEP eliminated tariffs on over 90% of goods traded within the bloc and introduced measures to simplify customs procedures and reduce non-tariff barriers. The agreement also advances digital trade by promoting paperless

transactions, strengthening cross-border data flows, and safeguarding consumer data. These provisions are designed to support the expansion of CBEC, improve trade facilitation, and strengthen supply chain connectivity.

As a comprehensive framework, RCEP plays a crucial role in promoting trade liberalization, deepening regional cooperation, and accelerating the development of the digital economy. For China and its RCEP partners, these institutional commitments present significant opportunities to enhance CBEC development through policy alignment, digital infrastructure investment, and greater market access.

1.1.4.2 China' Leading Role in Advancing and Implementing RCEP

As the largest economy within the RCEP framework, China has not only benefited significantly from the agreement but has also played a pivotal role in its promotion and implementation.

According to Guangming Daily (2025), in the trade dimension, China has become a core export market and import destination under RCEP. In 2023, China's total trade in goods with RCEP members reached RMB 12.7 trillion, up 6.3% from 2021, the year before RCEP entered into force. In the first eleven months of 2024 alone, this volume already hit RMB 12 trillion, reflecting a 4.4% year-on-year growth. China has committed to eliminating tariffs on 86% of Japanese industrial products in phases, while offering up to 92% tariff reduction to Singaporean exporters. By August 2023, China's imports under RCEP with preferential tariffs totaled RMB 121.3 billion, with tax reductions amounting to

RMB 3.04 billion. China has also pledged to import USD 150 billion worth of agricultural goods from ASEAN over five years. For instance, in the first eleven months of 2023, imports of fresh durians from Thailand and Vietnam reached RMB 46.61 billion—1.7 times the 2021 total.

In the investment sphere, China has promoted regional industrial cooperation through outbound FDI and the Belt and Road Initiative (BRI). In 2023, China's non-financial direct investment in other RCEP members reached USD 18.06 billion, a 26% increase year-on-year, outpacing the global average by 14 percentage points. Infrastructure projects like the China-Laos Railway have become crucial logistical connectors under RCEP, lowering transportation costs and enabling smoother regional trade. As the first cross-border railway invested and operated predominantly by China and linked directly to China's railway network, it exemplifies China's commitment to shared regional infrastructure (Guangming Daily, 2025).

In terms of rule-setting and multilateral institution-building, China has acted as both architect and promoter. In 2024, China and Indonesia jointly facilitated the establishment of an RCEP support institution in Jakarta, a major milestone in regional governance. Domestically, China has proactively reformed relevant laws and regulations to align with RCEP rules, including stricter intellectual property protections and first-time participation in binding commitments on cross-border data flows and localization.

For China, RCEP is not merely an economic agreement—it is a strategic platform to demonstrate leadership in global economic governance. China has undertaken bold domestic reforms, expanded market openness, and provided substantial public goods to ensure RCEP's implementation. In doing so, China has exemplified its role as a responsible regional power, promoting shared development and regional stability.

These characteristics make RCEP not only the most economically influential FTA in Asia-Pacific, but also the most strategically aligned with China's digital trade and CBEC ambitions—further justifying its selection as the regional focus of this study.

1.1.5 CBEC Trade between China and RCEP

Building on China's strategic role within the RCEP framework, this section turns to examine the development of CBEC trade between China and other RCEP member countries. Since the full implementation of RCEP in 2022, CBEC has emerged as a new engine of regional connectivity, fueled by policy alignment, digital infrastructure, and growing consumer demand.

This section explores both the export and import sides of CBEC trade, incorporating analysis at both the regional aggregate level and the country-specific level. Particular attention is given to key partners such as Japan, South Korea, and ASEAN, which represent the most economically integrated nodes in China's CBEC network. The insights presented here serve as an empirical foundation for the subsequent discussion of China-RCEP trade potential in the post-pandemic era.

1.1.5.1 China's Overall Trade and CBEC Ties with RCEP Countries

China plays a pivotal role in shaping the regional CBEC landscape under the RCEP framework, both as a dominant trading hub and as a policy initiator. As the initiator and most influential economy in RCEP, China has not only facilitated the negotiation and implementation of the agreement but also contributed significantly to the intra-regional trade volume through high levels of exports and imports with member countries.

According to data from the China National Bureau of Statistics (2025), ASEAN became China's largest export destination in 2024, accounting for 16.4% of total exports, followed by the United States (14.7%) and the European Union (14.4%). Among the top ten export destinations, five RCEP countries—ASEAN, Japan, South Korea, Hong Kong, and Taiwan—collectively accounted for over 34% of China's total exports. This highlights the strong trade connections China maintains within the RCEP framework and affirms its role as a regional export leader.

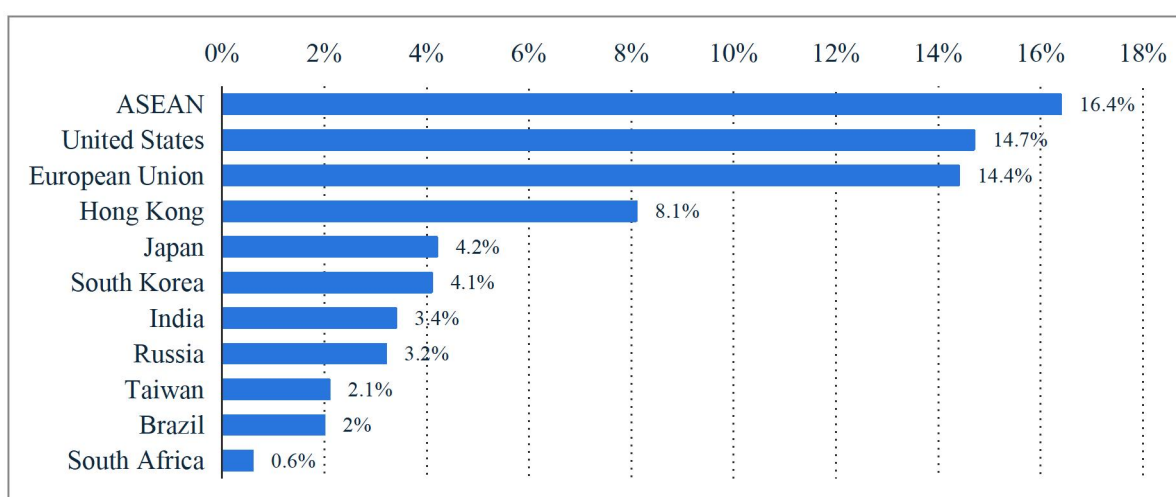


Figure 1.28: China's Export Trade Distribution by Partner Country, 2024

Note. From *Distribution of Chinese exports in 2024, by trade partner*, by National Bureau of Statistics of China, 2025 (<https://www.statista.com/statistics/270326/main-export-partners-for-china/>).

In 2024, China's imports from RCEP countries also demonstrated a high level of regional dependence. ASEAN was the top import source at 2.82 trillion yuan, with other RCEP partners including South Korea (1.29 trillion yuan) and Japan (1.11 trillion yuan) also ranking among the top five. Together with Taiwan, these RCEP countries accounted for more than 60% of China's major import partners, reflecting China's embeddedness in RCEP's value chains (National Bureau of Statistics of China, 2025).

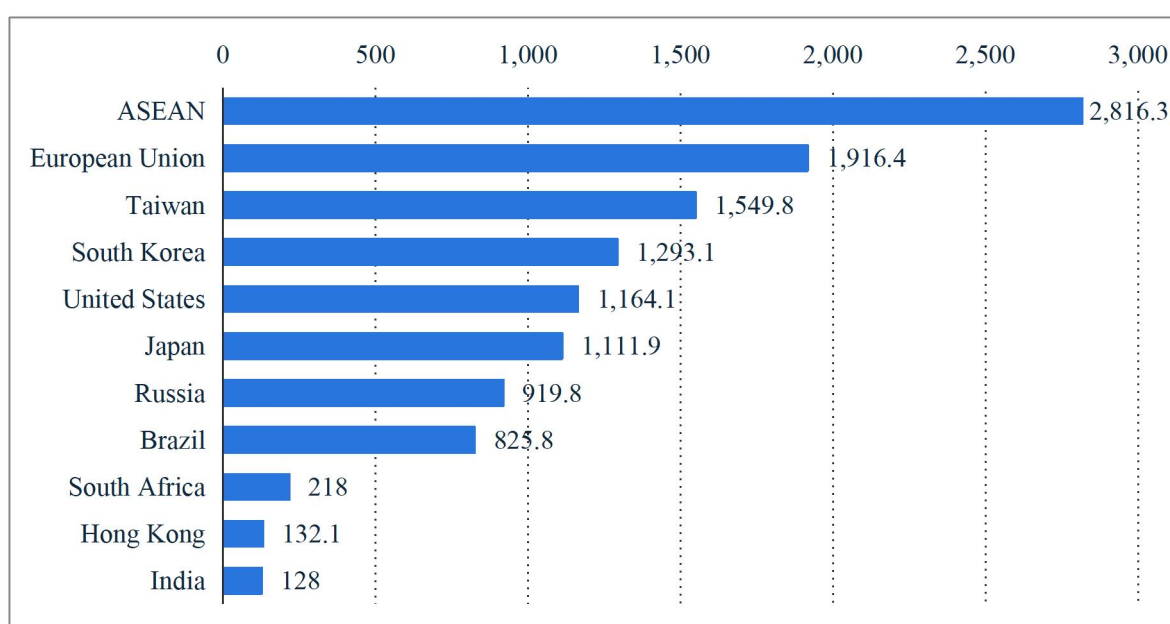


Figure 1.29: China's Import Volume by Country, 2024 (in billion yuan)

Note. From *China's leading import partners in 2024, based on import value (in billion yuan)*, by National Bureau of Statistics of China, 2025 (<https://www.statista.com/statistics/257042/chinas-main-import-partners-by-import-value/>).

Beyond conventional trade flows, CBEC has emerged as a key area of engagement between China and RCEP members, reflecting new trends in digital globalization. To further illustrate the importance of RCEP in China's overall trade landscape, Figure 1.30 presents RCEP countries among China's top ten CBEC trading partners in 2022. According to the China E-Commerce Report (2022), 80% of China's top ten CBEC export

destinations and 50% of its top CBEC import sources were RCEP countries, reinforcing the strategic relevance of this region to China's digital trade ambitions (Ministry of Commerce of the People's Republic of China, 2022).

Table 1.8: RCEP Countries among China's Top 10 CBEC Trade Partners (2022)

China's Top 10 CBEC Export Destinations in 2022			China's Top 10 CBEC Import Destinations in 2022		
Rank	Country/Region	RCEP Member	Rank	Country/Region	RCEP Member
1	United States	☐ No	1	Hong Kong, China	☒ Yes
2	Malaysia	☒ Yes	2	South Korea	☒ Yes
3	Singapore	☒ Yes	3	Japan	☒ Yes
4	Australia	☒ Yes	4	United States	☐ No
5	Vietnam	☒ Yes	5	Australia	☒ Yes
6	South Korea	☒ Yes	6	Netherlands	☐ No
7	Thailand	☒ Yes	7	New Zealand	☒ Yes
8	Philippines	☒ Yes	8	Germany	☐ No
9	India	☐ No	9	France	☐ No
10	Japan	☒ Yes	10	United Kingdom	☐ No

Note. From *E-commerce in China 2022*, by Ministry of Commerce of the People's Republic of China, 2022 (<http://images.mofcom.gov.cn/dzsws/202306/20230609104929992.pdf>).

Taken together, these figures demonstrate that RCEP countries are not only major players in China's traditional goods trade but also occupy central positions in the country's CBEC network. These close trade ties, supported by tariff reductions, logistics integration, and institutional frameworks, provide a compelling rationale for focusing this study on RCEP as China's most strategically aligned regional trading bloc.

1.1.5.2 Indicators of Regional CBEC Vitality and Potential

To assess the development potential of CBEC under the RCEP framework, this section introduces two authoritative indices: the RCEP CBEC Purchase (B2C) Index and the RCEP Small and Medium Enterprises (SMEs) CBEC B2B Index. These indices provide evidence of the vitality and ongoing expansion of digital trade in the region, especially in the post-pandemic context.

1) B2C: Strong Momentum of RCEP Cross-Border Import Growth

To assess the vitality of CBEC in the RCEP region, Alibaba Research Institute, in collaboration with the International Joint Institute of Zhejiang University and Tmall International, launched the world's first RCEP CBEC Purchase (B2C) Index in November 2021. This index offers a multi-dimensional measurement of CBEC import performance across RCEP economies, capturing trends in trade volume, SMEs development, market demand, and platform services.

As shown in Figure 1.30, the RCEP B2C Index grew steadily from Q1 2019 (baseline 100) to Q2 2021, reaching 248.8—an increase of 148.8% over 2.5 years. Although temporary declines were observed during Q1 2020 and Q1 2021, the overall trend demonstrates high resilience and recovery post-COVID. Notably, Q4 2020 marked the index's highest value (253.6), reflecting a surge in consumer demand and digital logistics adoption across the region (AliResearch, 2021).

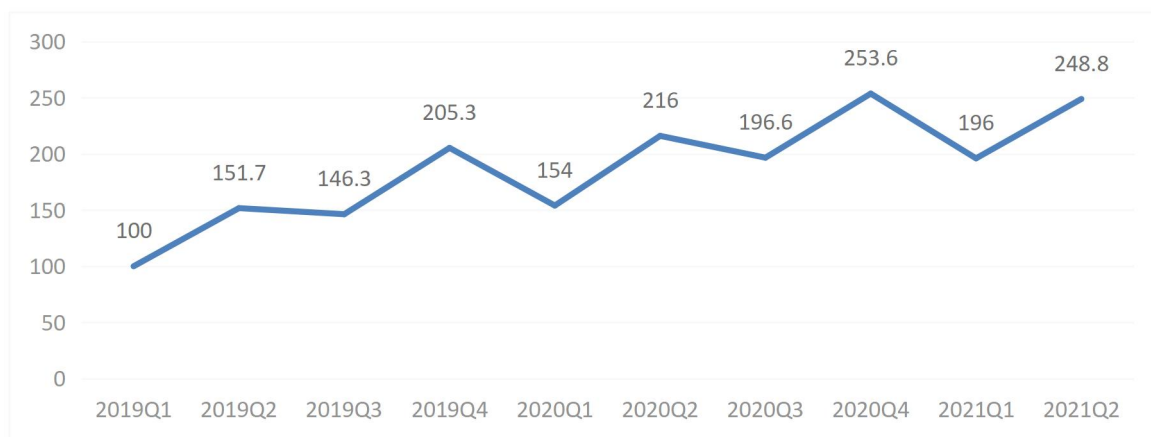


Figure 1.30: The RCEP CBEC Purchase (B2C) Index

Note. From *RCEP Is About to Take Effect! The First Regional Cross-Border E-Commerce Import Index Has Arrived!*, by AliResearch, 2021 (<http://www.aliresearch.com/ch/information/informationdetails?articleCode=268534302122315776>).

From January 2019 to June 2021, the index recorded a compound annual growth rate (CAGR) of 44%, with trade volume growing 3.8 times, reflecting a digital trade expansion significantly outpacing conventional import trade in the region. As visualized in Figure 1.31, all four dimensions exhibited upward trends, but at different paces.

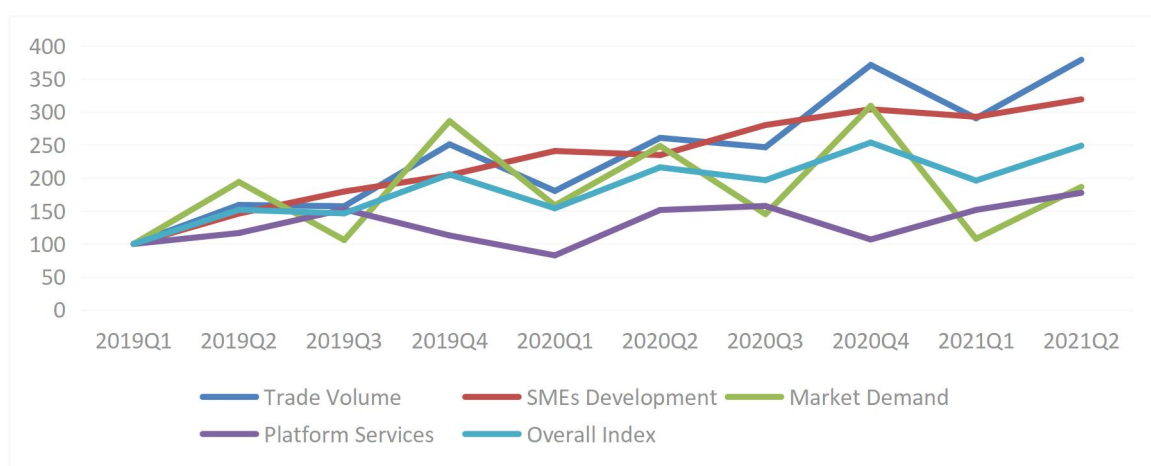


Figure 1.31: Trend Performances of the Four Dimensions Compared with the Total Index

Note. From *RCEP Is About to Take Effect! The First Regional Cross-Border E-Commerce Import Index Has Arrived!*, by AliResearch, 2021 (<http://www.aliresearch.com/ch/information/informationdetails?articleCode=268534302122315776>).

Key insights from the disaggregated indicators are as follows:

Trade Volume: This is the fastest-growing dimension, driven by robust digital infrastructure, streamlined logistics, and policy support. The 3.8x growth in just 2.5 years demonstrates CBEC's accelerating substitution effect over traditional trade.

SMEs Development: The index shows SMEs are increasingly active in product expansion and iteration. According to AliResearch, the average number of new products launched by regional sellers has risen notably, especially among Chinese, Japanese, and ASEAN enterprises.

Market Demand: Demand trends show strong seasonality, with demand peaks often corresponding to Chinese digital shopping festivals (e.g., 6.18, Double 11). Notably, Chinese consumers have emerged as global price anchors, shaping regional consumption behavior.

Platform Services: Improvements in transaction experience (e.g., customs pre-clearance, multilingual support, real-time customer service) have enhanced consumer satisfaction. According to AliResearch 2021, platform optimization has lowered entry barriers for overseas brands.

Collectively, the B2C Index offers a valuable tool for monitoring CBEC vitality and potential within RCEP. It reflects not only the scale but also the quality and resilience of CBEC trade links across the region. The continuous growth in SME participation and the

increasing diversification of product categories suggest that China's vast domestic demand is pulling global suppliers into its digital ecosystem.

Furthermore, the post-pandemic period has amplified this trend. As traditional supply chains faced disruption, cross-border digital commerce emerged as a stabilizing channel for regional exchange. The expansion of localized warehouses, bonded zone logistics, and overseas return centers has further integrated RCEP markets into China's CBEC system.

In conclusion, the B2C index confirms that RCEP is not only a key market but also a key source in China's cross-border consumption structure. This substantiates the rationale for this study's focus on China–RCEP CBEC ties and underpins subsequent analysis of export potential.

2) B2B: Expanding Role of RCEP SMEs in Regional Export

To evaluate the export-oriented potential of CBEC within the RCEP region, the RCEP SMEs CBEC B2B Index was jointly released in November 2022 during the 5th China International Import Expo. The report was a collaborative effort by the International Trade Center (ITC), Alibaba Research Institute, and Zhejiang University's International Joint Institute (Sohu Finance, 2023).

The B2B Index comprehensively assesses the development of CBEC among micro, small, and medium-sized enterprises (SMEs) in the RCEP region across three primary dimensions:

Trade Scale, including the total transaction value and number of cross-border orders within the RCEP;

Enterprise Development, measured by the average number of products per seller and the number of new product launches;

Market Diversification, indicating the number of export destinations and the proportion of inquiries received from markets outside the U.S. and Europe.

Table 1.9: Indices for CBEC (B2B) among SMEs in the RCEP

Overall Index	Primary Indicators	Tertiary Indicators
SMEs CBEC (B2B) Index	Trade Scale	Transaction amount of the orders in RCEP region
		Number of orders in the RCEP region
	Enterprise Development	Average number of products of sellers in the RCEP region
		Average number of new products of sellers in the RCEP region
	Market Diversification	Number of countries covered by RCEP regional sellers' exports
		Proportion of inquiries of RCEP sellers received from the markets outside the US and Europe.

Note. From *The Full Implementation of RCEP Brings New Opportunities for the Development of Digital Trade.*, by Sohu Finance, 2023 (https://www.sohu.com/a/603414188_384789).

From 2019 to 2021, the overall RCEP B2B Index doubled, reflecting an average annual growth rate of 34.4%. The Index recorded year-on-year growth rates exceeding 40% in both 2020 and 2021, indicating the post-COVID boom in digital trade activity among SMEs.

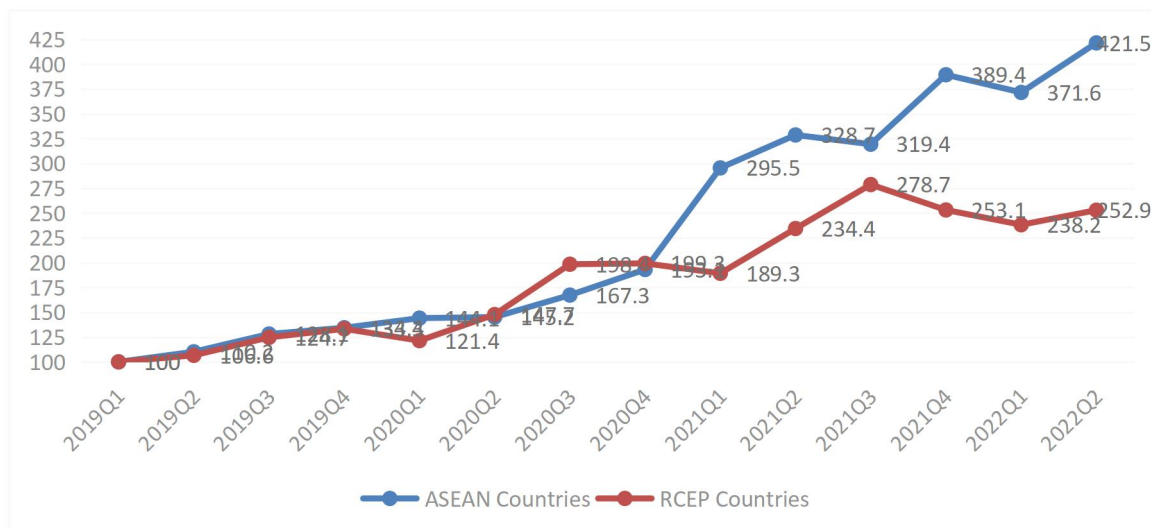


Figure 1.32: RCEP Regional CBEC Development B2B Index (2019-2021)

Note. From *The Full Implementation of RCEP Brings New Opportunities for the Development of Digital Trade.*, by Sohu Finance, 2023 (https://www.sohu.com/a/603414188_384789).

Seasonality was clearly observed, with Q2 and Q3 each year representing peak periods due to intensified procurement cycles and digital promotion events across the region.

Particularly notable is the performance of ASEAN countries, where the B2B index surged by 4.2 times between 2019 and 2021—significantly outpacing the average for the RCEP region. During the post-pandemic recovery phase (Q3 2021–Q2 2022), ASEAN's index growth exceeded that of the entire RCEP region, suggesting that ASEAN is becoming an increasingly pivotal driver of regional CBEC export growth.

These results underscore that RCEP SMEs are not only adapting to global trade digitalization but also actively leveraging CBEC channels to expand their international presence. Platform support, streamlined customs clearance, and policy facilitation have all contributed to this momentum.

In summary, the B2B Index reflects the strong export-side vitality and digital readiness of MSMEs in the RCEP region. This substantiates the strategic importance of SMEs in advancing China–RCEP e-commerce cooperation and reinforces the focus of this study on unlocking CBEC trade potential through digitally empowered regional integration.

1.1.5.3 Country-Level CBEC Interactions: Focus on Japan, South Korea, ASEAN

To complement the regional overview provided in the previous sections, this subsection delves deeper into the country-level dynamics of China's CBEC trade with three major RCEP partners: Japan, South Korea, and ASEAN. These economies not only represent China's largest trading partners in terms of both exports and imports, but also demonstrate diverse digital trade patterns shaped by unique consumer behaviors, regulatory environments, and platform ecosystems.

Through case-based comparisons and data-driven discussion, this section aims to reveal the heterogeneity of market opportunities, the depth of bilateral digital trade relationships, and the strategic positioning of China in fostering targeted CBEC cooperation across these sub-regions.

1) China–Japan CBEC Interaction

To deepen the understanding of bilateral digital trade dynamics, this subsection examines the CBEC interactions between China and Japan—two of Asia's largest economies and most active trading partners under the RCEP framework.

According to the PPRO Asia-Pacific E-Commerce Report (2022), China held the largest share of Japan's CBEC market in 2022, accounting for 32%, ahead of the United States (30%) and South Korea (19%). This data demonstrates China's dominance in Japan's online import landscape and the rising popularity of Chinese goods among Japanese consumers (PPRO, 2022).

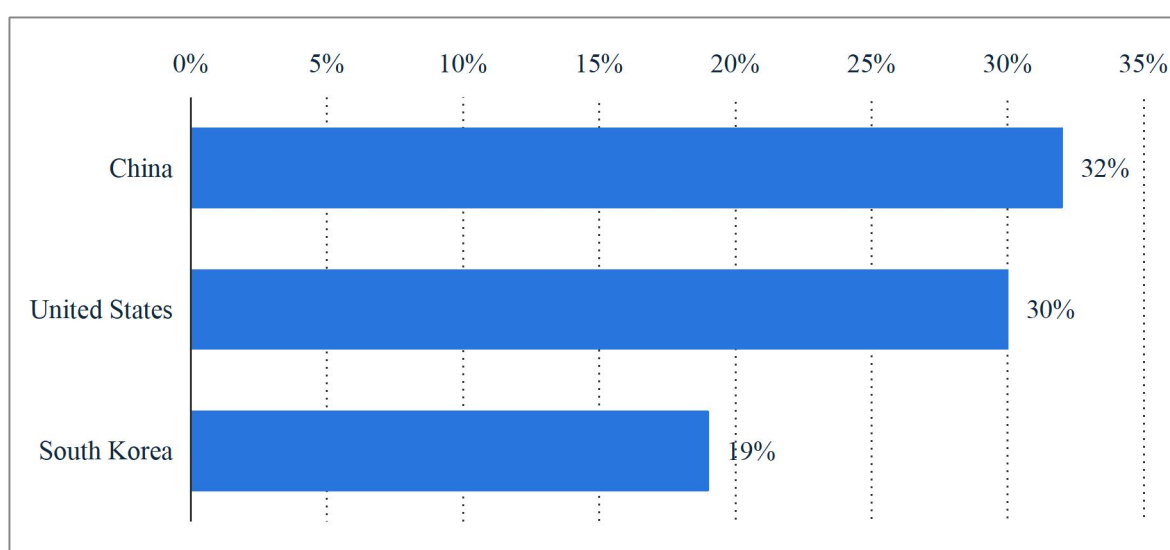


Figure 1.33: Market share of CBEC in Japan as of 2022, by country

Note. From *Market share of cross-border e-commerce in Japan as of 2022, by country*, by PPRO, 2022 (<https://www.statista.com/statistics/1379237/japan-e-commerce-cross-border-share-by-country/>).

From the reverse perspective, Japan also plays a vital role in China's CBEC import landscape. Chinese consumers' preference for Japanese products remains strong. In the first half of 2023, Japan was China's largest source of CBEC imports, contributing 21.9%, well above the United States (17.4%) and Australia (9.4%). This highlights the persistent appeal of Japanese goods in the Chinese market (Analysys, 2024).

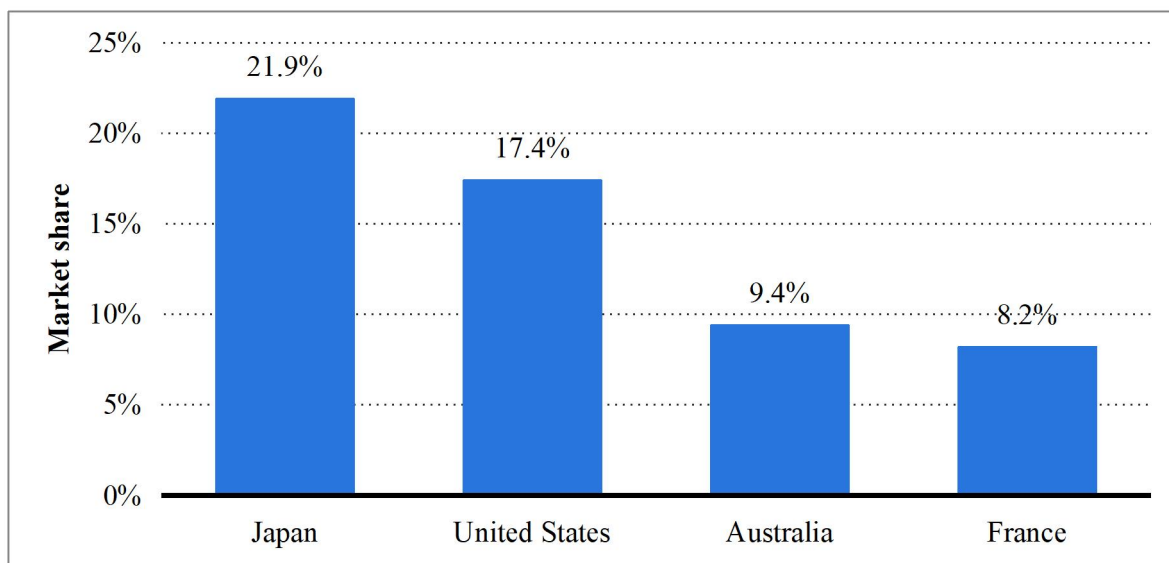


Figure 1.34: Market share of China's import CBEC in 1st half 2023, by country of origin

Note. From *Market share of China's import cross-border e-commerce in 1st half 2023, by country of origin*, by Analysys & China Customs, 2023 (<https://www.statista.com/statistics/1176682/china-ecommerce-cross-border-share-by-country/>).

The stable two-way CBEC trade between China and Japan is largely attributable to high compatibility in product standards, brand recognition, logistics infrastructure, and consumer culture. For instance, Chinese goods are known in Japan for their affordability and diversity—especially in categories such as homeware, consumer electronics, and accessories—while Japanese goods enjoy high brand loyalty among Chinese middle- and high-income consumers due to their perceived quality and craftsmanship.

In addition, platform collaboration has become a key driver of China–Japan CBEC connectivity. Japanese consumers mainly shop via Amazon Japan and Rakuten, while Chinese companies are expanding outbound sales through AliExpress, Tmall Global, and Shopee Japan. Meanwhile, Cainiao Logistics and JD Logistics are rapidly expanding their warehousing and fulfillment networks in Japan, providing strong supply chain support for bilateral e-commerce trade.

In summary, CBEC interactions between China and Japan have already evolved into a mature, high-frequency, bi-directional model. Under the RCEP framework—which promotes tariff reduction, regulatory alignment, and integrated logistics — China–Japan CBEC cooperation is expected to further diversify product categories, improve delivery efficiency, and broaden consumer reach, facilitating a more open, inclusive, and efficient bilateral digital trade system.

2) China–South Korea CBEC Interactions

South Korea is one of China's key CBEC partners under the RCEP framework. The two countries share strong complementarities in product structures, logistics infrastructure, and consumer habits, which have laid a solid foundation for the rapid development of bilateral digital trade.

In terms of exports, China has become a key source of CBEC products for South Korea. According to PPRO (2023), China accounted for 23% of South Korea's CBEC market share in 2022, surpassing the United States (21%) and Japan (9%), underscoring the sustained competitiveness of Chinese goods among Korean consumers (PPRO, 2023).

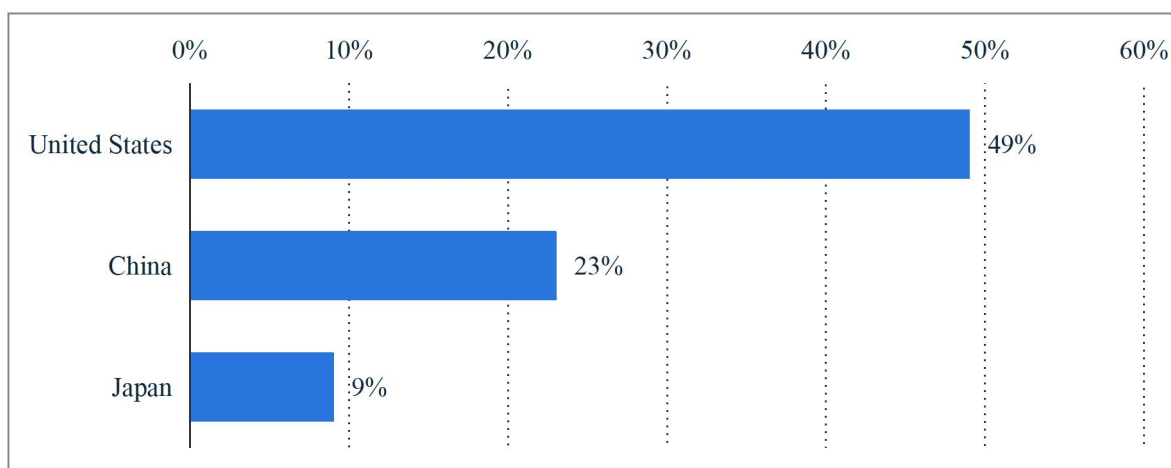


Figure 1.35: Market share of CBEC in South Korea in 2022, by country

Note. From *Market share of cross-border e-commerce in South Korea in 2022, by country*, by PPRO, 2023 (<https://www.statista.com/statistics/1176590/south-korea-e-commerce-cross-border-share-by-country/>).

According to Statistics Korea (2025), China ranked first as the destination of South Korea's direct cross-border online sales in 2024, with a transaction value of ₩977.67 billion, far surpassing the United States and Canada. This result highlights the depth and commercial viability of the China–Korea CBEC linkage (KOSIS, 2025).

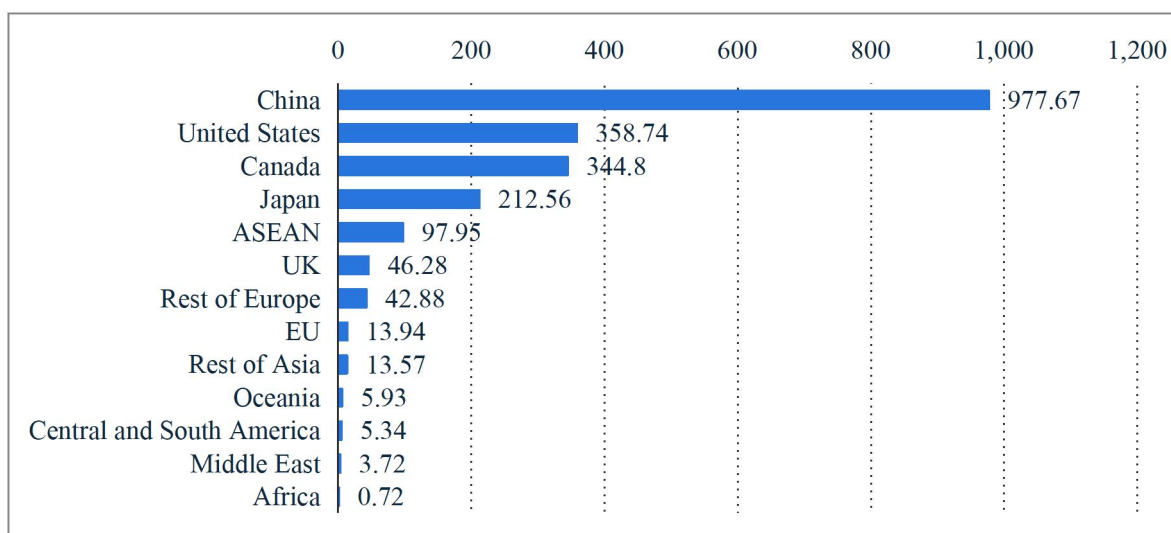


Figure 1.36: Transaction value of direct online overseas sales of South Korea in 2024, by region (in billion South Korean won)

Note. From *Transaction value of direct online overseas sales of South Korea in 2024, by region (in billion South Korean won)*, by KOSIS, 2025 (<https://www.statista.com/statistics/1489825/south-korea-direct-online-overseas-sales-transaction-value-by-region/>).

Chinese exports to South Korea are particularly competitive in sectors such as fast fashion, electronic accessories, cosmetics, and small home appliances. These goods are delivered efficiently through platforms like AliExpress, Shopee Korea, and Coupang. Moreover, logistics collaborations among Cainiao, JD Logistics, and Hanjin Shipping are optimizing cross-border delivery through air-rail intermodal and overseas warehouse models, with average delivery times to Seoul's inner zone reduced to under 72 hours.

On the import side, South Korea is also a major CBEC source country for China. According to the “E-Commerce in China 2022” report by the Ministry of Commerce, South Korea ranked as China's third-largest CBEC import partner, after Hong Kong and Japan, with key imports including beauty products, health supplements, and maternity goods.

Korean brands enjoy strong popularity among Chinese consumers—especially Gen Z and middle-class women. Leading Korean brands such as Amorepacific and LG Household & Health Care maintain strong sales performance on platforms like Tmall Global, JD Worldwide, and Xiaohongshu. As digital consumption habits in the two countries converge, more Korean sellers are embracing livestream e-commerce and private community marketing to localize operations and deepen market penetration.

Overall, China–South Korea CBEC interactions are characterized by two-way product complementarity, diversified platform integration, and cultural alignment in consumption behavior. Under the RCEP framework, mechanisms such as tariff reduction,

customs facilitation, and digital cooperation will further deepen CBEC cooperation between the two nations and unlock greater trade potential.

3) China–ASEAN CBEC Interactions

CBEC cooperation between China and ASEAN countries has deepened in recent years, becoming a vital component of regional digital trade. With the implementation of the RCEP agreement and the advancement of the Belt and Road Initiative, both sides have strengthened cooperation in e-commerce platforms, logistics infrastructure, and policy coordination, driving rapid growth in bilateral trade (China Briefing, 2024).

According to the General Administration of Customs of China, in 2023, China's exports to ASEAN countries totaled RMB 2.03 trillion (approximately USD 283.2 billion), marking a 14.2% year-on-year increase (China Briefing, 2024). Vietnam, Malaysia, and Thailand were China's top three trading partners within ASEAN.

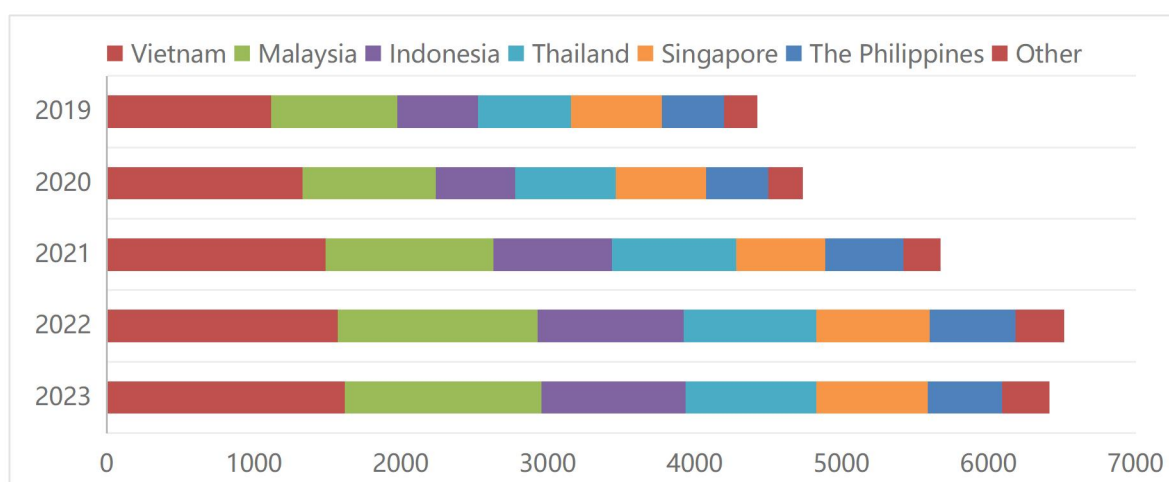


Figure 1.37: China-ASEAN Trade by Country (2019–2023)

Note. From *China-ASEAN Trade by Country (2019 – 2023)*, using data from the General Administration of Customs of China, as cited in China Briefing, 2024 (<https://www.china-briefing.com/news/china-asean-trade-and-investment-relations/>).

In Southeast Asia, Shopee and Lazada are the most popular e-commerce platforms, holding 48% and 16% of the market share respectively (Momentum Works, 2024). Chinese e-commerce platforms such as Alibaba and JD.com are also actively expanding into ASEAN markets, enhancing their influence through investments and partnerships.

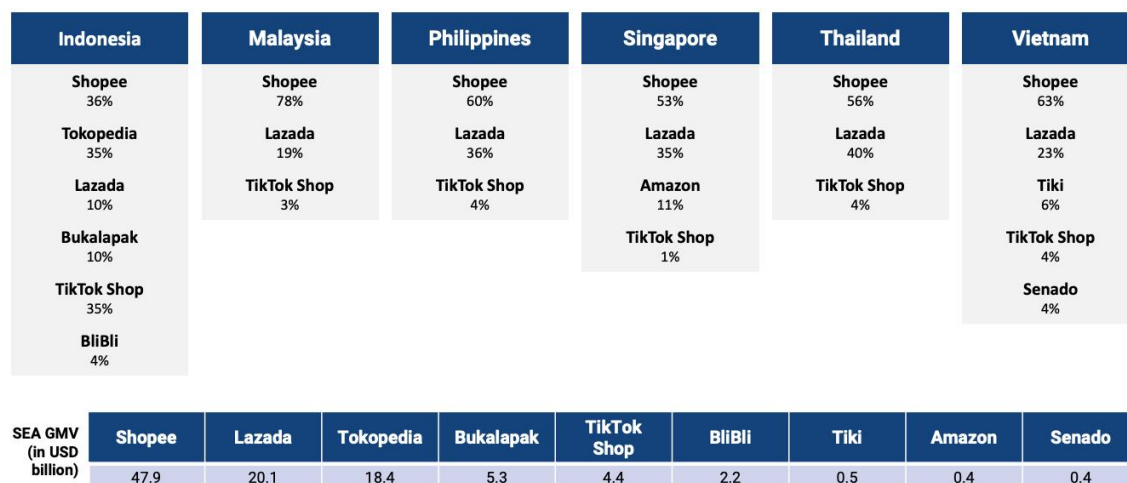


Figure 1.38: Market Share Distribution of Major E-commerce Platforms in Southeast Asia (2023)

Note. From *Ecommerce in Southeast Asia 2023*, by Momentum Works, 2024 (<https://momentum.asia/product/ecommerce-in-southeast-asia-2023/>).

China and ASEAN countries have been strengthening policy coordination in the field of CBEC. The two sides have signed multiple cooperation agreements to promote the formulation of digital trade rules and the unification of standards. Meanwhile, cooperation in digital payment and data interoperability is also deepening (ASEAN Statistical Yearbook, 2023).

Consumers in ASEAN countries actively participate in China's e-commerce festivals, such as "Double 11" and "618". These events have boosted the sales of Chinese

products in ASEAN markets, especially in categories like apparel, electronics, and home goods (Cube Asia, 2024).

The prospects for China–ASEAN cooperation in CBEC are promising. With the improvement of digital infrastructure and the optimization of the policy environment, both sides will achieve mutual benefits in more areas, promoting regional economic integration.

These analyses collectively suggest that China's trade connections with RCEP countries—both in traditional trade and CBEC—are not only well-established but also exhibit strong momentum and untapped potential. The institutional integration brought by RCEP, coupled with digital transformation and post-pandemic recovery, creates a favorable context for CBEC to thrive. These observations serve as a crucial foundation for framing the core research problems addressed in the next section.

1.2 Problem Statement

Over the past decade, the evolution of CBEC has reshaped international trade patterns, emerging as a vital engine for regional economic integration. This trend is particularly pronounced in the Asia-Pacific region, where advances in digital infrastructure, mobile internet penetration, and platform-based trade have fueled CBEC's rapid growth. However, despite the full implementation of RCEP (RCEP) in 2022, the trade potential of CBEC between China and other RCEP member countries remains largely under-identified and insufficiently quantified.

Trade potential refers to the gap between the actual volume of trade and the theoretically attainable trade volume under given institutional conditions, infrastructure levels, and geographical constraints (Nilsson, 2000; Egger, 2002). It captures the unrealized but achievable trade space and serves as a critical metric for assessing a country's trade elasticity and integrative capacity. Accordingly, this study defines CBEC trade potential as the volume of CBEC transactions between China and RCEP member states that remains unrealized but theoretically attainable, assuming no significant changes in capacity, policy, or institutional conditions.

The COVID-19 pandemic has significantly accelerated the digitalization of trade globally, driving both enterprises and consumers to adopt CBEC channels at unprecedented speed. According to Statista (2023), CBEC accounted for over 40.35% of China's total foreign trade volume by 2023, underscoring both strong demand and a structural transformation in trade modalities. As the world's largest trade agreement, RCEP—encompassing around 30% of global GDP and population—offers an unprecedented platform for institutionalizing regional digital trade. For China, it also provides a strategic buffer against external shocks such as U.S.–China trade tensions and offers a pathway to deepen regional integration while reducing overdependence on traditional Western markets.

Simultaneously, global trade dynamics are being reshaped by opposing forces of globalization and deglobalization. Geopolitical tensions, rising protectionism, and the decoupling of global supply chains have pushed countries toward more stable and regionalized trading relationships. In this context, RCEP's emphasis on digital trade

cooperation and institutional harmonization provides a resilient framework for countering fragmentation. Notably, RCEP member states account for more than 34% of China's total exports and over 60% of its total import sources, making the region strategically vital to China's trade structure.

Nevertheless, the full trade potential of CBEC within the RCEP region has yet to be realized, primarily due to three challenges:

First, there is no unified theoretical framework for systematically assessing CBEC development levels across the region.

Second, existing trade potential evaluations remain grounded in traditional trade models and fail to integrate digital trade indicators and platform-based variables.

Third, despite increasing policy support, issues such as institutional misalignment, data flow restrictions, and heterogeneous infrastructure persist, contributing to high transaction costs and operational friction in cross-border activities.

These barriers have significant implications for key stakeholders. For policymakers, they impede deeper economic integration, regulatory coordination, and digital connectivity. For enterprises—particularly micro, small, and medium-sized enterprises—they reflect missed market opportunities and resource inefficiencies due to asymmetric information and fragmented standards. For platform operators, institutional frictions and market fragmentation hinder ecosystem expansion and industrial clustering.

Thus, this study is guided by the following central research question:

“Against the backdrop of RCEP's ongoing institutional optimization, what are the differentiated characteristics of CBEC trade potential between China and its member countries? How can development evaluation indicators and trade potential estimation models be constructed to systematically identify the typology and distribution of trade potential, thereby providing actionable insights for enhancing regional digital trade?”

Addressing this problem will not only contribute to the academic literature but also offer timely, evidence-based insights for designing targeted strategies that promote trade inclusiveness and digital transformation within the RCEP framework. In doing so, it forms the foundation for the research hypotheses developed in Section 2.7.

1.3 Research Questions

In alignment with the research problem identified in Section 1.2, the following research questions are proposed to guide this study:

- 1) What is the level of CBEC development between China and RCEP member countries, as measured by a multidimensional CBEC Development Index?
- 2) What is the trade potential of CBEC between China and RCEP countries — specifically, in terms of import, export, and total trade dimensions—based on the estimated potential scores?
- 3) What are the key factors that significantly influence CBEC trade potential between China and RCEP countries, and how do they vary across countries?

- 4) How do moderating variables such as digital infrastructure and economic development influence the relationship between CBEC development and CBEC trade potential?

These research questions are designed to bridge the research problem and the hypotheses, ensuring a systematic inquiry into the development level, trade potential, influencing factors, and moderating mechanisms within the China – RCEP CBEC framework..

1.4 Objectives of Study

In alignment with the research questions, the primary objective of this study is to assess the CBEC trade potential between China and RCEP member countries. This overarching goal is supported by the following specific objectives, categorized for clarity:

Methodological Objectives

- 1) To construct a CBEC Development Index using Principal Component Analysis (PCA) in order to quantify the CBEC development levels of China and its RCEP partner countries. This index serves as the foundation for evaluating how CBEC infrastructure influences trade outcomes.

Analytical Objectives

- 2) To gauge the import, export and total CBEC trade potential scores between China and RCEP member countries by applying the Extended Gravity Model and

dynamic panel data regression (GMM). This analysis helps identify trade gaps and evaluate alignment between actual and potential trade.

- 3) To identify key determinants of CBEC trade potential, including factors such as CBEC development, economic indicators, and digital infrastructure. This objective supports the theoretical framework by empirically validating factor influence.
- 4) To examine the moderating effect of digital economy development on the relationship between CBEC development and trade potential scores. This reflects how digital readiness shapes the effectiveness of CBEC engagement.

Practical Objectives

- 5) To classify trade potential levels (e.g., ideal, under-trade, sufficient) based on the estimated trade potential scores, providing a basis for policy recommendations. This categorization informs decision-makers on where to target policy interventions.
- 6) To propose targeted policy suggestions for enhancing CBEC trade collaboration within the RCEP framework, especially by addressing digital barriers and trade asymmetries. These recommendations aim to improve regional integration and digital trade inclusiveness.

1.5 Scope and Limitations of the Study

This study focuses on the CBEC trade potential between China and RCEP (Regional Comprehensive Economic Partnership) member countries, covering a ten-year period from 2013 to 2022. The scope is carefully designed to ensure theoretical depth and empirical feasibility, while maintaining relevance to the RCEP framework.

1.5.1 Geographic Scope

The geographic focus includes China and 14 RCEP member countries, namely: Japan, South Korea, Australia, New Zealand, Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

However, due to occasional data unavailability, the empirical analysis in this study focuses on 12 RCEP member countries, excluding Brunei, Myanmar, and Cambodia. These exclusions are due to the lack of consistent panel data, and are compensated using alternative estimation techniques where necessary.

1.5.2 Temporal Scope

The study spans from 2013 to 2022, a period that captures the complete developmental trajectory of CBEC. The year 2013 marks the beginning of China's CBEC 3.0 era, characterized by platformization, government-led pilot zones, and policy-driven international expansion. The selected timeline covers both the early experimental stages and the formal implementation of the RCEP agreement in 2022, including the post-COVID digital trade acceleration period.

1.5.3 Thematic Scope

This research emphasizes: the construction of a CBEC Development Index using multidimensional indicators, the estimation of CBEC trade potential scores (import, export, and total) using the Extended Gravity Model and dynamic panel GMM methods, the analysis of moderating effects such as digital infrastructure and economic development levels.

1.5.4 Excluded Topics

To maintain focus, this study excludes: Consumer behavior studies and micro-level case analysis, Product-level or sector-specific evaluations, Logistics cost modeling and warehousing optimization, Comparative studies with non-RCEP countries.

1.5.5 Data Scope

The analysis uses secondary panel data sourced from the World Bank, Statista, and official Chinese platforms including the Ministry of Commerce. For countries with incomplete data coverage, proxy indicators or imputation methods were applied to ensure methodological robustness.

1.5.6 Practical Relevance

By delimiting the scope to selected RCEP countries and this specific time period, the research aims to provide actionable insights for regional CBEC cooperation, highlighting China's strategic role in fostering digital trade integration across the Asia-Pacific.

Table 1.10: Scope of the Study

Scope Dimension	Description
Geographic Scope	China and 12 RCEP countries (excluding Brunei, Myanmar, Cambodia)
Temporal Scope	2013–2022 (capturing early CBEC 3.0 era in China, policy pilot to post-RCEP era)
Data Scope	Panel data from World Bank, Statista, Chinese official sources; imputation used for some gaps
Key Variables	CBEC Development (PCA composite index), Trade Volume (import/export/total), Moderating Effects (e.g., digital economy, logistics), Control Variables (GDP, distance), Instrumental Variables (border, year)
Excluded Topics	Consumer behavior, sector-specific case studies, warehousing/logistics cost modeling

1.6 Significance of Study

This study carries both theoretical and practical significance in the context of accelerating digital trade under the RCEP framework and enhancing China's role in regional integration. Amidst the post-pandemic recovery and shifting global trade dynamics, the research provides timely insights into the potential of CBEC to drive economic cooperation in the Asia-Pacific.

1.6.1 Theoretical Contributions

Firstly, the study innovatively develops a CBEC Development Index tailored to the RCEP context, enriching the analytical tools available for digital trade research. Unlike traditional trade indices that focus primarily on tariff or infrastructure factors, this index incorporates dimensions such as digital readiness, logistics efficiency, and institutional frameworks. The index draws upon CBEC ecosystem theory, conceptualizing e-commerce as an interdependent system of platforms, regulation, technology, and market access.

Secondly, the study applies an Extended Gravity Model combined with dynamic panel data methods (GMM), extending classical trade theory into the digital trade context. This methodological integration offers a novel approach to measuring trade potential across heterogeneous economies, particularly in developing regions.

1.6.2 Empirical Contributions

The study quantitatively evaluates the import, export, and total CBEC trade potential between China and RCEP countries, offering a classification framework (e.g., under-trade, ideal trade, sufficient trade) that reveals bilateral trade asymmetries. This not only enhances the explanatory power of the research but also allows for systematic benchmarking of each country's digital trade performance.

Moreover, the identification of moderating factors — such as digital economy development and geographic distance — adds nuance to the understanding of structural differences that impact regional e-commerce flows.

1.6.3 Policy and Strategic Value

At the policy level, the findings offer a basis for differentiated cooperation strategies among RCEP countries. Countries with high potential but underutilized trade capacity can be targeted for strategic engagement, supporting the development of bilateral and multilateral CBEC mechanisms.

At the enterprise level, the insights can guide market segmentation, platform optimization, and regional logistics planning. The CBEC Development Index and potential

classifications serve as actionable tools for stakeholders to identify barriers, prioritize investments, and expand cross-border operations.

Overall, the study provides a data-supported foundation for transforming digital trade potential into economic reality—reinforcing China's strategic leadership in shaping the future of CBEC across the RCEP region.

1.7 Organization of Study

This dissertation is organized into five core chapters, each of which contributes to a systematic exploration of the CBEC trade potential between China and RCEP member countries. The structure progresses logically from conceptual foundations to empirical analysis and practical recommendations.

Chapter 1: Introduction

This chapter outlines the research background, defines the research problem, and presents the research questions, objectives, scope and limitations, significance, and hypotheses. It sets the conceptual stage by emphasizing the strategic relevance of CBEC and the RCEP framework, particularly in the context of post-pandemic global trade realignment.

Chapter 2: Literature Review

This chapter reviews key theoretical and empirical contributions related to CBEC, trade potential, and digital trade frameworks. It introduces the CBEC ecosystem theory and

the gravity model as the conceptual foundation of the study, while identifying critical research gaps the dissertation aims to address.

Chapter 3: Methodology

This chapter details the methodological approach, including the construction of the CBEC Development Index using Principal Component Analysis (PCA), data source selection, and application of the Extended Gravity Model with Generalized Method of Moments (GMM) estimation. It also explains the rationale for model selection and variable classification.

Chapter 4: Results and Discussion

This chapter presents the empirical findings of the CBEC Development Index and trade potential estimations for imports, exports, and total trade. It categorizes trade relationships into three types—under-trade, ideal trade, and sufficient trade—and analyzes the determinants and constraints derived from the model outputs.

Chapter 5: Conclusion and Policy Implications

This chapter summarizes the key findings, outlines theoretical and practical contributions, and provides policy recommendations to strengthen CBEC cooperation within the RCEP region. It also discusses the study's limitations and proposes directions for future research.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

In the context of globalization and digital transformation, CBEC has become a significant force reshaping global trade structures. Especially under regional cooperation frameworks such as RCEP (RCEP), CBEC plays a vital role in promoting digital trade connectivity, reducing institutional frictions, and expanding market access. Therefore, understanding the determinants of CBEC development and accurately assessing trade potential among RCEP member countries is not only academically valuable but also practically essential.

This chapter aims to establish a robust theoretical foundation for the study by reviewing relevant literature, synthesizing key theoretical perspectives, and identifying gaps that the present research seeks to address. The discussion is centered on three key tasks: (1) identifying and explaining the core theories that support the study's variables and empirical models, (2) reviewing prior studies on CBEC development evaluation and trade potential estimation, and (3) developing hypotheses grounded in both theory and empirical evidence.

To ensure logical coherence, the chapter is organized into the following sections. Section 2.2 presents the core theoretical foundations supporting the selection of explanatory variables and model design, including the gravity theory, regional economic

integration theory, and the CBEC ecosystem theory. Section 2.3 provides a review of studies evaluating CBEC development and introduces key variables and methodological rationales, such as the use of principal component analysis (PCA). Section 2.4 discusses literature on trade potential estimation, focusing on model selection, classification criteria, and application in the context of digital trade. Section 2.5 reviews recent studies on CBEC in the RCEP region. Section 2.6 outlines the key gaps in the existing literature and highlights this study's theoretical and methodological contributions. Section 2.7 presents the development of research hypotheses. Finally, Section 2.8 summarizes the chapter.

2.2 Core Theoretical Foundations for Model and Variable Construction

2.2.1 Gravity Model and Its Evolution in the Context of CBEC Trade

The gravity model, originally introduced by Tinbergen (1962) and Pöyhönen (1963), remains one of the most widely used theoretical frameworks in international trade analysis. The basic gravity model posits that bilateral trade flows between two countries are positively related to their economic sizes (usually measured by GDP) and negatively related to the geographic distance between them. This intuitive analogy to Newtonian physics has been extensively validated in empirical trade studies and serves as a foundational theory for evaluating trade potential.

As trade patterns evolved, scholars began to recognize the limitations of the basic gravity model, especially in explaining trade under modern globalization and digitalization. This led to the development of the Extended Gravity Model (EGM), which incorporates additional explanatory variables such as institutional quality, cultural proximity, trade

agreements, logistics infrastructure, and digital development. These additions allow the model to better reflect the complexity of contemporary trade mechanisms.

In the domain of CBEC, the traditional assumptions of the gravity model — particularly the deterrent role of physical distance — have been challenged. Digital technologies reduce information asymmetry, streamline logistics, and enable instant cross-border transactions, thereby weakening the traditional role of distance. However, empirical studies show that logistics cost and digital infrastructure still significantly influence CBEC trade volumes. Therefore, the extended gravity model has been widely adopted in CBEC studies, allowing researchers to incorporate variables such as internet penetration, digital infrastructure, customs efficiency, and e-payment readiness.

For example, Blum and Goldfarb (2006) applied an extended gravity model to assess the effect of distance on online trade, arguing that while the internet reduces some frictions, other barriers like language and culture still matter. Similarly, Zheng and Zhang (2021) applied an augmented gravity model to analyze the determinants of China's CBEC exports, confirming the significance of digital infrastructure and bilateral agreements. Wei et al. (2024) further verified the effectiveness of extended gravity specifications in estimating e-commerce flows between China and its trading partners using post-COVID-19 data.

To measure the level of digital readiness across countries, this study incorporates the Digital Economy Index, developed by the Chinese Academy of Social Sciences

(CASS). The index captures the composite performance of digital infrastructure, digital technology, digital governance, and market environment, providing a robust proxy for the digital foundations enabling CBEC trade.

Table 2.1: Representative Applications of the Extended Gravity Model in CBEC Research and Variable Alignment

Author(s) & Year	Context/Focus	Key CBEC Variables Used	Model Type
Blum & Goldfarb (2006)	U.S. online cross-border trade	Language, digital access, culture, distance	Extended Gravity Model
Zheng & Zhang (2021)	China's CBEC exports to Belt & Road countries	GDP, Digital Economy Index, bilateral agreements	Extended Gravity Model
Wei et al. (2024)	Post-COVID CBEC flows between China and partners	Digital infrastructure, logistics, oil-adjusted distance	EGM with CBEC-specific vars
Kimata (2024)	ASEAN digital trade flows	Internet penetration, institutional environment, trade cost	EGM with digital drivers
Jiang & Wang (2017)	CBEC vs. traditional exports in China	Platform factors, trade barriers, customs efficiency	Extended Gravity Model

The application of the extended gravity model in this study allows for a more nuanced assessment of China's CBEC trade potential within the RCEP framework. By integrating CBEC-specific factors and digital economy indicators into the model, the analysis moves beyond traditional goods trade to reflect the dynamics of platform-driven, data-intensive commerce. This evolution aligns well with the research objectives and supports the formulation of hypotheses concerning the relationship between digital capabilities and CBEC import potential.

2.2.2 Regional Economic Integration and the RCEP Framework

The theory of regional economic integration emphasizes the realization of trade liberalization, investment facilitation, and factor mobility among multiple countries

through institutional arrangements. It serves as a crucial theoretical foundation for explaining the potential of CBEC cooperation under the RCEP framework. Compared with traditional theories such as customs unions and free trade areas, RCEP features high flexibility and inclusiveness in its institutional design. It incorporates rules on cumulative origin, tariff concessions, and cross-border data flow, forming a practical path for a "new generation free trade area."

As the world's largest regional trade agreement, RCEP covers 15 Asia-Pacific countries and accounts for approximately 30% of the global population and GDP. The agreement not only reduces average tariffs within the region but also harmonizes emerging trade rules such as e-commerce, intellectual property, and data governance, providing institutionalized space for CBEC development.

According to a CGE simulation by Petri and Plummer (2020), RCEP is expected to increase member countries' annual income by USD 186 billion by 2030, with countries like China, Japan, and South Korea, which have manufacturing-based economies, benefiting the most (Petri & Plummer, 2020). Khan et al. (2022) further noted that China's average export tariffs to RCEP countries are expected to fall from 2.2% to 0.4%, generating economic gains of USD 214 billion, equivalent to 2.2% of GDP, and boosting foreign direct investment inflows by 13.4% (Khan et al., 2022).

Studies by ERIA (2021, 2022) emphasize that RCEP promotes the free flow of goods, services, capital, technology, data, and labor through institutionalized rules, creating

a seamless regional value chain. This framework provides a strategic channel for CBEC development, enhancing the integration and digitalization of the regional market.

Chatterjee (2020) highlighted that RCEP strengthens regional value chains in the Asia-Pacific, enhancing the integration of member states in high-tech manufacturing, services trade, and the digital economy. In particular, the establishment of e-commerce rules and the governance of cross-border data flows provide a regulatory foundation for CBEC development (Chatterjee, 2020).

Furthermore, the economic interdependence between China and RCEP countries has continued to deepen. Zhang (2022) analyzed bilateral trade dependency from 2008 to 2020 and found that China's interactions with ASEAN, Japan, and South Korea have extended beyond traditional manufacturing cooperation to emerging sectors such as digital trade and e-commerce logistics, forming a symbiotic regional economic structure based on interdependence.

In summary, RCEP serves not only as a key platform for regional economic integration but also provides strong theoretical and policy support for assessing the CBEC potential between China and RCEP member states.

2.2.3 Theory of CBEC Ecosystem

The theory of the CBEC ecosystem originates from the broader ecological framework developed in biology and applied to business systems. Tansley (1935) introduced the concept of the ecosystem to describe the dynamic interaction between

organisms and their environment. Moore (1999) extended this idea into business, defining a business ecosystem as a dynamic network of interdependent actors—including firms, suppliers, intermediaries, and governments—that co-evolve their capabilities and roles to align with the direction of the ecosystem.

Drawing upon Moore's framework, Frosch and Gallopoulos (1989) introduced the notion of an industrial ecosystem, highlighting the circulation of materials, energy, and information among production agents. This ecological thinking laid the groundwork for researchers such as Liu (2006) and Hu et al. (2009) to propose the concept of the CBEC ecosystem, where enterprises and institutions collaborate through digital platforms to achieve resource sharing, complementarity, and collective value creation.

According to Li et al. (2018), the CBEC ecosystem can be understood as a complex system comprising five key elements: core species (platform operators), key species (suppliers and consumers), supporting species (logistics, payment, and service providers), parasitic species (opportunistic entities), and the broader digital and institutional environment. The ecosystem's stability and development depend on efficient coordination among these actors and the seamless circulation of goods, information, funds, and services across borders.

This theory is particularly relevant to evaluating CBEC development levels, as it provides a comprehensive lens to construct multi-dimensional indicators. In this study, the CBEC ecosystem theory supports the development of a PCA-based index system by

categorizing variables into structural and ecological dimensions. Key indicators such as cross-border logistics capacity, payment infrastructure, internet penetration, and digital economic scale correspond to supporting or key species in the ecosystem (Li et al., 2018; Zhang, 2021a) .

Moreover, the CBEC ecosystem theory offers a systematic explanation for regional disparities in digital trade capacity by emphasizing institutional environments, platform scalability, and service interoperability. It underlines how differences in species composition and platform dominance can influence trade volumes, logistics efficiency, and cross-border consumer engagement.

In recent years, the CBEC ecosystem theory has also been adopted by global institutions. For instance, the International Chamber of Commerce (ICC) emphasizes the need to build modern digital trade ecosystems that ensure interoperability, resilience, and inclusiveness across borders. The ICC framework underscores the role of harmonized data standards, trust mechanisms, and digital infrastructure in fostering ecosystem-level connectivity for cross-border trade (International Chamber of Commerce, 2021).

Additionally, Wei and Xu (2023) emphasized the multidimensional interactions among infrastructure, policies, and market actors in building sustainable CBEC ecosystems across Asia-Pacific economies. Their empirical findings underline the role of public-private partnerships and regulatory harmonization in ecosystem performance. Similarly, Kimata and Sugiyama (2024) highlighted the contribution of regional digital governance and e-

commerce logistics integration in improving ecosystem resilience and trade adaptability among RCEP countries (Wei & Xu, 2023; Kimata & Sugiyama, 2024) .

In summary, CBEC ecosystem theory not only integrates diverse factors affecting digital trade but also provides a robust conceptual base for constructing CBEC development indicators and framing hypotheses related to trade potential between China and RCEP member countries.

2.3 Research on CBEC Development and Index Evaluation

2.3.1 Key Drivers and Indicator Sources of CBEC Development

Understanding the drivers of CBEC development is crucial for assessing the maturity of cross-border digital trade across economies. This section synthesizes the main influencing factors identified in existing studies and aligns them with the indicator system designed in Chapter 3. These drivers include: digital infrastructure, logistics and payment systems, and market and manufacturing capacity.

2.3.1.1 Digital Infrastructure

Digital infrastructure is widely recognized as a foundational condition for CBEC growth. Core indicators such as internet penetration, broadband subscription rates, and mobile network coverage are used to reflect a country's level of digital readiness. For instance, the "Digital Economy Development Index" employed in this study — sourced from reputable institutions like the Chinese Academy of Information and Communications

Technology—covers elements such as mobile broadband availability, internet usage, and cloud computing application.

Empirical evidence supports these views. Eliana et al. (2018), based on an analysis of 408 CBEC-related papers, identified ICT maturity, smartphone penetration, and access to bank-issued credit cards as key enablers of CBEC development. Using the TOE framework, Nazir and Azam (2020) interviewed managers of Pakistani SMEs and found that communication infrastructure, transaction security, and institutional support played vital roles. UNCTAD (2022) also emphasized the need to establish unified digital metrics—such as ICT usage, e-payment accessibility, and digital literacy—for assessing e-commerce readiness.

2.3.1.2 Logistics and Payment Systems

Efficient logistics and secure payment infrastructure are essential for the operation of CBEC. Relevant indicators include the Logistics Performance Index (LPI), customs clearance time, and cross-border e-payment capabilities, reflecting the capacity to complete international transactions.

Studies by Giuffrida et al. (2017) and Zhang & Ma (2015) identified lengthy delivery times and underdeveloped localized logistics as key bottlenecks. Yang & Yu (2014) also highlighted poor customs coordination and high logistics costs as major barriers to business participation in CBEC platforms. A 2023 Avalara survey reported that over 70%

of respondents saw logistics reliability and payment convenience as prerequisites for engaging in CBEC.

2.3.1.3 Market and Manufacturing Capacity

This dimension measures both the size of the consumer market and the production capabilities of the industrial system. Typical indicators include total population, per capita GDP, total exports, and manufacturing value-added—representing both supply and demand potential.

Zhang, Lu, and Li (2019) found that internet penetration, policy support, and logistics performance were the three primary drivers of China's CBEC development. Zhang & Wang (2019), using panel data from 2012 to 2017, found that importers' market openness, tourist flows to China, and bilateral trade distances significantly influenced CBEC exports. Gomez-Herrera et al. (2014) proposed adding legal governance quality and parcel delivery costs as digital-era trade determinants. Cognitive Market Research (2024) highlighted regional market expansion and manufacturing upgrades as key growth drivers in Asia-Pacific CBEC.

Together, these factors form the theoretical foundation for the indicator system developed in the next chapter. The effective mapping between theoretical drivers and variable construction enhances the credibility of the CBEC development index.

2.3.2 Review of Evaluation Methods for CBEC Development

2.3.2.1 Evolution of CBEC Evaluation Indicator Systems

To systematically assess CBEC development across countries, scholars have gradually established multidimensional evaluation frameworks, integrating macroeconomic and digital variables to gauge e-commerce readiness and capacity.

The OECD (1999) proposed measuring e-commerce across three dimensions: readiness, application, and impact. The APEC (2000) "E-Commerce Readiness Initiative" built an index system spanning six areas: infrastructure, connectivity, human capital, digital economy performance, internet application levels, and promotional activities.

Subsequent studies refined these systems to better suit CBEC scenarios. Martens & Turlea (2012) incorporated transaction cost savings, logistics models, and payment accessibility. Asosheh et al. (2012) proposed a three-layered framework — content, information, and business process—for CBEC evaluation.

In the Chinese context, Yang, Zheng, and Yang (2014) developed a five-dimension, 15-indicator system and used factor analysis to rank nine provinces. Zhao & Yang (2014) evaluated CBEC development using a sample of SMEs from Guangdong and Zhejiang. Su & Wang (2017) applied the AHP method to rank 13 CBEC pilot cities. Li, Chen, and Qin (2020) used fuzzy network analysis to identify key constraints and recommendations. Zhang (2021b) adopted the TOPSIS method to construct a performance model for overseas

warehouse services. Song (2021) used PCA to quantify CBEC development across China and ASEAN.

More recent studies, such as those by UNCTAD (2022), emphasize the need for harmonized CBEC indicator systems across nations, incorporating infrastructure, trade facilitation, and financial access. Reports by Avalara (2023) and Cognitive Market Research (2024) recommend integrating market potential, regulatory environment, and consumer behavior to create a comprehensive evaluation framework.

2.3.2.2 Comparative Analysis of PCA and AHP Methods

To ensure a scientifically robust and operationally feasible indicator system, two major approaches are frequently employed in CBEC evaluation research: Principal Component Analysis (PCA) and the Analytic Hierarchy Process (AHP), corresponding respectively to data-driven and expert-driven logics.

Principal Component Analysis (PCA) is a statistical technique for data dimensionality reduction. It extracts key components from a large set of correlated variables while minimizing information loss. Jolliffe and Cadima (2016) highlighted the method's wide applicability in economic and social sciences, particularly for comparative studies involving multiple dimensions. Yoseph (2023) emphasized PCA's advantages in terms of robustness, replicability, and suitability for international benchmarking, making it increasingly common in public management, digital economy, and e-governance evaluations.

The Analytic Hierarchy Process (AHP), introduced by Saaty (1980), is a subjective weighting method based on expert judgments. It involves constructing pairwise comparison matrices, performing consistency checks, and assigning weights, making it ideal for clearly structured yet expert-sensitive indicator systems. Zyoud and Fuchs-Hanusch (2017) noted its widespread use in sustainability assessments and multi-criteria decision-making, especially in policy analysis and small-sample contexts.

However, AHP suffers from several limitations, including bias from expert preferences, inconsistent judgments, and limited reproducibility, which pose challenges in large-scale, high-dimensional, cross-country research contexts. In contrast, PCA's objectivity and standardization are better suited for this study's goal of quantifying CBEC development across 15 RCEP member countries.

Accordingly, this research employs PCA to construct the CBEC Development Index, categorizing variables into ecosystem-based dimensions—such as core species and supporting species—thereby aligning theoretical structure with empirical modeling.

This methodological rationale enhances the reliability of the index system and reinforces the theoretical-explanatory basis of indicator selection.

2.4 Empirical Studies on Trade Potential Evaluation

2.4.1 Classification Methods and Thresholds of Trade Potential

In empirical studies of bilateral or multilateral trade potential, the most widely adopted approach is the ratio of actual trade value to theoretical trade value, derived from

extended gravity models. This ratio serves as a critical metric to assess whether trade between two economies is underperforming, matching expectations, or exceeding its potential, thereby guiding both academic interpretation and policy decisions (Nilsson, 2000; Egger, 2002).

A common refinement of this approach is the "benchmark interval method", which establishes clear thresholds for classifying trade potential. Batra (2006) initially proposed using 1 as the neutral benchmark: when actual trade equals predicted trade, the bilateral relationship is considered balanced. A ratio below 1 implies unexploited potential, while a ratio above 1 may suggest overtrading.

Building upon this, recent empirical studies—such as Shuai (2021), Guo & Mai (2023), and Zhang & Wang (2023)—have adopted the 0.8 – 1.2 interval classification, which divides trade potential into three categories:

- 1) Significant potential (ratio < 0.8): significant untapped potential exists;
- 2) Exploratory potential (ratio between 0.8 and 1.2): trade is near optimal, aligned with model expectations;
- 3) Reconstructive potential (ratio > 1.2): trade exceeds model predictions, possibly indicating saturation or structural overperformance.

This classification method has proven particularly effective in analyzing trade under the RCEP framework. For instance, Guo and Mai (2023), in their study on China's trade potential in photovoltaic products with RCEP countries, applied this ratio-based

categorization and found that nearly half of the examined partners fell into the under-trade category. Similarly, Zhang & Wang (2023) applied the same method to assess China's agricultural exports, demonstrating its applicability across both digital and traditional trade sectors.

Some scholars have also employed the Stochastic Frontier Analysis (SFA) model to estimate a trade efficiency frontier, offering an alternative that considers deviation from the optimal trade boundary. However, SFA requires strong assumptions about data distribution and complete datasets, making it less feasible for many CBEC contexts.

In conclusion, the trade potential ratio, combined with the 0.8 – 1.2 interval classification, provides a reliable and interpretable method for quantifying and categorizing trade potential. This approach not only strengthens the explanatory power of gravity model-based evaluations but also forms a robust methodological basis for subsequent classification and policy formulation.

2.4.2 Empirical Applications of Gravity Model in Trade Potential Estimation

Since its introduction by Tinbergen (1962) and Pöyhönen (1963), the gravity model has become one of the most influential empirical tools in international trade research. The model posits that bilateral trade flows are positively correlated with the economic size (typically measured by GDP) of the trading partners and negatively correlated with the geographical distance between them. Its structural clarity and theoretical robustness have

made it widely adopted for estimating trade potential (Kong & Dong, 2015; Zhang, Zhang, & Zhang, 2016).

However, with the rise of CBEC and digital trade, scholars have increasingly questioned the model's applicability. In borderless and dematerialized trade contexts like CBEC, traditional variables such as GDP and physical distance are insufficient to explain the underlying trade mechanisms. Nilsson (2000) and Egger (2002) introduced a ratio-based method for measuring trade potential — defined as the gap between actual and theoretical trade volumes—laying the theoretical foundation for subsequent CBEC-specific applications.

To better reflect the dynamics of trade in the digital economy, scholars have expanded the model's variable structure. For example, Wei (2024) incorporated internet penetration, the share of employment in services, and political stability into the gravity model when evaluating China's CBEC export potential to RCEP member countries. The study found these non-traditional variables to significantly influence trade potential, better capturing the digital readiness of partner economies.

At the same time, some researchers have critically reflected on whether the gravity model remains appropriate for CBEC scenarios. Kimata (2024) argued that the low marginal cost, real-time responsiveness, and decentralized nature of CBEC diminish the explanatory power of physical distance. Instead, he advocated for the inclusion of

institutional variables such as cybersecurity standards, cross-border payment infrastructure, and data governance rules to enhance model accuracy and contextual relevance.

In terms of methodological approaches, two common estimation techniques are widely adopted. The first is the extended gravity model, which calculates theoretical trade volumes based on regression outputs and compares them to actual trade to derive a potential index. The second is the Stochastic Frontier Gravity Model (SFGM), which estimates a trade efficiency frontier and calculates the maximum attainable trade volume (Zhou & Zheng, 2018). Due to its simplicity and interpretability, the extended gravity model remains the more widely used method in empirical studies.

Several studies have highlighted that omitting key digital variables — such as platform penetration rates and logistics efficiency — may lead to overestimating CBEC potential in underdeveloped markets. Conversely, incorporating such factors significantly improves the predictive power and explanatory capacity of the model (Chen, 2020; Jiang, Wang, & Li, 2017).

In conclusion, the application of the gravity model in CBEC trade potential estimation is evolving from a traditional “physical-variable dominant” approach to one that integrates both structural and digital indicators. This methodological shift not only enhances the theoretical robustness of trade potential modeling in digital trade contexts but also provides a sound empirical foundation for this study's estimation of CBEC trade potential between China and RCEP member countries.

To contextualize this modeling approach within a regional framework, the next section reviews empirical studies on CBEC development and trade interactions under the RCEP agreement.

2.5 Studies on CBEC in RCEP Region

Since the formal implementation of RCEP, CBEC in the region has entered a new phase of institutional advantage. As the largest economy in RCEP, China has deepened CBEC cooperation with ASEAN, Japan, South Korea, Australia, and New Zealand in various dimensions, including expanded export scale, improved logistics frameworks, and optimized platform services. According to Zheng and Xiao (2021), RCEP has driven China's CBEC import and export growth while facilitating innovations in customs clearance and regulatory mechanisms. Using a CGE model, Itakura (2015) forecasted that trade liberalization and investment growth under RCEP would significantly enhance GDP across ASEAN member states, revealing strong regional synergy effects.

Furthermore, several studies have examined the impact of RCEP from the perspectives of tariff reduction, non-tariff barriers, and regulatory alignment. Li, Wang, and Whalley (2014) used a general equilibrium model incorporating endogenous trade imbalances to compare the outcomes of multiple mega-regional trade agreements. They found that RCEP provided the most favorable results for China in terms of welfare, trade, and imports. Liu and Chen (2014), employing the GTAP simulation, confirmed the significant economic gains from reducing technical trade barriers under RCEP. Zhao and Chen (2015) highlighted RCEP's superior economic and welfare effects compared to the

China-Japan-Korea FTA. Ratna and Huang (2016), using a gravity model, empirically showed that the reduction of non-tariff measures (including technical standards and customs procedures) had a greater effect on promoting exports than tariff cuts alone.

In the CBEC domain, recent empirical studies have further enriched the field. Guo (2023), while analyzing China's trade potential in renewable energy products within RCEP, emphasized the need to strengthen digital trade infrastructure to support non-traditional CBEC exports. Liu and Sun (2023) conducted a multi-country e-commerce data comparison and found that while China holds a scale advantage in CBEC exports to the RCEP region, the penetration rate of service-based digital goods remains low, and platform ecosystems—particularly those serving SMEs in Southeast Asia—are underdeveloped.

However, existing literature still has notable gaps. First, most studies adopt an export-centric perspective, with limited analysis of China's CBEC import patterns within the RCEP framework. Second, the dominant analytical unit remains the nation-state, overlooking the growing role of platform-based actors such as Alibaba, Shopee, and Lazada in restructuring regional e-commerce networks. Moreover, institutional comparative studies at the micro-level are scarce, leaving the mechanisms of platform governance and policy interoperability underexplored.

Nonetheless, current research provides important theoretical and empirical support for this study, including insights into platform-driven CBEC structures, institutional facilitation mechanisms, and market potential identification approaches. These works also

affirm RCEP's strategic value to China as a core digital trade circle with strong institutional advantages and market prospects.

In summary, while macro-level analyses have laid a solid foundation, future research must address critical gaps in micro-level behavior, import-side dynamics, platform interactions, and intra-regional digital trade comparisons. This study aims to fill these voids through the construction of development indices and trade potential estimation models, enabling a more precise and actionable evaluation of China – RCEP CBEC interactions.

2.6 Research Gaps and Contributions

With the rapid rise of CBEC as a key driver of regional trade, existing literature has made progress in exploring CBEC development, platform ecosystems, and the application of traditional trade models. However, notable deficiencies remain in the areas of theoretical integration, methodological approaches, and empirical perspectives. This section identifies three critical research gaps and clarifies the theoretical and practical contributions of this study.

- 1) Theoretical Gap: Lack of an Integrated Framework Combining CBEC and the Gravity Model

Most CBEC studies to date have focused on market dynamics, platform operations, or supply chain optimization, but have rarely established a systematic framework that incorporates the gravity model into digital trade potential assessment. Particularly in the

context of regional economic integration, how to effectively integrate key variables such as digital infrastructure, platform capacity, and institutional environment into the classical gravity model remains underexplored. Existing theoretical work remains fragmented, lacking a cohesive linkage from theoretical foundation to variable system and empirical modeling.

2) Methodological Gap: Limited Application of PCA-GMM Integration

Many prior studies rely on static models such as OLS regression, AHP, or entropy methods, while the combination of Principal Component Analysis (PCA) and Generalized Method of Moments (GMM) remains underutilized. Especially from a regional trade perspective, few studies have compressed multidimensional development variables into an index and connected them to trade flow modeling. The current research lacks a comprehensive design path that simultaneously addresses multicollinearity and assesses trade potential under dynamic conditions.

3) Empirical Gap: Inadequate Coverage of Import Perspective and Digital Variables

Empirical analyses of CBEC have largely centered on exports or China's trade with individual countries, while systematic evaluations from the import perspective remain scarce. This oversight neglects the role of consumer-side factors in shaping trade potential. Additionally, although some studies incorporate digital variables, they often rely on single-dimensional indicators and fail to reflect the structural features of the digital economy. A

comprehensive mapping of digital finance, information infrastructure, and institutional environment into the evaluation system is still lacking.

This study offers the following key contributions:

- 1) Theoretical Contribution: It integrates the CBEC ecosystem theory, regional economic integration theory, and the extended gravity model to construct a holistic analytical framework for digital trade potential evaluation.
- 2) Methodological Contribution: It innovatively adopts a dual-track approach combining PCA-based development indices and GMM-based gravity modeling, enabling a coherent linkage between CBEC development levels and trade potential.
- 3) Empirical Contribution: It includes both export and import perspectives, addressing a major gap in CBEC literature, and enhances the structured representation of digital variables.
- 4) Policy Relevance: It provides quantifiable evidence for differentiated digital trade strategies between China and RCEP member countries, supporting high-quality development of CBEC under regional integration frameworks.

2.7 Hypotheses Development

Based on the literature review and the integrated theoretical framework, this study proposes six testable hypotheses to explore the determinants of CBEC trade potential between China and RCEP member countries.

Table 2.2: Summary of Research Hypotheses, Variable Paths, and Theoretical Foundations

Hypothesis	Variable Path	Theoretical Foundation	Explanation
H1	CBEC development level in China → CBEC import trade volume	CBEC Ecosystem Theory	A well-developed CBEC ecosystem in China—including platforms, payment, and logistics—facilitates the inflow of goods from RCEP countries, boosting import volumes.
H2	CBEC development level in RCEP countries → CBEC export trade volume from China	CBEC Ecosystem Theory	Higher digital maturity and infrastructure in RCEP countries support seamless access to Chinese CBEC platforms, increasing their capacity to import from China.
H3	CBEC development in China and RCEP countries → Total bilateral CBEC trade volume	CBEC Ecosystem Theory + Regional Integration Theory	Joint development of digital trade ecosystems enhances interoperability and reduces friction, promoting overall trade flows.
H4	Geographic distance → Total CBEC trade volume (negative effect)	Extended Gravity Model	Despite the virtual nature of CBEC, logistics costs and delivery time remain relevant, especially in countries with underdeveloped infrastructure.
H5	Digital Economy Index × CBEC development → CBEC import volume (moderation effect)	Extended Gravity Model (digital extension)	Countries with highly developed digital economies may rely more on domestic platforms, weakening the impact of China's CBEC infrastructure on imports.
H6	Per capita GDP of RCEP countries → CBEC export trade volume from China	Extended Gravity Model	Wealthier countries typically have stronger consumer purchasing power, driving greater demand for CBEC imports from China.

2.8 Chapter Summary

This chapter provided a comprehensive overview of the theoretical foundations, variable constructs, and empirical modeling strategies that underpin this study. Specifically, the Extended Gravity Model, Regional Economic Integration Theory, and CBEC Ecosystem Theory were introduced as the core theoretical pillars to support trade modeling, RCEP contextualization, and CBEC development index construction, respectively.

Additionally, recent literature was reviewed to identify key drivers of CBEC development, which informed the construction of a CBEC Development Index using the

PCA method. The chapter also explored the concept and classification of trade potential, highlighting both benchmark-based classification methods and the evolving application of the gravity model in CBEC scenarios.

Through a critical review of China – RCEP CBEC interaction patterns, several gaps were identified:

The evaluation of CBEC development in the RCEP region lacks a comprehensive and systematic indicator framework;

Existing studies are predominantly export-focused, with limited attention to import-side dynamics and platform-based variables;

Many models still rely on traditional macroeconomic variables, neglecting digital economy dimensions and institutional factors.

Accordingly, this study contributes by integrating relevant theories, enhancing modeling approaches, and introducing new variables, thereby addressing key gaps in theory, methodology, and empirical scope. The next chapter outlines the research design, variable definitions, and empirical framework used to systematically evaluate CBEC trade potential between China and RCEP member countries.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In the previous chapter, the theoretical foundation and existing related research were discussed, which identified the shortcomings in the current literature. This chapter outlines the methodology used to analyze the development levels and trade potential of CBEC between China and its RCEP (Regional Comprehensive Economic Partnership) partner countries. The chapter covers data sources, variable selection, model specifications, and estimation techniques employed in the study. The primary goal is to provide a robust analytical framework that can effectively assess the CBEC development levels and estimate CBEC trade volumes and potential scores.

3.2 Research Framework and Methodological Rationale

To bridge the theoretical foundations and empirical design, this section introduces the methodological rationale and conceptual framework of the study. It first explains the reasons for choosing PCA and GMM, followed by a diagrammatic representation of the overall research structure.

3.2.1 Justification for Methodological Choices

To ensure alignment between the research objectives and analytical strategies, this study adopts Principal Component Analysis (PCA) and the System Generalized Method of

Moments (System GMM) as its core methodological approaches. These methods are well-established in empirical research and are particularly suitable for addressing multidimensional variable structures and endogeneity issues inherent in this study.

First, PCA is applied to construct a composite index representing the CBEC development level of RCEP member countries. Given that the development level comprises a large set of interrelated variables, directly introducing them into the regression model would likely result in multicollinearity problems, undermining estimation accuracy. PCA serves as an objective dimensionality reduction technique that transforms correlated variables into uncorrelated principal components, preserving the core information while avoiding subjective weight assignments. Its statistical rigor and replicability make it widely applicable in cross-country assessments of digital economy and e-commerce performance (Jolliffe & Cadima, 2016).

Second, System GMM is employed to estimate the CBEC import, export, and total trade potential between China and RCEP partner countries. GMM is particularly well-suited for dynamic panel data models with a short time span (small T) and multiple cross-sectional units (large N), which is the case for this study (Arellano & Bond, 1991) (Blundell & Bond, 1998). It effectively addresses endogeneity by using internal instruments—typically lagged values of the endogenous variables—while controlling for unobserved heterogeneity. Given the persistence of trade volumes and the possibility of bidirectional causality between economic variables and CBEC trade, GMM provides

consistent and asymptotically efficient estimates that static panel models (e.g., OLS, fixed effects) cannot ensure.

In analyzing the relationship between CBEC development and trade potential, this study acknowledges the presence of dynamic interactions and potential endogeneity, particularly regarding the lagged effects of CBEC development on subsequent import and export performance. Static panel methods such as OLS or fixed effects are limited in capturing these dynamic processes and may yield biased estimates due to endogeneity between explanatory variables and the error term.

To address these concerns, the study adopts the System Generalized Method of Moments (System GMM), which offers strong capabilities for controlling unobserved heterogeneity and correcting for endogeneity. Although the dataset has a relatively small N and T, the study mitigates potential limitations by constructing valid internal instruments, aggregating time periods, and conducting robustness checks.

Overall, the combination of PCA and GMM aligns with the study's empirical goals—dimension reduction and potential estimation—and provides a reliable framework for evaluating China's CBEC trade potential with RCEP member countries. In summary, the combined use of PCA and GMM is methodologically sound and analytically aligned with the objectives of this research. This integrated approach offers both conceptual coherence and empirical robustness for evaluating the CBEC trade potential between China and RCEP member countries.

3.2.2 Conceptual Framework

Building on the methodological rationale presented above, this section introduces the conceptual framework that underpins the empirical models of this study. It illustrates the theoretical structure and the interrelationships among key variables, providing a coherent logic for model design (Camp, 2001). According to Kitchel and Ball (2014), a conceptual framework reflects a substantive theory with a well-justified selection of variables.

Figure 3.1 presents the Research Methodology Flowchart, visually summarizing the three major analytical stages of the study: index construction via PCA, trade modeling via GMM, and trade potential score estimation. It also illustrates the role of TIMG as a moderating variable and links each component to the empirical objectives of the study.

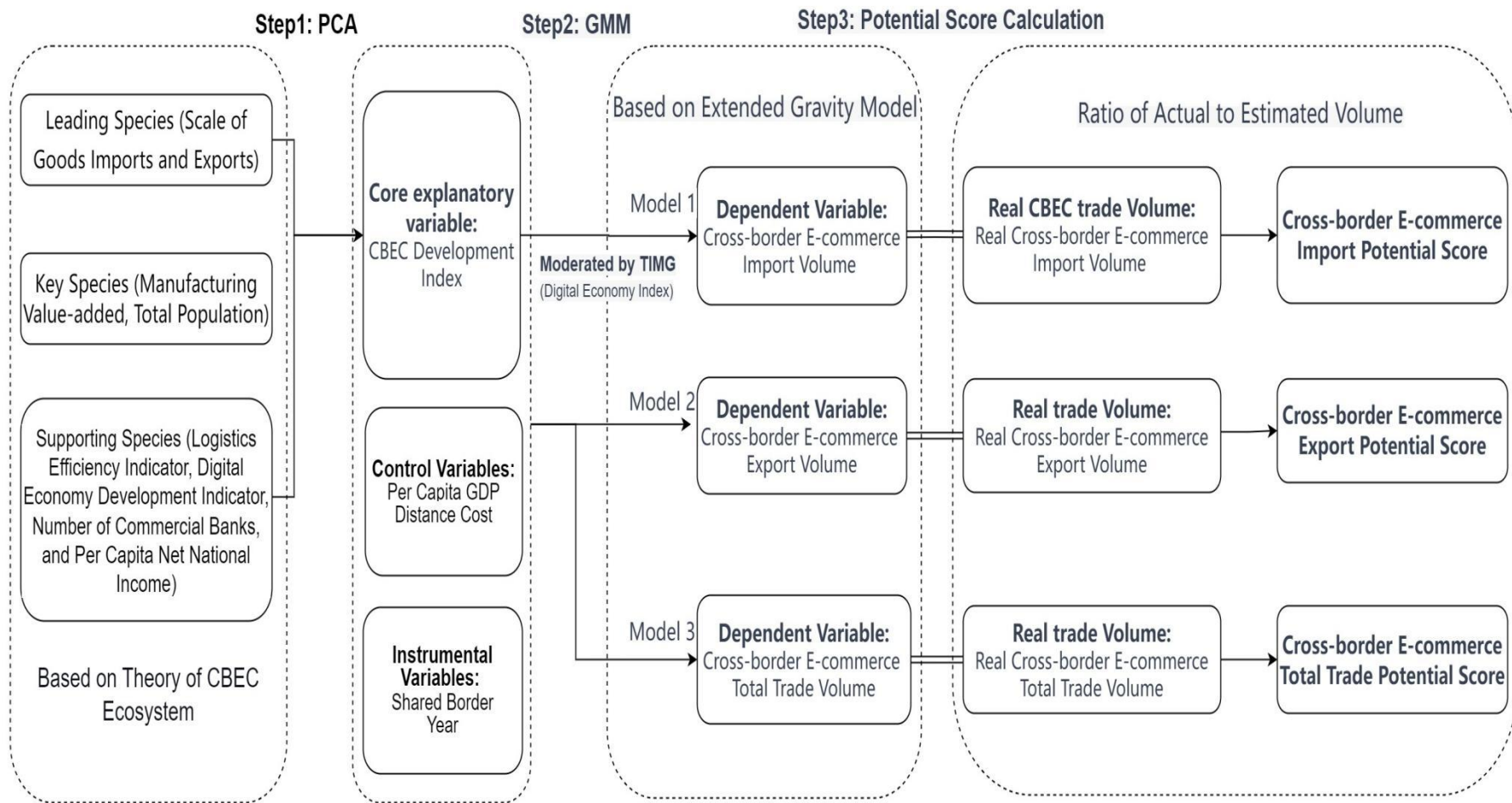


Figure 3.1: Conceptual Framework of Study

According to the CBEC ecosystem theory, the ecosystem consists of leading, key, and supporting species. Leading species represent CBEC platforms, but due to the difficulty in obtaining platform data, the indicator for core species is represented by the scale of goods imports and exports. Key species are suppliers and consumers, and their indicators are represented by manufacturing value-added and total population, respectively. Supporting species include logistics, information flow, and capital flow, and their indicators are represented by logistics efficiency, digital economy development, and the number of commercial banks and per capita net national income, respectively. With these indicators, the CBEC ecosystem is constructed.

The research framework diagram starts from the theory of the CBEC ecosystem and uses Principal Component Analysis (PCA) to extract the level of CBEC development as the core explanatory variable. The Extended Gravity Model includes three sub-models, each corresponding to different dependent variables (import volume, export volume, and total trade volume), and utilizes the system Generalized Method of Moments (GMM) method to estimate the models.

By calculating the differences between actual CBEC trade volumes and theoretical values, the import, export, and total trade potential scores of CBEC are obtained.

3.2.3 Mapping Research Objectives to Methodological Steps

To clarify how the study systematically addresses each research objective, Table 3.1 provides an explicit mapping between the stated objectives and the corresponding

methodological steps. The table categorizes the objectives into methodological, analytical, and practical levels and aligns them with specific empirical tasks—such as CBEC index construction using PCA, trade potential estimation via GMM, and trade potential classification through benchmark comparison. This mapping demonstrates how each stage of the empirical process is designed to fulfill the overarching goals of the research in a coherent and structured manner.

Table 3.1 Mapping between Research Objectives and Methodological Steps

Research Objectives	Methodological Steps
1) To construct a CBEC Development Index using PCA.	Step 1: Select CBEC ecosystem-based indicators → Standardize data → Conduct PCA to generate development index.
3) To estimate CBEC trade potential (import/export/total) using GMM.	Step 2: Specify extended gravity models → Use System GMM estimation to model 1, 2 and 3.
3) To identify key determinants of CBEC trade potential.	Step 2: Include variables such as CBEC index, GDP, distance, and digital indicators as regressors.
4) To examine the moderating effect of digital economy development (e.g., TIMG).	Step 2: Introduce interaction term between China's CBEC index and partner countries' TIMG index in import model.
5) To classify trade potential levels using threshold rules.	Step 3: Compare actual vs. predicted CBEC trade volumes → Apply 0.8–1.2 benchmark rule to categorize potential.
6) To provide policy recommendations for enhancing RCEP CBEC collaboration.	Step 3 + Chapter 5: Interpret results → Identify mismatches and asymmetries → Develop targeted strategic and policy suggestions.

3.3 Description of Methodology Approaches

3.3.1 Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is employed to assess the level of CBEC development among RCEP member countries.

PCA is a widely utilized technique for dimensionality reduction in multivariate data. It aims to map high-dimensional data onto a lower-dimensional space to capture the

primary variance inherent in the original data. Through linear transformation, PCA converts the original variables into a set of new variables called principal components. These principal components are linear combinations of the original variables and are orthogonal to each other.

The main steps and concepts of PCA are outlined as follows:

3.3.1.1 Data Suitability Testing

For each variable to be included in the indicator system, strong correlation is required for PCA. Therefore, in measuring the level of CBEC development, this study will conduct KMO (Kaiser-Meyer-Olkin) test and Bartlett's test of sphericity for 14 variables: goods export value, goods import value, manufacturing value-added, mobile phone users, logistics service efficiency index, international freight efficiency index, customs clearance efficiency index, destination country delivery efficiency index, digital technology index, digital infrastructure index, digital market index, digital government index, number of commercial banks, and per capita gross national income.

KMO Test (Kaiser-Meyer-Olkin Test): The KMO test evaluates the suitability of PCA, particularly to determine if the data sample is suitable for principal component analysis. It calculates the correlations among the variables in the sample and assesses the ratio between their common variance and independent variance. The KMO value, ranging between 0 and 1, signifies the suitability for conducting PCA. Higher values indicate a more favorable suitability for PCA analysis.

Bartlett's Test of Sphericity: Bartlett's test of sphericity examines whether the data's correlation matrix is an identity matrix (spherical structure). In PCA, we assume that the variables are correlated, so the data's correlation matrix should not be an identity matrix. Bartlett's test compares the data's correlation matrix with an identity matrix to determine if PCA is appropriate. If the test result is significant, it indicates that the data's correlation matrix is not an identity matrix and PCA is suitable.

3.3.1.2 Data Standardization

Since 13 correlated indicators were selected for measuring the level of CBEC development, there are differences in the trend and magnitude of each indicator. To facilitate factor analysis, the data is first standardized using the range method. This transformation involves converting the data into a standardized normal distribution, characterized by a mean of 0 and a standard deviation of 1. This process eliminates the unit difference between different indicators and ensures data is analyzed on the same scale. The specific formula is as follows:

$$S_i = \begin{cases} 0, & c_i \leq c_{imin} \\ \frac{c_i - c_{imin}}{c_{imax} - c_{imin}}, & c_{imin} < c_i < c_{imax} \\ 1, & c_i \geq c_{imax} \end{cases} \quad \text{Equation 3.1}$$

3.3.1.3 Calculation of Eigenvalues and Eigenvectors

The standardized data is used to calculate the correlation matrix, and then eigenvalue decomposition is performed to find the corresponding eigenvalues and eigenvectors.

3.3.1.4 Selection of Principal Components

Based on the magnitude of the eigenvalues, the principal components that explain the variables are chosen. Typically, principal components with eigenvalues greater than 1 are selected, as they can explain most of the variance in the original variables.

3.3.1.5 Calculation of Principal Component Scores

Using the selected principal components, the principal component scores for each sample are calculated, yielding new and independent variables.

3.3.2 Generalized Method of Moments (GMM)

In this study, dynamic panel models are employed to analyze the potential for CBEC trade between China and RCEP partner countries. Leveraging GMM estimation methods to analyze panel data serves to surmount the challenges posed by endogeneity, thereby enhancing the robustness of the analytical framework.

The Generalized Method of Moments (GMM), introduced by Hansen (1982), constitutes a statistical estimation paradigm that centers on approximating the population moment function through sample moment functions to achieve parameter estimation. This methodology has found extensive utilization in diverse domains, notably economics and statistics, particularly when confronted with situations marked by incomplete information or imprecise models.

A notable expansion of the Generalized Method of Moments emerges in the form of the GMM estimation method. Drawing upon the foundational concept of generalized

moment estimation, the GMM methodology hinges on the fulfillment of moment conditions by parameters embedded within a given model. This is facilitated through the maximization of an objective function to achieve parameter estimation. GMM techniques have garnered significant traction in the field of economics, encompassing tasks such as parameter estimation, model selection, and hypothesis testing. Their relevance becomes evident within the framework of dynamic panel data models.

In contrast to static panel models, dynamic panel models offer distinct advantages. Firstly, they provide a means to address heterogeneity effects among countries through methods such as system GMM estimation. Remarkably, within the context of the 15 member countries of RCEP (RCEP), considerable dissimilarities exist in terms of geographical location, religious affiliations, and socioeconomic systems. These enduring or evolving factors exert substantial influence on economic growth, and dynamic panel models offer partial alleviation of the impacts stemming from country-specific heterogeneity. Secondly, in scenarios where variables such as economic development exhibit bidirectional causal relationships with CBEC import and export trade, dynamic panel models prove advantageous. By employing lagged CBEC trade volume as an instrumental variable, these models help mitigate bidirectional causality concerns and subsequently address endogeneity issues.

Blundell and Bond (1998) highlighted that first-differenced GMM and level GMM estimations can sometimes suffer from weak instrument problems, leading to significant bias in GMM estimation results. To address this issue, they proposed a more effective

estimation method called the System GMM estimation, which combines the instruments from first-differenced GMM and the partial instruments from level GMM, generating a larger set of moment conditions.

For the panel data autoregressive model:

$$y_{it} = \alpha y_{it-1} + \varepsilon_i + \mu_{it}; \quad v_{it} = \varepsilon_i + \mu_{it}; \quad i = 1, \dots, N; \quad t = 1, \dots, T. \quad \text{Equation 3.2}$$

Where $y_{i1} = \frac{\varepsilon_i}{1-\alpha} + \eta_{i1}$, $\varepsilon_i \sim iid(0, \sigma_\varepsilon^2)$, $\mu_{it} \sim iid(0, \sigma_\mu^2)$. Additionally, ε_i , η_{i1} and μ_{it} are mutually independent.

The moment condition is expressed as follows:

$$E(Z'_{sy} \mu_{sy}) = 0, \quad \text{Equation 3.3}$$

Where,

$$Z_{sy} = \begin{bmatrix} Z_{di} & 0 & 0 & \dots & 0 \\ 0 & \Delta y_{i2} & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \dots & \vdots \\ 0 & 0 & 0 & \dots & \Delta y_{iT-1} \end{bmatrix}, \quad Z_{di} = \begin{bmatrix} y_{i1} & 0 & 0 & \dots & 0 & \dots & 0 \\ 0 & y_{i1} & y_{i2} & \dots & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ 0 & 0 & 0 & \dots & y_{i1} & \dots & y_{iT-2} \end{bmatrix};$$

$$\mu_{sy} = (\Delta \mu_{i3}, \Delta \mu_{i4}, \dots, \Delta \mu_{iT}, v_{i3}, v_{i4}, \dots, v_{iT})^T.$$

The System GMM estimation method allows for controlling unobserved effects through differencing regressions or instrumental variables. It utilizes lagged values of explanatory variables or lagged values of the dependent variable as internal instruments. As highlighted by Kamal (2012), when the time span is relatively short, the System GMM estimation method can enhance substantive efficiency by incorporating lagged differenced

variables as endogenous variables in the model. This approach can also estimate coefficients of non-time-varying variables. Moreover, with an increase in the panel's length, the augmented number of effective instruments in the model makes the System GMM estimation method preferable over the first-differenced GMM method. Additionally, Abdouli and Hammami (2017) emphasize that the stability of GMM estimation relies on the effectiveness of the instruments. Therefore, in the application of the GMM estimation method, it is essential to assess the overall validity of the instruments and perform autocorrelation tests on model residuals.

3.3.3 Moderating Variable – TIMG

To explore the moderating role of digital economic maturity in CBEC trade flows, this study introduces the Total Index of the Digital Economy (TIMG) as an interaction variable in the import potential model. Developed by the Chinese Academy of Social Sciences, the TIMG Index systematically evaluates the digital development of countries across four dimensions: digital technology, digital infrastructure, digital market, and digital government (Wang, Chen, & Zhang, 2021). The TIMG dataset used in this study was developed by the Chinese Academy of Social Sciences and covers 106 global economies, including all RCEP member countries, for the period 2013 to 2021. The dataset includes a composite index and four sub-indices: digital technology, digital infrastructure, digital market, and digital governance. All data are publicly accessible and encouraged for scholarly use, as stated by the TIMG research group. This study uses the most recent data available from 2021.

The rationale for including TIMG lies in the hypothesis that the digital maturity of RCEP partner countries may influence the relationship between China's CBEC development and its CBEC import volumes. Specifically, in highly digitized economies, domestic platforms and localized e-commerce ecosystems may reduce dependency on China's CBEC platforms, thus weakening the effect of China's CBEC development on import volumes. Conversely, in countries with lower digital economy indices, Chinese platforms and logistics networks may play a more prominent role in enabling cross-border imports.

By integrating TIMG as an interaction term with China's CBEC development index in the import model, the study aims to explore whether digital economic maturity conditions the trade-enhancing effects of CBEC. This approach is consistent with the extended gravity model framework, which incorporates contextual variables to improve the estimation of trade potential.

3.4 Data Description

The study on the CBEC trade potential between China and RCEP partner countries encompasses the RCEP15 nations ranging from 2013 to 2022. However, due to occasional data gaps, this research focuses on the primary 12 RCEP member countries excluding Brunei, Myanmar, and Cambodia.

To facilitate effective analysis of short panel data, the 10-year dataset was divided into five equidistant intervals. Using a pooling technique, each interval was constructed by

aggregating data across two consecutive years. This method was adopted to simplify the subsequent panel data analysis by mitigating the temporal complexities inherent in the dataset.

The selection and organization of variables in this study are strategically aligned with the research objectives outlined in Section 1.4. Specifically, the indicators used for constructing the CBEC Development Index via PCA directly serve Objective (1), enabling the quantification of CBEC development levels across China and RCEP countries. Variables such as per capita GDP, trade distance, and digital economy development are incorporated into the dynamic panel model (GMM) to estimate CBEC import, export, and total trade potential (Objectives 2 and 3). The inclusion of moderating variables like China's Digital Economy Development Index facilitates the assessment of interaction effects (Objective 4). Finally, the estimated trade potential scores derived from these variables lay the empirical foundation for trade potential classification (Objective 5) and targeted policy recommendations (Objective 6). This coherent design ensures the methodological and analytical consistency of the study.

3.4.1 Indicators and Data Sources for Measuring the CBEC Development Level of RCEP Member Countries

Based on the connotation of the CBEC ecosystem and in conjunction with the CBEC evaluation system proposed by existing scholars (Huang, 2019) and the evaluation indicators of national e-commerce demonstration cities (trial), the study constructs an evaluation indicator system for the CBEC ecosystem.

In subdividing the elements of the CBEC ecosystem, the study considers the objectivity and availability of the indicator data. Due to the lack of specific CBEC platform data, the study uses the indicator of goods import and export trade volume to represent the trading subjects on the platform, which mainly involve goods. This variable reflects the scale of transaction activities in CBEC and captures the operational strength of the ecosystem, supporting the construction of the CBEC Development Index (Objective 1).

For the leading species, which includes manufacturers and wholesalers / retailers, the study selects the indicator of manufacturing value-added. This indicator captures the production capacity behind CBEC supply chains, contributing to ecosystem evaluation (Objective 1). As for consumers, who are online shoppers on CBEC platforms, the study employs the number of internet users as a substitute indicator to measure the potential consumer population. This is due to the fact that official statistics do not disaggregate CBEC users from general online consumers. As a widely accepted proxy, the number of internet users is commonly used in digital economy research to approximate the online consumer base, particularly in cross-country studies where more specific indicators (e.g., cross-border shoppers or e-commerce transaction volumes) are unavailable. A higher number of internet users suggests greater digital access and a higher potential demand for CBEC activities. This variable reflects the demand-side readiness of CBEC and facilitates the quantification of consumer-side digital participation (Objective 1).

In the supporting species, the study adopts the logistics performance index (LPI) as the indicator for logistics, including logistics service efficiency, international freight

efficiency, customs clearance efficiency, and destination country delivery efficiency. LPI reflects the efficiency and reliability of cross-border delivery, which is a critical infrastructure component in CBEC operations (Objective 1). For the information flow, the study mainly considers the development of the digital economy and thus uses the digital economy index (ITMG) published by the Chinese Academy of Social Sciences in 2023, which consists of three sub-indices: digital technology indicators, digital infrastructure indicators, and digital market indicators. The digital economy index measures the technological backbone supporting CBEC, aligning with infrastructure development evaluation (Objective 1). For the capital flow, the study uses two indicators: the number of commercial banks and per capita national net income (Wang et al., 2021). These financial indicators assess access to capital and purchasing power in the ecosystem, contributing to a well-rounded CBEC development evaluation (Objective 1) (see Table 3.2).

Table 3.2: The Specific Indicator System and Data Sources

Primary Indicators	Secondary Indicators	Tertiary Indicators		Data Source
Leading Species	Scale of goods import and export transactions	Import volume of goods		World Bank Database
		Export volume of goods		World Bank Database
Key species	Manufacturers	Manufacturing value added		World Bank Database
	Consumers	Total population		World Bank Database
Supporting species	Logistics	Logistics Performance Index	Ability to track and trace consignments	World Bank Database
			Competence and quality of logistics services	World Bank Database
			Ease of arranging competitively priced shipments	World Bank Database
			Efficiency of customs clearance process	World Bank Database
			Frequency with which shipments reach consignee within scheduled or expected time	World Bank Database
	Information Flow	Digital Economy Index	Digital technology	Chinese Academy of Social Sciences (CASS)
			Digital Infrastructure	
			Digital Market	World Bank Database
			Digital Government	
	Cash Flow	Number of commercial banks		International Monetary Fund Database
		Per capita net national income		World Bank Database

3.4.2 Definition of Variables and Data Sources for Measuring CBEC Trade Potential between China and RCEP Partner Countries

CBEC import volume to RCEP partner countries (Ime_{jt}): The import volume of goods from China's CBEC market to RCEP partner countries. In this study, the CBEC import volume is estimated using the method adopted by iResearch, which relies on the import data between China and RCEP partner countries, along with the total CBEC import volume for China. The detailed calculation is provided in Equation 3.10 below. This variable serves as the dependent variable in the import potential model, enabling the estimation of China's CBEC import intensity from RCEP countries (Objective 2).

CBEC export volume from RCEP partner countries (Exe_{jt}): The export volume of goods from RCEP partner countries to China's CBEC market. Similarly, the CBEC export volume is estimated following the iResearch method, which uses the export data between China and RCEP partner countries, along with the total CBEC export volume from China. The detailed calculation is given in Equation 3.11 below. As a core dependent variable, this measures CBEC export potential from RCEP countries to China, supporting trade potential analysis (Objective 2).

CBEC total trade volume to RCEP partner countries (Tre_{ijt}): The total trade volume of goods from China's CBEC market to RCEP partner countries, which is the sum of import and export volumes. This variable captures the overall trade interaction under CBEC frameworks, supporting a bilateral assessment of trade potential (Objective 2).

CBEC development level of RCEP partner countries ($CBEC_{jt}$): This variable is obtained through principal component analysis (PCA) estimation, representing the overall development level of CBEC in RCEP partner countries. As a key explanatory variable, it quantifies digital and logistical readiness of RCEP countries for CBEC trade, serving as a main predictor in the model (Objective 3).

CBEC development level of China ($CBEC_{it}$): Also obtained through PCA estimation, representing the development level of CBEC in China. This variable reflects China's own CBEC infrastructure, which is expected to enhance trade potential through supply-side digital and logistical capacity (Objective 3).

Per capita Gross Domestic Product (GDP) of RCEP partner countries ($PGDP_{jt}$): The GDP per capita of RCEP partner countries, obtained from the World Bank Database. These variable captures market capacity and purchasing power in RCEP countries, a key determinant in trade gravity logic (Objective 3).

Per capita Gross Domestic Product (GDP) of China ($PGDP_{it}$): The GDP per capita of China, obtained from the World Bank Database. Reflects China's production capability and domestic economic strength, likely to affect CBEC export potential (Objective 3).

Distance between China and RCEP partner countries ($Distoil_{ijt}$): The trade distance between China and each RCEP partner country, weighted by oil prices. Obtained from the CEPII dataset. Used as a proxy for trade cost, it is expected to negatively affect trade

potential, consistent with the gravity model logic (Objective 3).

Digital Economy Development Total Index ($TIMG_{it}$): An index representing the development level of the digital economy in China, used as a moderating variable in the import potential model. These variable tests whether digital economy development enhances the impact of CBEC readiness on trade potential, thus evaluating interaction effects (Objective 4).

Shared Border ($BORDER_{ij}$): A dummy variable indicating whether China shares a common border with the RCEP partner countries. This binary control variable captures geographic proximity, which typically reduces trade costs and boosts CBEC transactions (Objective 3).

These variables and their data sources are used to construct the model for estimating the CBEC trade potential score between China and RCEP partner countries.

3.5 Estimation Model

3.5.1 Calculation of CBEC Development Level (Using PCA)

Given that the CBEC development level indicator system covers multiple indicators that influence various aspects of CBEC development, there may be correlations among these indicators. Directly introducing them into the empirical model could lead to serious multicollinearity issues among the variables. Moreover, applying these indicators directly may increase the complexity of the empirical model, thereby affecting the accuracy of the

empirical results. To address this problem, this study employs Principal Component Analysis (PCA) to process the CBEC development level indicator system.

Principal Component Analysis involves extracting principal components to transform the data and derive different combinations of indicators while calculating the contribution rate of each indicator. By extracting several principal components with higher contribution rates, this study aims to fit a new set of indicators that are mutually independent and better reflect the overall situation. This approach helps to improve the accuracy of empirical testing by reducing redundant information among the indicators, simplifying the empirical model, and capturing the comprehensive performance of CBEC development level.

The basic formula of principal component analysis is expressed as follows:

$$F_i = a_{1i}X_1 + a_{2i}X_2 + \cdots + a_{pi}X_p \quad \text{Equation 3.4}$$

$X_1, X_2, \cdots X_p$ represents the index of each individual, $a_{1i}, a_{2i}, \cdots a_{pi}$ represents P constant vectors, F_i represents the linear combination of P index vectors $X_1, X_2, \cdots X_p$ of data matrix X (i.e., comprehensive index vector).

3.5.2 Estimation of CBEC Trade Volume (Using GMM Regression Analysis of the Extended Gravity Model)

As early as the 1960s, Tinbergen (1962) and Poyhonen (1963) attempted to apply the gravity model to the issue of bilateral trade flows. Their findings indicated that the economic size of two countries could promote trade flows, while the distance between

them could hinder the increase of trade flows. Over the years, through the efforts and contributions of successive scholars, the gravity model has evolved into a significant analytical method for predicting trade potential between countries or regions in traditional international trade. It can be expressed as follows:

$$T_{ijt} = \frac{A \cdot Y_{it} \cdot Y_{jt}}{D_{ij}} \quad \text{Equation 3.5}$$

Where T_{ijt} represents the bilateral trade volume between country i and country j in year t , A is a constant, Y_{it} represents the GDP of country i in year t , Y_{jt} represents the GDP of country j in year t , and D_{ij} represents the distance between country i and country j . To clearly illustrate the relationships between the explanatory variables and the dependent variable, the model is transformed into a logarithmic form, as shown in Equation 3.6.

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + u_{ij} \quad \text{Equation 3.6}$$

Where X_{ij} represents the trade flow from country i to country j , Y_i and Y_j respectively denote the GDP of country i and country j , D_{ij} represents the distance between country i and country j , B is the constant term, β_1 , β_2 , and β_3 are the estimated parameters, and u_{ij} represents the random error term.

Subsequently, scholars continuously expanded and studied this model, exploring additional factors affecting foreign trade flows and attempting to incorporate various new variables. For instance, Linnemann (1966) introduced population size and trade policy variables, Aitken (1973) introduced bilateral trade agreement variables, Leamer (1974)

introduced tariff variables, Bergstrand (1985) introduced variables like national income level, exchange rate level, and common border, Fischer (1996) introduced variables such as per capita GDP, common language, and free trade agreement, while Andrew (2000) introduced variables like colonial history and exchange rates. Zhang (2020), when using the gravity model, included trade facilitation and trade dependency as part of the gravity model. It's evident that scholars have constructed various expanded forms of the gravity model for empirical analysis. The extended gravity model has gradually matured in international trade research and has been widely applied in studying a country's trade competitiveness, estimating and analyzing its trade potential and trade volume, and exploring factors influencing inter-country trade flows.

In this study, drawing on existing research, the CBEC development level is incorporated into the gravity model. Considering that trade flows generally exhibit highly persistent characteristics and bilateral trade often possesses transitivity, earlier export trade tends to exert a demonstration effect on later trade, thereby influencing the CBEC trade volume between the two sides. Therefore, the lagged value of CBEC trade volume is incorporated for one period to construct a dynamic panel model:

$$\begin{aligned} \ln lme_{jt} = & \alpha + \beta_1 \ln lme_{jt-1} + \beta_2 \ln CBEC_{it} + \beta_3 \ln CBEC_{jt} \\ & + \beta_5 (\ln CBEC_{it} \times TIMG_{it}) + \beta_6 \ln PGDP_{jt} + \beta_7 \ln Distoil_{ijt} + \varepsilon_j \end{aligned} \quad \text{Equation 3.7}$$

$$\begin{aligned} \ln Exe_{jt} = & \alpha + \beta_1 \ln Exe_{jt-1} + \beta_2 \ln CBEC_{it} + \beta_3 \ln CBEC_{jt} \\ & + \beta_4 \ln PGDP_{it} + \beta_5 \ln PGDP_{jt} + \beta_6 \ln Distoil_{ijt} + \varepsilon_j \end{aligned} \quad \text{Equation 3.8}$$

$$\begin{aligned} \ln Tre_{jt} = & \alpha + \beta_1 \ln Tre_{jt-1} + \beta_2 \ln CBEC_{it} + \beta_3 \ln CBEC_{jt} \\ & + \beta_4 \ln PGDP_{it} + \beta_5 \ln PGDP_{jt} + \beta_6 \ln Distoil_{ijt} + \varepsilon_j \end{aligned} \quad \text{Equation 3.9}$$

Where i represents China, j represents RCEP partner countries, and t denotes time.

“ $\ln$ ” indicates logarithm in the equation for all variables to standardize the dataset.

Further, Exe , Ime , Tre , $CBEC$, $PGDP$, $Distoil$ and ϵ represent cross border e-commerce exports, cross border e-commerce imports, cross border e-commerce total trade, cross border e-commerce development level, per capital gross domestic product, trade distance and the error term, respectively.

Regarding the variable of trade distance between China and RCEP partner countries, most scholars have traditionally used the distance between the capitals of the trading partners to represent it. However, this approach overlooks the variations in transportation costs caused by factors such as international crude oil prices and labor costs. Therefore, in this study, the trade distance between the trading partners is represented as the product of spatial distance and international crude oil prices. This approach aims to capture a more comprehensive and accurate measure of the actual trade distance considering the influence of transportation costs.

However, the CBEC trade volume between China and RCEP partner countries is challenging to obtain directly. Therefore, this study adopts the method used by iResearch to estimate the trade volume based on the trade data between China and RCEP partner countries and the total CBEC trade volume of China. The specific calculation method is as follows:

$$Ime_{jt} = \frac{Im_{jt} * Ime_{it}}{Im_{it}} \quad \text{Equation 3.10}$$

$$Exe_{jt} = \frac{Ex_{jt} * Exe_{it}}{Ex_{it}} \quad \text{Equation 3.11}$$

$$Tre_{jt} = Exe_{jt} + Ime_{jt} \quad \text{Equation 3.12}$$

In this context, Exe_{jt} , Ime_{jt} and Tre_{jt} respectively represent China's CBEC export, import and total trade volume with RCEP partner countries. Ex_{jt} and Im_{jt} denote China's export and import volume with RCEP partner countries. Ex_{it} and Im_{it} represent China's total export and import volume. Exe_{it} and Ime_{it} indicate China's total CBEC export and import transaction scale.

3.6 Calculation of CBEC Trade Potential

To evaluate the trade potential between China and RCEP partner countries in the context of CBEC, this study adopts a comparative approach by analyzing the ratio of actual trade volumes to theoretical trade volumes. The theoretical trade volumes are derived from the extended gravity model constructed in this study, which incorporates CBEC development indicators and key control variables, and are estimated using the Generalized Method of Moments (GMM) method.

The trade potential score (TPS) for each country pair and time period is calculated using the following formula:

$$TPS_{ij,t} = \frac{Actual\ Trade_{ij,t}}{Theoretical\ Trade_{ij,t}} \quad \text{Equation 3. 13}$$

Where:

$Actual\ Trade_{ij,t}$: the observed CBEC trade volume between China (i) and partner country (j) in year (t)

Theoretical Trade_{ij,t}: the predicted trade volume from the gravity model

TPS_{ij,t}: trade potential score in year (t)

To facilitate interpretation, this study adopts the “0.8 – 1.2 benchmark method” , a widely used classification system in trade potential research (Jin & Yang, 2015; Li, 2013; Sheng & Liao, 2004). The classification is summarized in Table 3.3.

Table 3.3: CBEC Trade Potential Classification

Ratio	Classification	Recommendations
Below 0.8	Significant Potential	Substantial trade gap; indicates unrealized potential. Reduce trade barriers and strengthen facilitation.
Between 0.8 and 1.2	Exploratory Potential	Moderate development; explore new mechanisms and eliminate soft trade frictions.
Above 1.2	ReconstructivePotential	Trade volume exceeds theoretical level; seek new CBEC cooperation models.

Additionally, following Liu (2022), exploratory potential can be further subdivided into three detailed categories—under-trade (0.8 – 1.0), ideal trade (=1.0), and sufficient trade (1.0 – 1.2)—to reflect subtle trade mismatches and guide more precise strategy formulation.

3.7 Limitations of Methodology

3.7.1 Data availability and proxy limitations

Although Section 3.4 and 3.5.2 have outlined the strategies to address data gaps—such as excluding countries with severe data unavailability (e.g., Brunei, Myanmar, Cambodia), and aggregating time intervals for panel balancing—certain limitations remain.

In particular, the CBEC trade volumes between China and individual RCEP countries are not directly reported in official statistics. This study, therefore, adopts the iResearch method to indirectly estimate these values using China's total CBEC trade volume and proportional trade shares with RCEP partners. While this approach is widely cited, it remains a proxy-based estimation, which may understate the contribution of non-commodity or service-based CBEC flows.

3.7.2 Model structure and sample design

As discussed in Section 3.4, the panel is composed of 12 countries across 10 years and restructured into five pooled intervals. Although this approach improves time balance and statistical stability, it reduces temporal variability and may limit the granularity of GMM estimation. The small sample size may also result in weaker instrument strength in GMM, a concern partially addressed through internal lag selection and validity tests (e.g., Hansen test).

3.7.3 Assumptions and unobservable effects

In the gravity model framework, several classical assumptions—such as log-linearity and stable bilateral trade relationships—may not fully hold in dynamic CBEC contexts, where platform effects, regulatory shifts, or sudden technological changes play a role. Moreover, macro-level variables (e.g., logistics, GDP per capita) used in the PCA index may not fully reflect consumer-side dynamics, such as payment behavior or SME participation in platform trade.

3.7.4 Model Reliability Considerations

Although this study does not conduct separate robustness checks for each of the three GMM estimation models, it incorporates several measures to enhance the reliability of the results.

First, the use of System GMM — rather than difference GMM — ensures greater efficiency and instrument validity, especially for small T and medium-sized N panels (Blundell & Bond, 1998). Lagged dependent variables are carefully chosen to mitigate reverse causality, and Hansen tests are employed to validate instrument over-identification.

Second, variable multicollinearity is mitigated by using PCA to construct a composite CBEC Development Index. This reduces noise in the model and ensures that the explanatory variable structure is stable across different model specifications (import, export, total trade).

Third, the models are based on a log-linear specification of the gravity equation, which has been widely adopted and validated in trade potential research. While country heterogeneity and omitted variable bias may exist, fixed effects and dynamic controls are incorporated where possible.

Finally, the study acknowledges that future research can strengthen robustness through sensitivity tests, such as (i) alternative specifications of trade cost (e.g., using logistics sub-indices separately), (ii) replacing TIMG with other digital economy indicators, or (iii) comparing GMM estimates with OLS and fixed-effects models as benchmarks.

3.8 Chapter Summary

This chapter presents the quantitative research design and methodology to achieve the study's objectives. It includes the definition of variables, data sources, model estimation, and econometric techniques adopted for results estimation. Additionally, it presents the conceptual framework of the study. The chapter outlines the methodology used to examine the CBEC import, export and total trade volumes and potential scores between China and RCEP partner countries.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter provides a comprehensive empirical analysis of the development level and trade potential of CBEC between China and member countries of the Regional Comprehensive Economic Partnership. The analysis utilizes data from 2013 to 2022, focusing on a sample of 12 key RCEP countries due to data availability limitations. The primary aim of this chapter is to evaluate the CBEC development levels among RCEP countries, identify the key factors influencing this development, and explore the trade potential within the RCEP region.

The chapter is structured into three main sections:

Measuring of CBEC Development Level

This section introduces a comprehensive index system with 16 indicators sourced from reputable databases such as the World Bank, IMF, and the Chinese Academy of Social Sciences (CASS). The data is standardized and any missing values are imputed using the interpolation method. Principal Component Analysis (PCA) is employed to identify the most significant factors affecting the CBEC development levels. The findings highlight significant disparities in CBEC development levels among RCEP member countries, with China leading the rankings, followed by Singapore and Japan.

Estimation of CBEC Import, Export and Total Trade Volumes

This section examines the import, export, and total trade volumes between China and its RCEP partners. By employing a dynamic panel data model, the study utilizes a moderating effect and the two-step system Generalized Method of Moments (GMM) to identify critical factors influencing trade volumes, such as per capita GDP, levels of e-commerce development, distance.

Analysis of CBEC Trade Potentials

This section evaluates the trade potential for imports, exports, and total trade by comparing actual and theoretical values of CBEC. Based on these comparisons, trade potential is classified into different categories, such as significant potential, exploratory potential, and reconstructive potential, offering valuable insights into untapped opportunities and areas for strategic enhancement.

4.2 Results of CBEC Development Level and Discussion

4.2.1 Descriptive Statistics

This section focuses on the CBEC development levels between China and its RCEP partner countries, covering the 15 RCEP nations from 2013 to 2022. However, due to occasional data gaps, this research primarily focuses on a sample of 12 main RCEP members, excluding Brunei, Myanmar, and Cambodia. The study utilizes 16 indicators to compute CBEC development level in the index system are sourced from the World Bank,

IMF Database, and Chinese Academy of Social Sciences (CASS) Database. Missing data were supplemented using the interpolation method.

Descriptive statistics involve techniques for summarizing and organizing data. The descriptive analysis includes the total number of observations, the mean, the standard deviation, and the minimum and maximum values for each variable. Table 4.1 presents the descriptive statistics of the variables which are used for the Principal Component Analysis to gauge CBEC development level. It includes the mean, standard deviation, minimum, and maximum values for each variable, based on 120 observations.

Both import and export volumes (LS1 and LS2) show high variability, with means of USD 451.388 billion and USD 389.701 billion, respectively, and significant standard deviations. Manufacturing value added (KS1) also exhibits considerable variation with a mean of USD 720.84 billion. In contrast, internet usage (KS2) has a lower variability, with a mean of 68.11% of population. Logistics performance index (LP1 to LP6) show moderate variability, with consistent mean scores ranging from 3.31 to 3.71. IF Indicators such as digital technology and infrastructure show varied results, with mean scores from 58.93 to 66.42. Cash flow (CF1 and CF2) exhibit significant differences, particularly in the number of commercial banks (mean of 14.39 per 100,000 adults) and per capita net national income (mean of USD 17498.12)

Table 4.1: Descriptive Statistics of Variables for CBEC Index Calculation

Variable	Full name	Mean	Std. Dev.	Min	Max	Observations
LS1	Import Volume (billion US\$)	451.39	655.80	2.26	3346.88	N=120 n=12 t=10
LS2	Export Volume (billion US\$)	389.70	530.25	3.05	2678.24	
KS1	Manufacturing Value Added (billion US\$)	720.84	1471.91	3.65	7171.64	
KS2	Internet Users (% of population)	68.11	24.03	12.5	97.57	
LP1	Tracking Ability Index	3.5	0.48	1.76	4.4	
LP2	Logistics Quality Index	3.45	0.48	2.10	4.4	
LP3	Pricing Ease Index	3.31	0.34	2.18	4	
LP4	Customs Efficiency Index	3.27	0.51	1.85	4.2	
LP5	Timeliness Index	3.71	0.41	2.65	4.40	
LP6	Infrastructure Quality Index	3.47	0.61	1.76	4.6	
IF1	Digital Technology Index	58.93	16.98	23.55	80.88	
IF2	Digital Infrastructure Index	66.42	14.95	19.65	90.53	
IF3	Digital Market Index	62.28	19.10	3.66	95.57	
IF4	Digital Governance Index	65.49	20.09	24.41	97.50	
CF1	Number of Banks (per 100,000 adults)	14.39	9.43	2.73	34.14	
CF2	Per Capita Income (US\$)	17498.12	16293.97	1364.39	53871.56	
LS represents Leading Species, with LS1 and LS2 denoting the import volume of goods and export volume of goods, respectively. KS denotes Key Species, where KS1 and KS2 refer to manufacturing value added and individuals using the internet. LP represents Logistics Performance within the Supporting Species category, with LP1 through LP6 indicating the ability to track and trace consignments, competence and quality of logistics services, ease of arranging competitively priced shipments, efficiency of the customs clearance process, frequency with which shipments reach the consignee within the scheduled or expected time, and quality of trade and transport-related infrastructure. IF denotes Information Flow within the Supporting Species category, with IF1 through IF4 representing digital technology, digital infrastructure, digital market, and digital governance. CF represents Cash Flow within the Supporting Species category, where CF1 denotes the number of commercial banks and CF2 represents per capita net national income.						

The descriptive statistics in Table 4.1 reveal significant heterogeneity among CBEC-related indicators. Notably, variables such as manufacturing value added and import/export volumes display wide standard deviations, reflecting structural differences in trade and industrial capacity across RCEP countries. Meanwhile, digital governance and infrastructure indices also exhibit large ranges, indicating uneven digital readiness, which may affect CBEC development levels.

4.2.2 Correlation Analysis

Before conducting factor analysis, it is essential to perform a correlation analysis to determine whether the variables are sufficiently correlated. Correlation analysis helps to understand the structure of the data and evaluate the performance of each variable within the dataset. This section details the process and results of the correlation analysis.

The correlation matrix shows the Pearson correlation coefficients between each pair of variables, ranging from -1 to 1. Positive correlations indicate that two variables move in the same direction, while negative correlations indicate that they move in opposite directions. The closer the correlation coefficient is to 1 in absolute value, the stronger the correlation. Table 4.2 is the correlation matrix for the variables used in this study.

Table 4.2: Correlation Matrix

Variable	LS1	LS2	KS1	KS2	LP1	LP2	LP3	LP4	LP5	LP6	IF1	IF2	IF3	IF4	CF1	CF2
LS1	1.00	0.99	0.98	0.10	0.32	0.33	0.37	0.23	0.25	0.38	0.37	0.37	0.54	0.03	0.03	0.05
LS2	0.99	1.00	0.97	0.12	0.33	0.34	0.37	0.24	0.26	0.39	0.38	0.38	0.55	0.04	0.01	0.04
KS1	0.98	0.97	1.00	0.00	0.22	0.22	0.27	0.12	0.16	0.27	0.29	0.30	0.48	0.06	0.01	0.12
KS2	0.10	0.12	0.00	1.00	0.72	0.73	0.56	0.72	0.65	0.74	0.75	0.71	0.56	0.86	0.47	0.72
LP1	0.32	0.33	0.22	0.72	1.00	0.98	0.81	0.93	0.91	0.96	0.79	0.76	0.74	0.77	0.48	0.69
LP2	0.33	0.34	0.22	0.73	0.98	1.00	0.82	0.95	0.92	0.98	0.81	0.73	0.70	0.79	0.49	0.72
LP3	0.37	0.37	0.27	0.56	0.81	0.82	1.00	0.77	0.79	0.80	0.68	0.68	0.71	0.64	0.25	0.45
LP4	0.23	0.24	0.12	0.72	0.93	0.95	0.77	1.00	0.88	0.96	0.79	0.63	0.58	0.78	0.53	0.80
LP5	0.25	0.26	0.16	0.65	0.91	0.92	0.79	0.88	1.00	0.90	0.82	0.69	0.68	0.80	0.52	0.72
LP6	0.38	0.39	0.27	0.74	0.96	0.98	0.80	0.96	0.90	1.00	0.83	0.71	0.69	0.78	0.50	0.73
IF1	0.37	0.38	0.29	0.75	0.79	0.81	0.68	0.79	0.82	0.83	1.00	0.77	0.77	0.89	0.59	0.76
IF2	0.37	0.38	0.30	0.71	0.76	0.73	0.68	0.63	0.69	0.71	0.77	1.00	0.91	0.76	0.41	0.51
IF3	0.54	0.55	0.48	0.56	0.74	0.70	0.71	0.58	0.68	0.69	0.77	0.91	1.00	0.62	0.36	0.38
IF4	0.03	0.04	0.06	0.86	0.77	0.79	0.64	0.78	0.80	0.78	0.89	0.76	0.62	1.00	0.58	0.86
CF1	0.03	0.01	0.01	0.47	0.48	0.49	0.25	0.53	0.52	0.50	0.59	0.41	0.36	0.58	1.00	0.61
CF2	0.05	0.04	0.12	0.72	0.69	0.72	0.45	0.80	0.72	0.73	0.76	0.51	0.38	0.86	0.61	1.00

As shown in Table 4.2, most logistics performance indicators (LP1 to LP6) and information flow indicators (IF1 to IF4) exhibit high correlations. For example, the correlation between LP1 and LP6 is 0.96, and the correlation between LP4 and IF1 is 0.79. Additionally, there is a moderate positive correlation between manufacturing value added (KS1) and goods import/export volumes (LS1 and LS2), with correlation coefficients ranging from 0.97 to 0.98. Conversely, some variables exhibit low correlations. For instance, CF1 (number of commercial banks) shows low correlation with most variables, indicating it may have a limited impact on other variables in the factor analysis. These correlation patterns suggest a strong internal consistency within thematic groups (logistics, digital infrastructure, trade scale), supporting their suitability for dimensional reduction via PCA and the conceptual integrity of the CBEC ecosystem framework.

The observed correlation patterns demonstrate sufficient internal consistency among most variables, particularly within logistics and digital infrastructure clusters, suggesting their appropriateness for dimensional reduction via PCA. To formally assess this suitability, the subsequent section performs the KMO test and Bartlett's test of sphericity.

4.2.3 Testing for Data Suitability

To ensure the variables meet the strong correlation prerequisite for principal component analysis, this study carried out the KMO (Kaiser-Meyer-Olkin) test and Bartlett's test of sphericity. As is shown in Table 4.3.

Table 4.3: Summary of Bartlett's Test and KMO Measure

Measure	Value
Bartlett's Test of Sphericity χ^2	3887.212
Degrees of Freedom (df)	120
p-value	< 0.001
Kaiser-Meyer-Olkin (KMO)	0.858

Note. Obtained through STATA18 software calculation

As shown in Table 4.3, the KMO value reaches 0.858, well above the acceptable threshold of 0.7 (Kaiser, 1974), while Bartlett's test yields a highly significant result ($\chi^2 = 3887.212$, $p < 0.001$), indicating strong inter-variable correlations. These results jointly confirm the dataset's suitability for principal component analysis (PCA).

4.2.4 Data Standardization

Before conducting factor analysis, it is essential to standardize the data to ensure that variables with different units and scales can be compared on the same level. This step improves the reliability and accuracy of the factor analysis results. We used the Min-Max normalization method, as described in Equation 3.1, to standardize the data. After standardization, each variable has a mean of 0 and a variance of 1, ensuring that each variable contributes equally to the factor structure.

4.2.5 Factor Analysis

Factor analysis is a robust statistical method used to reduce data dimensionality and detect hidden patterns among variables. Prior to conducting factor analysis, the number of factors to be extracted was determined using the Kaiser criterion (eigenvalues greater than 1) and the scree plot method. Principal Component Analysis (PCA) was employed to

extract the factors, followed by Varimax rotation to enhance the interpretability and clarity of the factor loadings.

As shown in Table 4.4, the factor analysis extracted two principal components with eigenvalues exceeding 1, in accordance with the Kaiser criterion (Kaiser, 1960). The first component explains 62.53% of the total variance, and the second adds another 19.55%, bringing the cumulative explained variance to 82.08%. This high explanatory power suggests that the two components sufficiently capture the underlying structure of the CBEC development indicators. The sharp drop in eigenvalues after the second component further supports the validity of extracting only two factors, aligning with the “elbow rule” commonly used in PCA interpretation.

Table 4.4: Variance Explained by Extracted Factors Based on PCA

Component	Eigenvalue	Proportion	Cumulative
Comp1	10.0054	0.6253	0.6253
Comp2	3.1281	0.1955	0.8208
Comp3	0.8422	0.0526	0.8735
Comp4	0.736	0.265	0.046
Comp5	0.472	0.211	0.029
Comp6	0.260	0.059	0.016
Comp7	0.201	0.083	0.013
Comp8	0.118	0.039	0.007
Comp9	0.079	0.021	0.005
Comp10	0.058	0.019	0.004
Comp11	0.039	0.020	0.002
Comp12	0.018	0.001	0.001
Comp13	0.017	0.005	0.001
Comp14	0.013	0.001	0.001
Comp15	0.011	0.009	0.001
Comp16	0.003	0.000	0.000

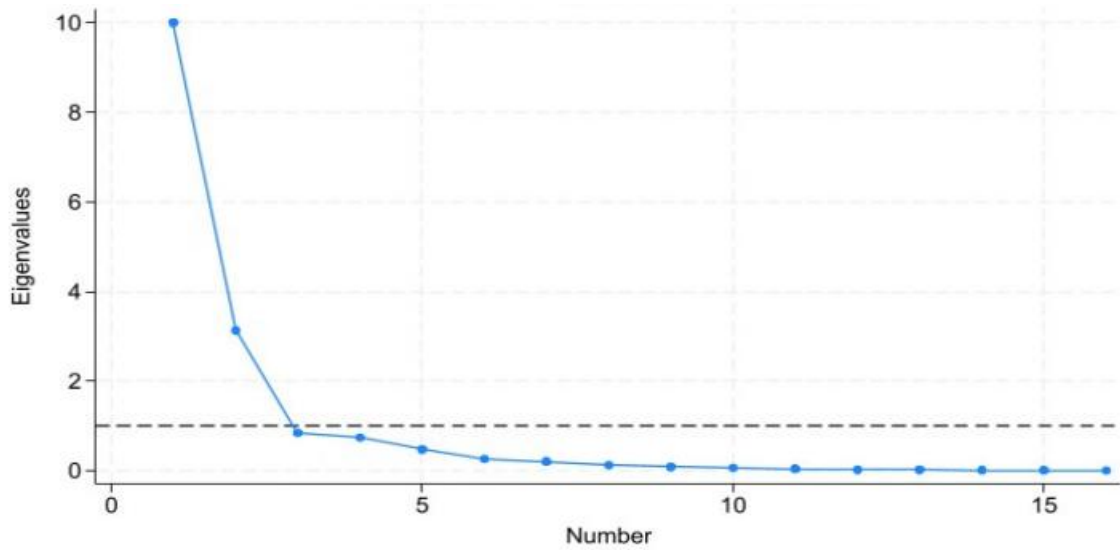


Figure 4.1: Scree Plot of Eigenvalues Supporting the Extraction of Two Principal Components

Figure 4.1 illustrates the scree plot of the eigenvalues, which provides a visual representation of the variance explained by each principal component. The plot reveals a distinct "elbow" after the second component, where the eigenvalues sharply decline and then plateau. This pattern confirms that the first two components account for the most significant portion of the variance and retain the essential information embedded in the original indicators. This visual evidence supports the extraction decision based on both the Kaiser criterion and the elbow rule (Jolliffe, 2002), reinforcing the methodological robustness of the PCA process.

The corresponding factor loadings are detailed in Table 4.5.

Table 4.5: Factor Loadings

Variable	Comp1	Comp2
LS1	0.125	0.510
LS2	0.130	0.504
KS1	0.095	0.522
KS2	0.253	-0.151
LP1	0.299	-0.023
LP2	0.302	-0.028
LP3	0.259	0.058
LP4	0.290	-0.097
LP5	0.290	-0.064
LP6	0.303	-0.007
IF1	0.292	-0.009
IF2	0.265	0.054
IF3	0.256	0.177
IF4	0.276	-0.204
CF1	0.179	-0.175
CF2	0.240	-0.256

These factor loadings offer clear interpretive insight into the nature of the two principal components. Component 1 (Comp1) can be interpreted as the “ Digital and Logistics Infrastructure ” dimension, given its strong associations with logistics quality (LP1 – LP6) and digital readiness (IF1 – IF4). This component captures the supporting environment of CBEC, such as infrastructure efficiency, shipment reliability, and the development of digital tools and governance.

In contrast, Component 2 (Comp2) reflects a “Trade Scale and Industrial Capacity” dimension, as it loads heavily on variables like import/export volumes (LS1, LS2) and manufacturing value added (KS1). This component emphasizes the scale and industrial foundation of CBEC transactions.

The distinction between these two components not only validates the ecosystem perspective adopted in this study but also supports the subsequent construction of the CBEC Development Index. It shows that both structural capability (Comp1) and economic magnitude (Comp2) are essential but separable dimensions in evaluating CBEC readiness among RCEP countries.

4.2.6 Calculation of Coefficients for Linear Combinations

The coefficients for the linear combinations Comp1 and Comp2 are obtained by dividing the component value of each indicator by the square root of the corresponding principal component's eigenvalue. This ensures that the contributions of each variable to the factors are appropriately scaled.

For example, the eigenvalue of the first principal component (Comp1) is 10.005, and the eigenvalue of the second principal component (Comp2) is 3.128. For the variable LS1, its component value on Comp1 is 0.125 and on Comp2 is 0.51. The calculation of the coefficients for the linear combinations is as follows:

For the coefficient for Comp1:

$$\text{Coefficient for Comp1} = \frac{0.125}{\sqrt{10.005}} = 0.0395$$

For the coefficient for Comp2:

$$\text{Coefficient for Comp2} = \frac{0.51}{\sqrt{3.128}} = 0.2876$$

By following the same method, we can calculate the coefficients for all other variables. The resulting coefficients for Comp1 and Comp2 are then used to construct the linear combination equations 4.1 and 4.2.

$$\begin{aligned} \text{Comp1} = & 0.0396 \times \text{LS1} + 0.041 \times \text{LS2} + 0.03 \times \text{KS1} + 0.0799 \times \text{KS2} + 0.0947 \\ & \times \text{LP1} + 0.0955 \times \text{LP2} + 0.0819 \times \text{LP3} + 0.0916 \times \text{LP4} \\ & + 0.0916 \times \text{LP5} + 0.0958 \times \text{LP6} + 0.0922 \times \text{IF1} + 0.0838 \times \text{IF2} \\ & + 0.0809 \times \text{IF3} + 0.0871 \times \text{IF4} + 0.0565 \times \text{CF1} + 0.0759 \times \text{CF2} \end{aligned} \quad \text{Equation 4.1}$$

$$\begin{aligned} \text{Comp2} = & 0.2881 \times \text{LS1} + 0.2851 \times \text{LS2} + 0.2953 \times \text{KS1} - 0.0854 \times \text{KS2} - 0.0129 \\ & \times \text{LP1} - 0.0158 \times \text{LP2} + 0.0327 \times \text{LP3} - 0.0548 \times \text{LP4} - 0.036 \\ & \times \text{LP5} - 0.0037 \times \text{LP6} - 0.005 \times \text{IF1} + 0.0307 \times \text{IF2} + 0.1002 \\ & \times \text{IF3} - 0.1154 \times \text{IF4} - 0.099 \times \text{CF1} - 0.1447 \times \text{CF2} \end{aligned} \quad \text{Equation 4.2}$$

Comp1 and Comp2 represent the scores of RCEP member countries under the influence of the two principal components, respectively, while Comp denotes the composite score. To obtain the composite score for each variable, multiply each variable's coefficient by its weight in Comp1 and Comp2, then sum these values. Divide the sum by the total variance proportion explained by the two principal components (0.8208).

For example, for the variable LS1:

$$\text{Comp Score for LS1} = \frac{0.0395 \times 0.625 + 0.2876 \times 0.196}{0.8208} = 0.0953$$

By applying the same method, the composite scores for all other variables were calculated. To ensure comparability across variables on a unified scale, the composite scores were subsequently normalized. This process involved calculating the total sum of the composite scores and dividing each individual score by this aggregate value. The results are presented in Table 4.6.

Table 4.6: Composite Scores and Adjusted Coefficients for Linear Combinations

Variable	Comp	Adjusted Comp
LS1	0.0988	0.0953
LS2	0.0992	0.0956
KS1	0.0932	0.0898
KS2	0.0406	0.0391
LP1	0.0690	0.0666
LP2	0.0690	0.0665
LP3	0.0702	0.0676
LP4	0.0568	0.0547
LP5	0.0612	0.0590
LP6	0.0721	0.0695
IF1	0.0691	0.0666
IF2	0.0711	0.0686
IF3	0.0855	0.0824
IF4	0.0389	0.0375
CF1	0.0195	0.0188
CF2	0.0234	0.0225

Table 4.6 displays both the composite scores and the adjusted coefficients used in the linear combinations and clearly shows the relative importance of each variable after normalization. Among all indicators, IF3 (Digital Market) has the highest adjusted coefficient (0.0824), followed closely by LP6 (Infrastructure Quality) and LP3 (Pricing Ease). This suggests that a well-developed digital marketplace and robust logistics infrastructure play a pivotal role in determining the overall CBEC development level. Conversely, CF1 (Number of Banks) and CF2 (Per Capita Income) have the lowest weights, implying a more limited contribution of cash flow indicators to the composite index.

These results highlight that Supporting Species—especially logistics performance and information flow—contribute more substantially to CBEC development than Leading Species (import/export volumes) or Key Species (manufacturing and internet usage). This finding reinforces the ecosystem-based approach of this study and offers a data-driven rationale for focusing policy and infrastructure efforts on strengthening digital logistics and market integration across RCEP nations.

The final normalized linear combination equations can be seen in Equation 4.3.

$$\begin{aligned}
 CBEC = & 0.0953 \times LS1 + 0.0956 \times LS2 + 0.0898 \times KS1 + 0.0391 \times KS2 \\
 & + 0.0666 \times LP1 + 0.0665 \times LP2 + 0.0676 \times LP3 + 0.0547 \\
 & \times LP4 + 0.059 \times LP5 + 0.0695 \times LP6 + 0.0666 \times IF1 + 0.0686 \\
 & \times IF2 + 0.0824 \times IF3 + 0.0375 \times IF4 + 0.0188 \times CF1 + 0.0225 \\
 & \times CF2
 \end{aligned}
 \tag{Equation 4.3}$$

In the final normalized linear combination equations, each variable's coefficient represents its relative contribution to the composite score. By categorizing variables according to primary indicators and interpreting the composite scores for each primary indicator, we can understand which primary indicators play a more significant role in the factor structure.

The weights for the primary indicators within the RCEP countries' CBEC framework were calculated by summing the weights of their respective secondary indicators. The results and their significance in the factor structure are as follows:

Scale of goods import and export transactions (LS) = 0.1908 (derived by summing the coefficients for LS1 and LS2: 0.0953 + 0.0955). The import volume of goods (LS1) and export volume of goods (LS2) are highly significant in the factor structure, with

coefficients of 0.0953 and 0.0956, respectively. This indicates that both import and export volumes play equally important roles in influencing the composite score.

Manufacturers and Consumers (KS) = 0.1289 (derived by summing the coefficients for KS1 and KS2: $0.0898 + 0.0391$). Manufacturing value added (KS1) has a significant impact on the composite score, with a coefficient of 0.0898. In contrast, the contribution of individuals using the internet (KS2) is smaller, with a coefficient of 0.0391.

Logistics Performance (LP) = 0.3839 (derived by summing the coefficients for LP1 through LP6: $0.0666 + 0.0665 + 0.0676 + 0.0547 + 0.0590 + 0.0695$). The coefficients indicate that logistics performance indicators have relatively balanced importance in the composite score. Notably, LP3 and LP6, with coefficients of 0.0676 and 0.0695, respectively, make significant contributions.

Information Flow (IF) = 0.2551 (derived by summing the coefficients for IF1 through IF4: $0.0666 + 0.0686 + 0.0824 + 0.0375$). These coefficients show that the digital market (IF3) has the highest contribution to the composite score, with a coefficient of 0.0824, while digital governance (IF4) has a smaller contribution, with a coefficient of 0.0375.

Cash Flow (CF) = 0.0413 (derived by summing the coefficients for CF1 and CF2: $0.0188 + 0.0225$). The coefficients for cash flow indicators are relatively low, indicating their smaller contribution to the composite score.

By analyzing these weights, we can see the relative importance of each primary indicator in the factor structure, providing a clearer understanding of the key factors influencing CBEC within RCEP countries.

4.2.7 Calculation of CBEC Development Levels

By substituting the variables from the established indicator system into the Equation 4.3, we can perform the above calculation for each country to obtain their composite scores. These scores represent the relative position of 12 RCEP countries (excluding Brunei, Myanmar, and Cambodia) in terms of CBEC development levels. The development level and ranking of CBEC among them were obtained, as depicted in Table 4.7 and Table 4.8 respectively.

Table 4.7: Development Level of CBEC in RCEP Countries

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AUS	0.4561	0.4459	0.4472	0.4474	0.439	0.4339	0.4432	0.4576	0.4925	0.3273
CHN	0.8344	0.8291	0.8668	0.9414	1.053	1.2216	1.2653	1.3424	1.6864	1.4985
IDN	-0.4344	-0.6938	-0.7233	-0.7383	-0.5994	-0.4063	-0.4225	-0.4204	-0.3819	-0.3308
JPN	0.3604	0.7573	0.7696	0.8163	0.8625	0.9465	0.9303	0.9069	0.9162	0.7545
KOR	0.4317	0.3572	0.4283	0.4707	0.4376	0.4392	0.4589	0.5165	0.609	0.1651
LAO	-1.2998	-1.8714	-1.9697	-2.0771	-1.7422	-1.4872	-1.5132	-1.5473	-1.5823	-1.3698
MYS	-0.5292	0.0005	-0.0393	-0.0806	-0.1451	-0.2	-0.1051	0.0114	0.1421	0.2113
NZL	0.0809	0.0867	-0.0159	-0.1173	0.1087	0.3356	0.2787	0.2309	0.2069	-0.138
PHL	-0.6651	-0.8624	-0.8726	-0.9083	-0.8355	-0.7436	-0.6562	-0.5342	-0.4448	-0.2363
SGP	0.2992	0.6095	0.6815	0.7797	0.7666	0.7306	0.7977	0.9026	1.0333	0.8118
THA	-0.0518	-0.3813	-0.4157	-0.4313	-0.3038	-0.1857	-0.1287	-0.0781	-0.0282	-0.1873
VNM	-0.6598	-0.766	-0.8174	-0.8363	-0.6855	-0.4222	-0.375	-0.3211	-0.2837	-0.2708

Note: A negative sign indicates below the average level.

As shown in Table 4.7, the development levels of CBEC vary considerably among RCEP countries across the years. China stands out with consistently high and increasing composite scores, especially from 2016 onwards, reflecting the rapid expansion of its digital infrastructure, e-commerce platforms, and supportive policy environment. In contrast, countries such as Laos, the Philippines, and Vietnam remain below the average level throughout the period, highlighting persistent digital and infrastructural bottlenecks.

Notably, Japan and Singapore demonstrate stable and positive growth in CBEC development, aligning with their high digital economy readiness and regional trade connectivity. Meanwhile, Malaysia and Thailand gradually improve from negative to near-neutral scores in later years, suggesting slow but steady progress. These country-level divergences underline the heterogeneity in digital trade capacity and the need for differentiated regional strategies within the RCEP framework.

Table 4.8 presents the annual rankings of CBEC development levels among RCEP countries. The ranking results in Table 4.8 further confirm the development heterogeneity observed in Table 4.7. China's stable top position reflects its strong logistics infrastructure, digital economy foundation, and sustained policy support for CBEC. Singapore and Japan's consistently high ranks demonstrate their advanced digital ecosystems and integration with regional trade networks.

Table 4.8: Ranking of CBEC Development Level in RCEP Countries

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AUS	2	4	4	5	4	5	5	5	5	4
CHN	1	1	1	1	1	1	1	1	1	1
IDN	8	9	9	9	9	9	10	10	10	11
JPN	4	2	2	2	2	2	2	2	3	3
KOR	3	5	5	4	5	4	4	4	4	6
LAO	12	12	12	12	12	12	12	12	12	12
MYS	9	7	7	6	7	8	7	7	7	5
NZL	6	6	6	7	6	6	6	6	6	7
PHL	11	11	11	11	11	11	11	11	11	9
SGP	5	3	3	3	3	3	3	3	2	2
THA	7	8	8	8	8	7	8	8	8	8
VNM	10	10	10	10	10	10	9	9	9	10

In contrast, countries such as the Philippines, Indonesia, and Vietnam repeatedly fall into the bottom half of the ranking, indicating persistent challenges in digital infrastructure, cross-border logistics, and financial inclusion. Notably, Malaysia and New Zealand show moderate rankings with fluctuating trends, reflecting transitional stages of CBEC development.

These variations imply that CBEC growth is not only driven by economic size but also by digital readiness, regulatory coordination, and e-commerce logistics capacity, reinforcing the need for country-specific strategies to promote inclusive CBEC growth across the RCEP region.

From the perspective of national differences, Figure 4.2 shows the trends in CBEC development levels in RCEP countries from 2013 to 2022. Each subplot represents the

changes in CBEC development levels over time for a specific country. Below is the analysis of the trends for each country.

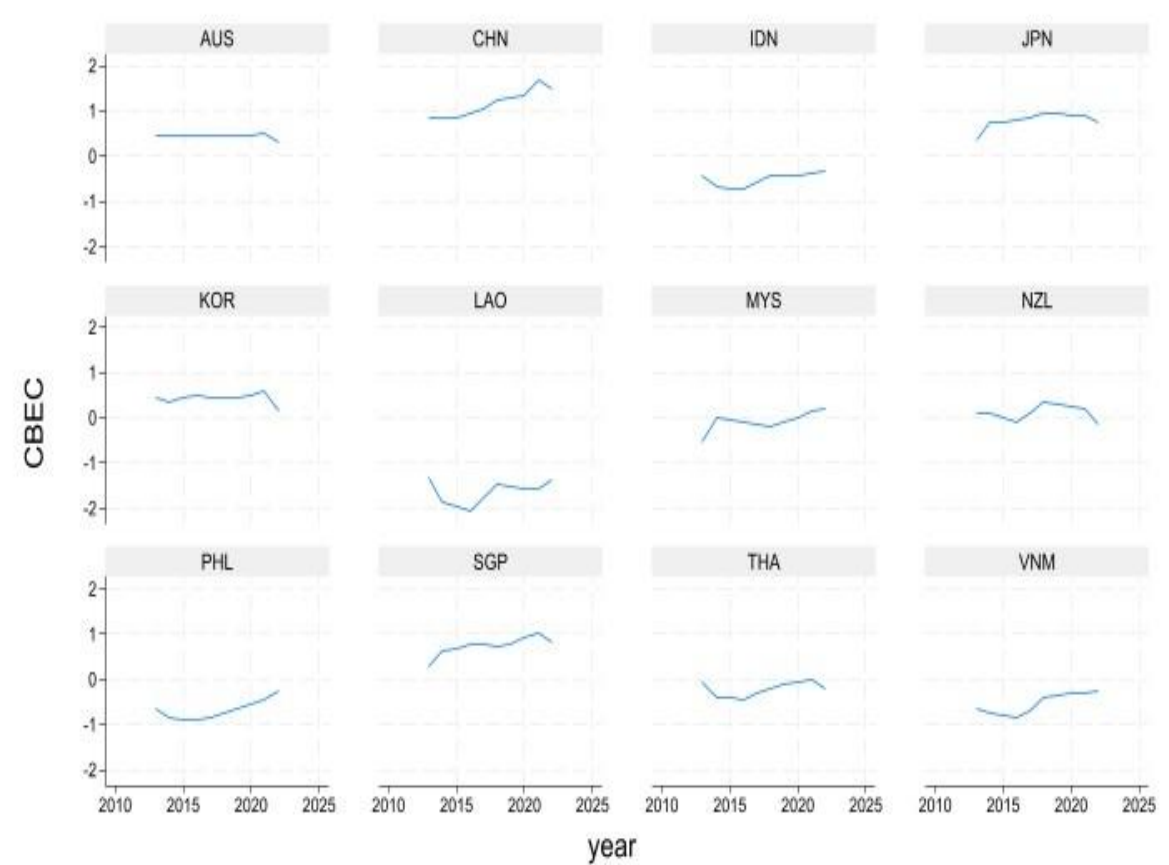


Figure 4.2: Trends in CBEC Development Levels in RCEP Countries

During the study period, the CBEC development levels of the RCEP countries exhibited significant variations. Australia's development level remained relatively stable but showed a notable decline in 2022. In contrast, China continuously increased from 2010 to 2021, showing a significant upward trend, although there was a slight decline in 2022, the overall level remained high. Indonesia experienced a decline from 2010 to 2015 but gradually recovered, particularly after 2020. Japan saw significant growth from 2013 to

2017, followed by slight fluctuations and a notable decline in 2022. South Korea's development level fluctuated, initially increasing and then declining by 2022.

Laos consistently remained low throughout the period, with some improvement after 2015 but still at an overall low level. Malaysia's level declined before 2013 but gradually recovered after 2014. New Zealand fluctuated significantly from 2010 to 2015, stabilized after 2016, and showed a slight increase after 2020. The Philippines showed overall improvement from 2010 to 2022 but with significant fluctuations, maintaining a generally low level. Singapore steadily increased from 2010 to 2021, with a slight decline in 2022, but remained high overall. Thailand declined from 2010 to 2016 but gradually recovered after 2017, while Vietnam declined from 2010 to 2015, improved gradually after 2016, and stabilized after 2020.

4.2.8 Discussion on CBEC Development Level

Following the analysis of the CBEC development levels, we derived the composite score weights for various primary and secondary indicators, as shown in Table 4.9. These weights highlight the relative importance of each indicator in calculating the CBEC development levels among RCEP countries. Understanding these weights is essential for identifying key factors influencing e-commerce growth and areas for improvement.

Table 4.9 provides detailed information on the weights of composite scores, categorized into primary and secondary indicators. This helps to clearly see the relative importance of each indicator in the calculation of CBEC development levels, which is

crucial for understanding the development levels and influencing factors in the field of CBEC among different countries.

Table 4.9: Weights of Composite Scores for Primary and Secondary Indicators

Species	Primary Indicator	Secondary Indicator	Coefficient	Composite Weight
Leading Species	Scale of Transactions (LS)	Import Volume (LS1)	0.0953	0.1908
		Export Volume (LS2)	0.0955	
Key Species	Manufacturers and Consumers (KS)	Manufacturing Value Added (KS1)	0.0898	0.1289
		Internet Users (KS2)	0.0391	
Supporting Species	Logistics Performance (LP)	Tracking Ability (LP1)	0.0666	0.384
		Logistics Quality (LP2)	0.0665	
		Pricing Ease (LP3)	0.0676	
		Customs Efficiency (LP4)	0.0547	
		Timeliness (LP5)	0.059	
		Infrastructure Quality (LP6)	0.0695	
	Information Flow (IF)	Digital Technology (IF1)	0.0666	0.2551
		Digital Infrastructure (IF2)	0.0686	
		Digital Market (IF3)	0.0824	
		Digital Governance (IF4)	0.0375	
	Cash Flow (CF)	Number of Banks (CF1)	0.0188	0.0413
		Per Capita Income (CF2)	0.0225	

Primary Indicators:

Scale of Transactions (LS): Includes Import Volume (LS1) and Export Volume (LS2). The weights of these two indicators sum up to provide the composite weight for the Scale of Transactions. Manufacturers and Consumers (KS): Includes Manufacturing Value Added (KS1) and Internet Users (KS2). The weights of these two indicators sum up to provide the composite weight for Manufacturers and Consumers. Logistics Performance (LP): Includes Tracking Ability (LP1), Logistics Quality (LP2), Pricing Ease (LP3), Customs Efficiency (LP4), Timeliness (LP5), and Infrastructure Quality (LP6). The weights of these indicators sum up to provide the composite weight for Logistics Performance. Information Flow (IF): Includes Digital Technology (IF1), Digital Infrastructure (IF2), Digital Market (IF3), and Digital Governance (IF4). The weights of these indicators sum up to provide the composite weight for Information Flow. Cash Flow (CF): Includes Number of Banks (CF1) and Per Capita Income (CF2). The weights of these two indicators sum up to provide the composite weight for Cash Flow.

Secondary Indicators:

Each secondary indicator's weight is listed along with the adjusted composite weight.

From the ecosystem perspective of CBEC, the distribution of total weights across Leading Species, Key Species, and Supporting Species at 0.1908, 0.1289, and 0.6804 (derived by summing the coefficients for LP, IF and CF: $0.384 + 0.2551 + 0.0413$) respectively, highlights the predominant influence of Supporting Species, which account for 68.03% of the development level of CBEC. This empirical evidence underscores the critical role of Supporting Species in enhancing CBEC development, corroborating Li's findings (Li & Wang, 2018).

For primary indicators, the allocation of weights to the Scale of goods imports and export transactions (19.09%), Manufacturers and Consumers (12.89%), Logistics Performance (38.4%), Information Flow (25.51%), and Cash Flow (4.13%) reinforces Zhang's (2021) view of the CBEC ecosystem. Wang et al. (2020) found that CBEC companies significantly improved supply chain service capabilities and customer satisfaction through effective management of information, logistics, and capital flows (Wang et al., 2020). Liu (2018) discussed the impact of international logistics models on CBEC business scale, emphasizing the critical role of logistics infrastructure in promoting CBEC development (Liu, 2018). Jiang (2021) noted that the application of information technology in CBEC significantly reduced operating costs and facilitated efficient resource interaction, contributing positively to CBEC development (Jiang, 2021). The prominence of logistics underscores its essential role in CBEC development, aligning with Zhang and Ma's (2015) argument about the developmental constraints posed by inadequate logistics. The significant weighting of the TIMG index, representing Information Flow and second

only to logistics, supports Zhang and Li's (2020) assertion of the digital economy as foundational to CBEC and digital trade development. Fedulova (2021) studied the impact of data flow on global e-commerce growth and found that digital technology plays a crucial role in supporting international trade and economic activities (Fedulova, 2021).

At the secondary indicator level, weights for the Import volume of goods, Export volume of goods, and Manufacturing value added, all exceeding 9%, lend partial support to He and Wang's (2019) observation of GDP's influence on CBEC trade. Conversely, the minor weights assigned to Cash Flow's secondary indicators suggest a limited impact of capital flow on CBEC development. Li (2014) showed that stable cash flow can effectively improve the operational efficiency of e-commerce enterprises, but its overall impact on CBEC development is relatively low (Li, 2014).

Nationally, China's leading position in global CBEC development is attributed to its rapidly advancing logistics and network infrastructure and enhanced customs efficiency, mirroring real-world observations and validating the constructed index system's authenticity and comprehensiveness. Tang (2023) studied the coordinated development of CBEC and international transportation, showing significant growth in CBEC transaction volume and the orderliness of the logistics subsystem, confirming China's leading position in CBEC development (Tang, 2023). Singapore's advanced financial services, manufacturing sector, and open policies contribute to its high ranking within RCEP, reflecting economic development. The study notes a universally positive, albeit varied, growth trend in CBEC development across countries, diverging from Shen's findings on

Australia and South Korea's comparable levels, likely due to dataset variations between G20 and RCEP countries, indicating further research opportunities(Shen, 2023). Laos's position at the lower end, attributed to its economic and e-commerce infrastructure development levels, aligns with Song 's assessments of ASEAN countries like Myanmar, Laos, and Cambodia, highlighting the influence of economic status, infrastructure, and logistics efficiency on CBEC development disparities(Song, 2021).

4.3 Analysis of CBEC Trade Volumes and Potential Scores

This section presents the results of the analysis, focusing on the theoretical CBEC trade volumes between China and RCEP member countries and their corresponding trade potential scores.

4.3.1 Descriptive Statistics

The dataset used in this study covers CBEC trade-related data between China and the 15 RCEP countries from 2013 to 2022. Descriptive statistical analysis of key variables is conducted to show their basic characteristics such as mean, standard deviation, minimum, and maximum values.

Table 4.10 presents the descriptive statistics of the original values for key variables. These include the import trade volume (Im_{ej}), calculated using Equation 3.10; the CBEC export trade volume (Ex_{ej}), calculated using Equation 3.11; and the total trade volume (Tre_{ij}), which is the sum of Ex_{ej} and Im_{ej} , calculated using Equation 3.12. Additionally, the table includes the partner country per capita GDP ($PGDP_j$), China's per capita GDP

(PGDP_i), and a variable representing the interaction of physical distance and international oil price (Distoil), which signifies transaction costs related to distance.

Table 4.10: Descriptive Statistics of Original Values

Variable	Obs	Mean	Std. Dev.	Min	Max	Metric
Exe _j	110	163.0	144.0	2.11	592.0	million USD
Ime _j	110	60.2	66.9	0.23	255.0	million USD
Tre _{ij}	110	223.0	204.0	2.34	823.0	million USD
CBEC _i	110	1.15	0.28	0.83	1.69	—
CBEC _j	110	-0.1	0.71	-2.08	1.03	—
PGDP _j	110	32.43	26.71	5.24	127.61	thousand USD
PGDP _i	110	15.53	3.02	11.87	21.48	thousand USD
Distoil	110	0.304	0.236	0.039	1.169	million km * USD/barrel
TIMG _i	110	73.58	6.74	63.43	81.42	—
BORDER _{ij}	110	0.18	0.39	0.0	1.0	0 or 1

*The data includes various variables such as CBEC export trade volume (Exe_j, unit: million USD), CBEC import trade volume (Ime_j, unit: million USD), total CBEC trade volume (Tre_{ij}, unit: million USD), partner country per capita GDP (PGDP_j, unit: thousand USD), China's per capita GDP (PGDP_i, unit: thousand USD), the product of physical distance and international oil price (Distoil, unit: million km * USD / barrel), China's digital economy development index (TIMG_i), and BORDER_{ij}, which is a dummy variable indicating whether the trading partners share a common border.*

The mean, standard deviation, minimum, and maximum values of each variable are expressed in their original units, providing an intuitive understanding of the data distribution. For example, the mean of Exe_j is USD 163 million, with a standard deviation of USD 144 million, a minimum of USD 2.11 million, and a maximum of USD 592 million. Similarly, the means of PGDP_j and PGDP_i are USD 32.43 thousand and USD 15.53 thousand, respectively, reflecting the per capita GDP levels of partner countries and China.

To reduce heteroscedasticity and skewness in the data and to make nonlinear relationships more linear, we performed log transformations on some variables. Table 4.11 presents the descriptive statistics of the log-transformed values.

Table 4.11: Descriptive Statistics of Log-Transformed Values

Variable	Obs	Mean	Std. Dev.	Min	Max
$\ln Ex_{ej}$	110	18.3	1.38	14.56	20.2
$\ln Im_{ej}$	110	17.14	1.48	12.36	19.36
$\ln Tre_{ij}$	110	18.6	1.39	14.67	20.53
$\ln CBEC_i$	110	0.11	0.24	-0.19	0.52
$\ln CBEC_j$	110	0.56	0.67	-3.77	1.14
$\ln PGDP_j$	110	10.05	0.85	8.56	11.76
$\ln PGDP_i$	110	9.63	0.19	9.38	9.97
$\ln Distoil$	110	12.36	0.74	10.57	13.97
<i>The variables include $\ln Ex_{ej}$ which represents the log of CBEC exports; $\ln Im_{ej}$, the log of CBEC imports; $\ln CBEC_i$, the log of the China's CBEC development level; $\ln CBEC_j$, the log of the partner country's CBEC development level; $\ln PGDP_i$, the log of PGDP of China; $\ln PGDP_j$, the log of PGDP of the partner country; $\ln Distoil$, the log of the distance weighted by oil prices.</i>					

Table 4.11 presents the descriptive statistics of the log-transformed values of key variables. The purpose of the log transformation is to reduce heteroscedasticity and skewness in the data and to make nonlinear relationships more linear. The mean and standard deviation of the log-transformed variables, such as $\ln Ex_{ej}$, $\ln Im_{ej}$, and $\ln Tre_{ij}$, show a more uniform distribution. For example, the mean of $\ln Ex_{ej}$ is 18.30 with a standard deviation of 1.38, a minimum of 14.56, and a maximum of 20.20. The log-transformed data distribution is closer to a normal distribution, which helps to improve the robustness and accuracy.

4.3.2 CBEC Import Volumes Estimation Results: Baseline and Moderating Effect Models

In this section, we present the estimation results for CBEC import trade volume, including both the baseline model and the model with moderating effects. The two-step system Generalized Method of Moments (GMM) method was used for the analysis.

The selection of the moderating variable, $TIMG_i$, is based on the hypothesis that China's digital economy development influences the relationship between CBEC development and CBEC import trade volumes. This hypothesis is supported by prior research, such as Zhang and Li (2020), who emphasized the foundational role of the digital economy in CBEC import. $TIMG_i$, China's digital economy development index, captures the level of digital infrastructure and digital market development in China. By interacting $\ln CBEC_i$ with $TIMG_i$, the model tests whether the impact of CBEC development on imports is moderated by the digital economy.

The selection of instrumental variables in the two-step system GMM estimation is critical for addressing potential endogeneity issues. The instruments used include lagged values of the dependent variable and endogenous regressors. This approach is supported by Arellano and Bond (1991) and Arellano and Bover (1995), who demonstrated the effectiveness of using lagged variables as instruments in dynamic panel models. Specifically:

Lagged values of $\ln Ime_j$ (lagged by two and three periods) are used as GMM-type instruments for the lagged dependent variable.

Lagged values of $\ln\text{CBEC}_i$ (lagged by two and three periods) are used as GMM-type instruments for the CBEC development variable.

$\ln\text{Distoil}$ and BORDER_{ij} are used as standard instruments for the levels equation. These variables are assumed to be exogenous and provide additional identification for the model, following the practice recommended by Blundell and Bond (1998).

Table 4.12 provides an overview of each variable used in the model, including its definition, transformation method, and expected or theoretical role in the CBEC import trade equation.

Table 4.12: Variables Used in the CBEC Import Estimation Models

Variable	Definition	Transformation	Theoretical Role
$\ln\text{Imej}$ (Lagged)	Lagged value of log CBEC import trade volume	Log-transformed, lagged	Captures dynamic trade behavior and path dependence
$\ln\text{CBEC}_i$	China's CBEC development level	Log-transformed	Expected positive impact on imports
$\ln\text{CBEC}_j$	Partner country's CBEC development level	Log-transformed	Expected positive impact, facilitating export to China
$\ln\text{CBEC}_i \times \text{TIMG}_i$	Interaction of China's CBEC level and digital economy index	Constructed term	Tests moderating effect of digital development
$\ln\text{PGDP}_j$	Per capita GDP of partner country	Log-transformed	Expected positive or neutral (demand side effect)
$\ln\text{PGDP}_i$	Per capita GDP of China	Log-transformed	Expected positive or neutral (income elasticity)
$\ln\text{Distoil}$	Distance multiplied by international oil prices	Log-transformed	Proxy for trade cost; expected negative impact
Constant	Constant term in regression	—	Baseline intercept

The results of the baseline and moderating effect models are shown in Table 4.12, which presents the results of the two-step system GMM estimation for CBEC import trade volume, focusing on the moderating effect model.

Table 4.13: Two-Step System GMM Estimation Results for CBEC Import Volume with Moderating Effect

Variable	Baseline Model Coefficient	Std. Error (Baseline)	T-value (Baseline)	Moderating Effect Model Coefficient	Std. Error (Moderating)	T-value (Moderating)
$\ln \text{Ime}_j$ (Lagged)	1.0156***	0.1003	10.13	1.0224***	0.0886	11.54
$\ln \text{CBEC}_i$	-0.1990	0.3974	-0.50	3.3763**	1.1685	2.89
$\ln \text{CBEC}_j$	0.1124	0.1066	1.05	0.1170*	0.0436	2.69
$\ln \text{CBEC}_i \times \text{TIMG}_i$	—	—	—	-0.0483**	0.0140	-3.45
$\ln \text{PGDP}_j$	-0.2011	0.2929	-0.69	-0.2173	0.1810	-1.20
$\ln \text{PGDP}_i$	-0.5885	0.5525	-1.07	-0.3676	0.3645	-1.01
$\ln \text{Distoil}$	0.0625	0.1025	0.61	0.0856	0.1053	0.81
Constant	6.8988	3.9581	1.74	4.5912	2.6217	1.75
Number of Observations	99	—	—	99	—	—
Number of Groups	11	—	—	11	—	—
Number of Instruments	9	—	—	9	—	—
AR (1) p-value	0.018	—	—	0.008	—	—
AR (2) p-value	0.495	—	—	0.314	—	—
Hansen J-test p-value	0.025	—	—	0.299	—	—
Sargan test p-value	0.043	—	—	0.316	—	—

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The coefficient for the lagged dependent variable ($\ln \text{Ime}_j$) is significant, indicating significant dynamic effects in CBEC import trade. The coefficient is 1.0224 ($t = 11.54$, $p < 0.001$), suggesting strong persistence in import trade.

For the variable $\ln \text{CBEC}_i$, the coefficient for China's CBEC import trade volume is positive and significant ($\beta = 3.3763$, $t = 2.89$, $p < 0.01$), indicating that China's digital economy development significantly enhances the impact of CBEC development on import trade.

The coefficient for the partner country's CBEC export trade volume ($\ln \text{CBEC}_j$) is also positive and significant ($\beta = 0.1170$, $t = 2.69$, $p < 0.05$), suggesting a positive impact on import trade.

The interaction term $\ln \text{CBEC}_i \times \text{TIMG}_i$ is significant ($\beta = -0.0483$, $t = -3.45$, $p < 0.01$), indicating that China's digital economy development mitigates the direct impact of CBEC development on import trade.

The coefficients for other variables, such as partner country per capita GDP ($\ln \text{PGDP}_j$), China's per capita GDP ($\ln \text{PGDP}_i$), and the product of physical distance and international oil price ($\ln \text{Distoil}$), are not significant, suggesting a minor direct impact on CBEC import trade. Specifically, for $\ln \text{PGDP}_j$, the coefficient is -0.2173 ($t = -1.20$). For $\ln \text{PGDP}_i$, the coefficient is -0.3676 ($t = -1.01$). For $\ln \text{Distoil}$, the coefficient is 0.0856 ($t = 0.81$). The constant term is not significant, with a coefficient of 4.5912 ($t = 1.75$).

For statistical tests, the AR (1) test is significant, while the AR (2) test is not, indicating that the first-order differencing adequately addresses the autocorrelation issue. The AR (1) p-value is 0.008, and the AR (2) p-value is 0.314. Both the Sargan and Hansen tests are passed, indicating that the choice of instruments is appropriate. The Hansen J-test p-value is 0.299, and the Sargan test p-value is 0.316. The statistical tests confirm the robustness and validity of the model.

Table 4.13 highlights the significant factors influencing CBEC import trade volume, emphasizing the role of China's digital economy in moderating the effects of CBEC development on imports. Specifically,

1) Impact of CBEC Development Level

The CBEC development level between China and RCEP partner countries has a significant positive impact on CBEC import volumes, consistent with the initial hypothesis. Under the influence of globalization and advancements in information technology, CBEC has significantly influenced China's international trade, enhancing economic connections and cooperation between countries. CBEC platforms have facilitated trade between China and ASEAN countries, leading to noticeable growth in imports (Li et al., 2022). Additionally, the development of CBEC has notably improved trade efficiency between China and countries along the Belt and Road Initiative, particularly in terms of infrastructure development and e-commerce environment enhancement (Shen & Chen, 2020).

2) Moderating Effect of the Digital Economy Development Index

Under the moderating effect of the Digital Economy Development Index, the positive impact of China's CBEC development on import volumes becomes negative. Gurumurthy et al. (2017) highlight that cross-border data flows in trade agreements can negatively impact economic growth, particularly in countries with a high Digital Economy Development Index, potentially exacerbating inequality and trade imbalances. Similarly, Zainuddin et al. (2020) find that the impact of non-tariff measures on bilateral exports among RCEP countries varies significantly depending on their level of digital economy development and technology, with high digital economy index countries potentially experiencing suppressed import growth. Some studies indicate that while CBEC promotes imports by reducing transaction costs and improving market accessibility, the dynamics introduced by the digital economy might reduce reliance on traditional import mechanisms, thus weakening or even reversing the positive impact of CBEC on imports (Wang, 2020). The combination of rapid digital economy development and CBEC indeed has complex effects on imports. Although CBEC facilitates imports, this effect may be moderated in a highly developed digital economy, and under certain conditions, it could turn negative. For instance, digital trade barriers and unequal development can inhibit the positive effects of CBEC (Liao & Yu, 2023). Digital service trade barriers can reduce the positive impact of CBEC, especially in countries with highly developed digital economies, where these barriers more significantly inhibit import growth (Hao et al., 2023).

The final model for CBEC import trade volume, incorporating the moderating effect, is expressed as follows:

$$\begin{aligned} \ln Ime_{jt} = & 4.5912 + 1.0224 \ln Ime_{jt-1} + 3.3763 \ln CBEC_{it} + 0.117 \ln CBEC_{jt} \\ & - 0.3676 \ln PGDP_{it} - 0.0483 (\ln CBEC_{it} \times TIMG_{it}) \\ & - 0.2173 \ln PGDP_{jt} + 0.0856 \ln Distoil_{ijt} \end{aligned} \quad \text{Equation 4.4}$$

4.3.3 CBEC Export Volumes Estimation Results: Dynamic Panel System GMM

In this section, the estimation results for CBEC export trade volume are presented using the dynamic panel system GMM method. Although the dataset covers 2013 to 2022, the regression analysis starts from 2015 due to the model's requirement for lagged variables and the short panel structure. Specifically, to meet the data sufficiency conditions of the system GMM method, the data were grouped into five intervals (e.g., 2013 – 2014, 2015 – 2016), with each group treated as a composite period. This grouping approach enables more stable parameter estimation by reducing short-term fluctuations while satisfying lag structure conditions.

The selection of instrumental variables in the two-step system GMM estimation for export trade volume is crucial to address potential endogeneity issues. In this analysis, the instruments were chosen based on their relevance and exogeneity:

Lagged values of $\ln Exe_j$ (lagged by two periods) are used as GMM-type instruments for the lagged dependent variable. This choice helps to control for the dynamic nature of the panel data and correct for potential endogeneity arising from the lagged dependent variable.

Lagged values of $\ln\text{CBEC}_i$ and $\ln\text{CBEC}_j$ (lagged by two periods) are included as GMM-type instruments to address the potential endogeneity of the CBEC variables. Using lagged values helps to mitigate simultaneity bias and ensures that the instruments are not contemporaneously correlated with the error terms.

BORDER_{ij} and Year are used as standard instruments for the levels equation. BORDER_{ij} represents the presence of a common border between China and its partner countries, while Year accounts for the time periods. Both are assumed to be exogenous. They help provide additional identification for the model, following Blundell and Bond (1998), ensuring the robustness of the estimation.

Table 4.14 provides an overview of each variable used in the model, including its definition, transformation method, and expected or theoretical role in the CBEC export trade equation.

Table 4.14: Variables Used in the CBEC Export Estimation Models

Variable	Definition	Transformation	Theoretical Role
$\ln\text{Exe}_j$ (Lagged)	Lagged value of log CBEC export trade volume	Log-transformed, lagged	Captures export dynamics and autocorrelation
$\ln\text{CBEC}_i$	China's CBEC development level	Log-transformed	Expected to influence exports, possibly negatively due to domestic substitution
$\ln\text{CBEC}_j$	Partner country's CBEC development level	Log-transformed	Expected positive impact, facilitating import from China
$\ln\text{PGDP}_j$	Per capita GDP of partner country	Log-transformed	Expected positive or neutral impact on export demand
$\ln\text{PGDP}_i$	Per capita GDP of China	Log-transformed	Expected positive impact due to enhanced supply capacity
$\ln\text{Distoil}$	Distance multiplied by oil prices	Log-transformed	Trade cost proxy; expected negative effect
Constant	Constant term	—	Intercept in the regression equation

The estimation results of the baseline and moderating effect models are presented in Table 4.15.

Table 4.15: Two-Step System GMM Estimation Results for CBEC Export Trade Volume

Variable	Coefficient	Std. Error	T-value
$\ln \text{Exe}_j$ (Lagged)	0.9648***	0.0609	15.86
$\ln \text{CBEC}_i$	-1.8409***	0.5085	-3.62
$\ln \text{CBEC}_j$	0.162**	0.0696	2.33
$\ln \text{PGDP}_j$	-0.0856	0.1005	-0.85
$\ln \text{PGDP}_i$	2.0945***	0.6104	3.43
$\ln \text{Distoil}$	-0.0698	0.1477	-0.47
Constant	-17.3159**	6.118	-2.83
Number of Observations	44		
Number of Groups	11		
Number of Instruments	9		
AR (1) p-value	0.099		
AR (2) p-value	0.902		
Hansen J-test p-value	0.177		
Sargan test p-value	0.143		

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.15 summarizes the results of the baseline model estimating CBEC export trade volume using the two-step system GMM method. The coefficient for the lagged dependent variable ($\ln \text{Exe}_j$) is 0.9648 with a t-value of 15.84, indicating strong persistence in export volumes. The coefficient for China's per capita GDP ($\ln \text{PGDP}_i$) is 2.0945 with a t-value of 3.43, showing a significant positive effect of China's economic status on CBEC exports. The negative coefficient for $\ln \text{CBEC}_i$ is -1.8409 with a t-value of -3.62, suggesting that an increase in China's CBEC development level may reduce the need for exports to partner countries. Additionally, the positive coefficient for $\ln \text{CBEC}_j$ is 0.162 with a t-value of 2.33, implying that the CBEC development level of partner countries positively

influences China's export volumes, significant at the 5% level. The coefficient for $\ln \text{PGDP}_j$ is -0.0856 with a t-value of -0.85 indicating a negative but not significant effect of partner countries' per capita GDP on export volumes. The coefficient for $\ln \text{Distoil}$ is -0.0698 with a t-value of -0.47, suggesting that transaction costs related to distance do not significantly affect export volumes. The constant term is -17.3159 with a t-value of -2.83, highlighting other underlying factors affecting export volume.

The Hansen and Sargan tests indicate that the instruments used are appropriate and the model is correctly specified. Specifically, the Hansen test p-value is 0.177 and the Sargan test p-value is 0.143, indicating that the instruments are valid and the model does not suffer from over-identification issues.

These results underscore the importance of China's economic status and CBEC development level on its export volume. The model also highlights the varying impacts of the economic and development levels of partner countries on export. Specifically,

1) Impact of China's CBEC Development Level

The development level of CBEC in China negatively affects CBEC export volumes. An analysis using time series data and VAR models found that although CBEC promotes the export structure in certain cases, its overall development has not significantly increased export volumes and, in some instances, has shown a negative impact (Kang et al., 2022). Research on China's seafood exports found that while CBEC has promoted trade in certain aspects, it has not significantly boosted overall export volumes and may even result in

negative effects due to market saturation and other factors (Jin & Wang, 2022). Additionally, studies have indicated that the rapid growth of CBEC has not led to a sustained increase in export volumes, suggesting limited benefits in enhancing export volumes and even potential negative impacts (Lei & Yan, 2019).

2) Impact of Partner Countries' CBEC Development Level

The development level of CBEC in partner countries positively affects CBEC export volumes. Li et al. (2016) used a computable general equilibrium model to simulate the potential impact of RCEP on China and other major countries, finding that the economic development levels of RCEP member countries, including per capita GDP, have a significant positive effect on China's export trade volume. This partially explains China's insufficient CBEC export trade with Japan and South Korea, indicating that these countries still hold significant export potential. The development of CBEC plays an active role in promoting high-quality foreign trade growth, especially in regions with high internet penetration rates. This is particularly evident in China's trade with developed countries like Japan and South Korea, highlighting their significant potential in CBEC trade (Han & Lee, 2022).

3) Impact of China's Per Capita GDP

China's per capita GDP positively affects CBEC export volumes. Studies have shown that increased per capita GDP not only boosts domestic market demand but also enhances firms' production and export capacities, positively influencing CBEC export

supply (Jin & Wang, 2022). Under the Belt and Road Initiative, China's per capita GDP has significantly improved the supply capacity of CBEC exports, demonstrating the positive impact of economic development on export supply (N' da et al., 2023). Research shows a significant positive correlation between China's economic scale and the supply of CBEC export goods. As the economic scale expands, firms possess stronger production and supply capacities, promoting growth in CBEC export supply (Zhao, 2020). Overall, the increase in China's per capita GDP leads to growth in CBEC export supply, driven by enhanced production and supply capacities due to higher economic development.

4) Impact of Partner Countries' Per Capita GDP

Partner countries' per capita GDP do not significantly affect China's CBEC export volumes. Li et al. (2017) employed a Computable General Equilibrium (CGE) model to assess the potential impact of RCEP on China and other Asian countries, finding that while trade liberalization policies under RCEP can promote trade growth, the per capita GDP of RCEP member countries does not have a significant positive effect on China's CBEC export trade volume. Similarly, Khan et al. (2022) analyzed the potential economic benefits of RCEP for China and found that despite RCEP's role in reducing tariffs and increasing trade flows, the economic development level of member countries, such as per capita GDP, does not show a significant positive impact on China's export trade volume. Research using gravity models indicates that the roles of partner countries' per capita GDP and distance costs are minimal in CBEC trade. These studies highlight other factors, such as internet penetration rates, trade openness, and policy support, as having more significant

impacts on CBEC exports (Ding et al., 2023). Research on ASEAN countries shows that China's CBEC trade volume with these countries is primarily influenced by economic factors, internet penetration rates, and geographical location, with per capita GDP and geographical distance having insignificant impacts on trade volumes (Wang & Cao, 2021).

Based on the estimation results in Table 4.15, we can construct the equation for CBEC export trade volume. Using the coefficients from the model output, we obtain the following equation:

$$\begin{aligned} \ln Exe_{jt} = & -17.3159 + 0.9648 \ln Exe_{jt-1} - 1.8409 \ln CBEC_{it} \\ & + 0.162 \ln CBEC_{jt} + 2.0945 \ln PGDP_{it} - 0.0856 \ln PGDP_{jt} \\ & - 0.0698 \ln Distoil_{ijt} \end{aligned} \quad \text{Equation 4.5}$$

4.3.4 CBEC Total Trade Volumes Estimation Results: Dynamic Panel System GMM

In this section, we present the estimation results for CBEC total trade volume using the dynamic panel system GMM method. This approach is consistent with the method used in the analysis of CBEC export volume. The time is divided into five groups.

The selection of instrumental variables in the two-step system GMM estimation for total trade volume is critical to address potential endogeneity issues. In this analysis, the instruments were chosen based on their relevance and exogeneity:

Lagged values of $\ln Tre_{ij}$ (lagged by one period): These are used as GMM-type instruments for the lagged dependent variable. This choice helps to control for the dynamic nature of the panel data and correct for potential endogeneity arising from the lagged dependent variable.

Lagged values of $\ln\text{CBEC}_i$ and $\ln\text{CBEC}_j$ (lagged by one period): These are included as GMM-type instruments to address the potential endogeneity of CBEC development variables. Using lagged values helps to mitigate simultaneity bias and ensures that the instruments are not contemporaneously correlated with the error terms.

BORDER_{ij} and Year: These are used as standard instruments for the levels equation. BORDER_{ij} represents the presence of a common border between China and partners, while Year accounts for the time periods. Both are assumed to be exogenous and help provide additional identification for the model, ensuring the robustness of the estimation.

Table 4.16 provides an overview of each variable used in the model, including its definition, transformation method, and expected or theoretical role in the CBEC total trade equation.

Table 4.16: Variables Used in the CBEC Total Trade Estimation Model

Variable	Definition	Transformation	Theoretical Role
$\ln\text{Treij}$ (Lagged)	Lagged value of log CBEC total trade volume	Log-transformed, lagged	Captures persistence in total trade behavior
$\ln\text{CBEC}_i$	China's CBEC development level	Log-transformed	May reduce trade due to domestic consumption shift
$\ln\text{CBEC}_j$	Partner country's CBEC development level	Log-transformed	Expected positive impact, increasing trade flows
$\ln\text{PGDP}_j$	Per capita GDP of partner country	Log-transformed	Potentially negative or neutral
$\ln\text{PGDP}_i$	Per capita GDP of China	Log-transformed	Expected positive impact on trade supply capacity
$\ln\text{Distoil}$	Distance multiplied by international oil prices	Log-transformed	Proxy for trade cost; expected negative impact
Constant	Constant term in regression	—	Baseline intercept

These instruments were selected based on their theoretical relevance and empirical effectiveness, ensuring that the model accurately captures the dynamics of CBEC total trade volume. The results of the estimation are presented in Table 4.17, which summarizes the results of the baseline model estimating CBEC total trade volume using the two-step system GMM method.

The coefficient for the lagged total trade volume ($\ln Tre_{ij} L1$) is 1.1264 with a t-value of 4.95, demonstrating a strong persistence in total trade volumes, meaning past total trade volumes significantly influence current total trade volumes. For China's CBEC development level ($\ln CBEC_i$), the coefficient is -1.7571 with a t-value of -2.50, significant at the 5% level, suggesting that as China's CBEC development level increases, the total trade volume with partner countries decreases, which might be due to increased domestic consumption or shifts in trade patterns. Conversely, the partner country's CBEC development level ($\ln CBEC_j$) has a positive coefficient of 0.204 with a t-value of 5.60, significant at the 1% level, indicating that as the partner country's CBEC development level increases, the total trade volume with China also increases.

The partner country's per capita GDP ($\ln PGDP_j$) has a coefficient of -0.181 and a t-value of -1.23, which is not statistically significant, suggesting a potential negative relationship between the partner country's economic status and total trade volume. In contrast, China's per capita GDP ($\ln PGDP_i$) shows a strong positive effect on CBEC total trade, with a coefficient of 1.4562 and a t-value of 3.24, significant at the 1% level. The interaction of physical distance and international oil price ($\ln Distoil$) has a negative

coefficient of -0.173 and a t-value of -1.95, significant at the 10% level, suggesting a negative relationship between transportation costs and total trade volume.

Table 4.17: Two-Step System GMM Estimation Results for CBEC Total Trade Volume

Variable	Coefficient	Std. Error	T-value
$\ln Tre_{ij}$ (Lagged)	1.1264***	0.2276	4.95
$\ln CBEC_i$	-1.7571**	0.7037	-2.50
$\ln CBEC_j$	0.2040***	0.0364	5.60
$\ln PGDP_j$	-0.1810	0.1467	-1.23
$\ln PGDP_i$	1.4562***	0.4492	3.24
$\ln Dist_{oil}$	-0.1729*	0.0888	-1.95
Constant	-11.8955*	5.9150	-2.01
Number of Observations	44		
Number of Groups	11		
Number of Instruments	9		
AR (1) p-value	0.090		
AR (2) p-value	0.343		
Hansen J-test p-value	0.482		
Sargan test p-value	0.293		

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Hansen and Sargan tests confirm that the instruments used are appropriate and the model is correctly specified, ensuring the robustness of the estimation results.

Overall, these results highlight the significant roles of both China's and partner countries' CBEC development levels and China's economic status in influencing CBEC total trade volumes. Specifically,

1) Impact of China's CBEC Development Level

Research indicates that the development of CBEC in China has not significantly altered its import-export structure, and the rapid growth of CBEC has not led to sustained

growth in total trade volumes. This suggests that the development of CBEC has limited effects on increasing total trade volumes and may even have negative impacts (Peng, 2021).

2) Impact of Partner Countries' CBEC Development Level

Studies show that the development of CBEC in partner countries has a significant positive effect on total trade volumes, particularly in regions with high internet penetration rates and good electronic payment environments. The development level of CBEC in partner countries significantly enhances their total trade volumes with China (Han & Lee, 2022). Panel data analysis of five ASEAN countries reveals that the electronic payment environment and per capita income of the importing countries significantly promote China's export trade. Improved electronic payment environments accelerate the convenience and security of CBEC transactions, thereby increasing total trade volumes (Wang, 2019). Research based on the Belt and Road Initiative shows that the development of CBEC further promotes China's trade with related countries. By improving logistics, simplifying customs procedures, and optimizing policy environments, the CBEC development level of partner countries significantly enhances their trade volumes with China (Liu et al., 2020).

3) Impact of China's Per Capita GDP

Research shows that China's per capita GDP has a significant positive effect on total CBEC trade volumes. The development of CBEC reduces trade barriers and costs,

enabling more enterprises to participate in international trade. This promotes total trade growth, especially in contexts with higher economic development levels (Li et al., 2022).

4) Impact of Distance Costs

Distance costs have a negative effect on total CBEC trade volumes at the 10% significance level. Although the impact is not significant when analyzing imports or exports separately, cumulative effects and data aggregation reveal the significance when considering total trade volumes. Research on the EU market finds that logistics and delivery services in CBEC significantly impact distance costs. While rapid delivery services can reduce time-related distances, increased logistics costs still negatively affect transaction volumes (Kim et al., 2017). Analysis of CBEC transaction costs, including transportation costs and tariffs, shows that these costs have a significant negative impact on international trade growth. Despite the facilitation of trade by CBEC, increased distance costs still limit total import-export trade volumes (Wang et al., 2017). Llano - Verduras et al. (2011) analyzed the negative impact of geographical distance on trade flows by combining international and domestic flow data, finding that the negative effect of distance on international trade is accurately estimated when smaller geographical units are used to measure bilateral trade flows, indicating a significant adverse impact of distance on CBEC trade volume.

Based on the estimation results presented in Table 4.17, we can construct the equation for CBEC total trade volume. Using the coefficients obtained from the GMM model, the equation is as follows:

$$\begin{aligned} \ln Tre_{jt} = & -11.89533 + 1.1264 \ln Tre_{jt-1} - 1.7571 \ln CBEC_{it} \\ & + 0.204 \ln CBEC_{jt} + 1.4562 \ln PGDP_{it} - 0.181 \ln PGDP_{jt} \\ & - 0.173 \ln Distoil_{ijt} \end{aligned} \quad \text{Equation 4.6}$$

Equation 4.6 incorporates the lagged value of the total trade volume, China's and the partner country's CBEC development levels, the per capita GDP of both China and the partner country, and the interaction of physical distance and international oil price. The coefficients reflect the estimated impact of each variable on the total trade volume.

The results presented across Sections 4.3.2 to 4.3.4 reveal nuanced dynamics in the CBEC trade potential between China and RCEP member countries. First, although China's CBEC development significantly promotes import volumes, this effect is moderated by its digital economy development level, suggesting that high digitalization may shift some cross-border demand to domestic platforms due to efficiency gains and consumer substitution effects (Zainuddin et al., 2020; Hao et al., 2023). Second, partner countries' CBEC development levels exhibit a consistent positive impact across import, export, and total trade models. However, the strength of this impact is not uniform. Economies like Singapore, South Korea, and Japan—characterized by mature e-commerce infrastructure—benefit more from digital trade integration with China, while lower-income RCEP countries such as Laos or the Philippines, constrained by logistics and digital infrastructure, may underperform relative to their trade potential (Han & Lee, 2022; Wang & Cao, 2021).

Furthermore, the finding that China's CBEC development negatively impacts export volumes may reflect a growing inward focus of Chinese platforms or consumer market saturation in some product categories (Lei & Yan, 2019; Kang et al., 2022). Meanwhile, the non-significance of partner countries' per capita GDP in most models suggests that digital readiness and CBEC-specific ecosystems may outweigh traditional economic size in driving trade growth (Ding et al., 2023). Lastly, the observed negative effect of distance-related costs on total trade underscores the persistent role of physical and logistical barriers even within the digital trade era (Llano - Verduras et al., 2011).

These findings collectively indicate that CBEC trade potential is shaped not only by technological and economic fundamentals but also by structural asymmetries between China and its RCEP partners. Countries at different stages of digital and e-commerce development face distinct constraints and opportunities. Therefore, policy recommendations should be tailored to country-specific profiles—for instance, enhancing digital payment systems and logistics infrastructure in ASEAN least developed members, while fostering platform interoperability and trust mechanisms in high-income RCEP economies.

The robustness of the GMM estimation was assessed using standard diagnostic tests. The Arellano-Bond test for first-order autocorrelation (AR(1)) was significant while the second-order test (AR(2)) was not, suggesting no serial correlation in the differenced residuals. Moreover, both the Hansen J-test and Sargan test indicate that the over-identifying restrictions are valid, confirming the appropriateness of the instruments. These

results validate the reliability of the model estimations across import, export, and total trade models.

4.3.5 Calculation of CBEC Trade Potential Scores

By inputting the variable values into the Equation 4.4, 4.5 and 4.6, respectively, theoretical values for CBEC import, export and total trade are calculated. Subsequently, the ratio of actual to theoretical values is used to assess the import, export and total trade potentials between China and its RCEP partner countries (refer to Equation 3.13)

Table 4.18: Import Potential Scores between China and RCEP Partners

Country	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average
AUS	0.9236	0.8709	0.9545	1.016	0.9129	1.2372	0.9876	1.2674	0.9093	1.0088
IDN	0.6035	0.7854	0.8914	0.8377	0.8045	0.8897	0.9183	1.2757	1.0304	0.893
JPN	1.0007	1.0901	1.0716	0.9127	0.9408	1.0752	1.0819	1.1144	0.9683	1.0284
KOR	1.0963	1.2139	1.0292	0.9711	1.0907	1.0495	1.171	1.2912	1.1321	1.1161
LAO	1.7008	1.1107	1.1932	0.8987	0.9813	1.1064	0.9499	1.135	1.2071	1.1426
MYS	0.8237	1.0616	0.8762	0.8085	0.93	1.1959	1.0129	1.1276	1.1053	0.9935
NZL	1.0843	0.8107	1.1047	1.0171	0.9695	1.239	0.9885	1.2367	1.054	1.0561
PHL	0.8881	0.8655	0.7586	0.7002	0.7353	0.8854	0.7892	0.947	0.7775	0.8163
SGP	1.1798	1.2788	1.1464	1.2371	1.0059	1.4012	1.1217	1.4064	1.1457	1.2137
THA	1.0237	1.618	1.1415	0.9417	0.9515	0.9838	1.1151	0.9538	0.8883	1.0686
VNM	0.7672	0.9403	0.8689	0.6924	0.7407	0.9476	0.9022	0.9934	0.8114	0.8516

Note: The values represent the ratio of actual to theoretical import potential, with higher values indicating lower potential and lower values indicating greater potential.

Table 4.18 displays the import potential scores between China and its RCEP partner countries from 2014 to 2022. Due to the one-period lag, values for 2013 are not available. The values represent the ratio of actual to theoretical import potential, with higher values indicating lower potential and lower values indicating greater potential. The table also includes the average import potential score for each country over the period.

Overall, the data reveals significant variation in import potential scores across different countries and years. Countries such as Laos, Indonesia, and the Philippines generally show lower import potential scores, indicating greater potential for growth in CBEC with China. These countries have average import potential scores closer to or below 1.0, reflecting substantial room for trade expansion.

Conversely, countries like Singapore, South Korea, and Japan exhibit higher average import potential scores, suggesting relatively lower potential for further growth. These countries often have values above 1.0, indicating that their actual import volumes are closer to the theoretical import volumes.

Australia, Malaysia, and New Zealand show moderate import potential scores, with averages around 1.0, indicating balanced trade potential. Fluctuations in their yearly values suggest variable performance across different periods.

Table 4.19 presents the export trade potential scores for CBEC between China and its RCEP partners.

Table 4.19 presents the export potential scores between China and its RCEP partner countries for the periods 2015-2016, 2017-2018, 2019-2020, and 2021-2022, along with the average potential scores across these periods. Due to a one-period lag, the values for 2013-2014 are missing. The export potential scores indicate the ratio of actual exports to theoretical export potential, with higher values signifying closer alignment or exceeding of actual trade to theoretical potential, thereby suggesting smaller room for growth in CBEC trade.

Table 4.19: Export Potential Scores between China and RCEP Partners

Country	2015-2016	2017-2018	2019-2020	2021-2022	Average
AUS	1.085	1.1232	1.1132	1.1194	1.1102
IDN	0.8785	1.0485	0.9735	1.0706	0.9928
JPN	0.8722	0.9529	0.8729	0.8255	0.8809
KOR	0.95	0.9273	0.8852	0.9446	0.9268
LAO	0.8587	1.1644	0.965	0.8449	0.9582
MYS	0.8858	0.9915	1.126	1.1412	1.0361
NZL	1.1295	1.0408	0.9915	1.121	1.0707
PHL	1.2388	1.0173	1.0169	0.9587	1.0579
SGP	1.0823	0.9587	1.1419	0.9397	1.0307
THA	1.0977	0.9496	1.0129	1.06	1.03
VNM	1.0858	1.0471	1.1434	0.9089	1.0463

Note: The export potential scores indicate the ratio of actual exports to theoretical export potential, with higher values signifying closer alignment or exceeding of actual trade to theoretical potential, thereby suggesting smaller room for growth in CBEC trade.

The data shows that Australia (AUS) has relatively high export potential scores, with an average of 1.1102, indicating consistent performance across the periods. In contrast, Indonesia (IDN) shows variability in its export potential, with an average value of 0.9928, peaking at 1.0706 in 2021-2022. Japan (JPN) displays lower potential scores, with

an average of 0.8809, suggesting higher trade potential score. South Korea (KOR) maintains relatively stable potential scores, with an average of 0.9268. Laos (LAO) shows higher export potential scores, with an average of 0.9582, reaching its peak in 2017-2018.

Malaysia (MYS) displays increasing potential scores with an average of 1.0361, while New Zealand (NZL) has high potential scores, averaging 1.0707. The Philippines (PHL) shows potential scores with an average of 1.0579. Singapore (SGP) exhibits varying potential scores with an average of 1.0307. Thailand (THA) displays relatively balanced potential scores, averaging 1.03. Vietnam (VNM) shows higher potential scores with an average of 1.0463.

Table 4.20 presents the total trade potential scores between China and its RCEP partner countries for the periods 2015-2016, 2017-2018, 2019-2020, and 2021-2022, along with the average potential scores across these periods. Table 4.17 provides the calculated potential scores for CBEC total trade between China and its RCEP partner countries from 2015 to 2022. These values are derived using the established equation, reflecting the ratio of actual trade to the theoretical trade volume. Because of the one-period lag, data for 2013-2014 is missing. The average potential scores across the years offer insights into the trade dynamics and indicate which countries have higher or lower trade potential in relation to China. Higher potential scores indicate that the actual trade is close to or exceeds the theoretical trade volume, signifying smaller room for growth in CBEC trade.

Table 4.20: Total Trade Potential Scores between China and RCEP Partners

Country	2015-2016	2017-2018	2019-2020	2021-2022	Average
AUS	1.1341	1.3006	1.2711	1.2127	1.2296
IDN	0.8152	1.0304	0.9417	1.1724	0.9899
JPN	0.6774	0.735	0.6793	0.6739	0.6914
KOR	0.7131	0.6864	0.6375	0.7161	0.6883
LAO	1.5453	1.7603	1.5119	1.4244	1.5605
MYS	0.8714	0.9632	1.1222	1.1193	1.019
NZL	1.7005	1.7492	1.654	1.7388	1.7106
PHL	1.1153	0.8902	0.8786	0.8848	0.9422
SGP	1.1367	1.0444	1.2015	1.0824	1.1163
THA	1.1325	0.9668	0.9724	0.9623	1.0085
VNM	0.8537	0.7937	0.8587	0.7374	0.8109

Note: Higher potential scores indicate that the actual trade is close to or exceeds the theoretical trade volume, signifying smaller room for growth in CBEC trade.

Australia (AUS) maintains a relatively high average potential score of 1.2296, with its highest value in the 2017-2018 period (1.3006) and a slight decrease in the subsequent years. Indonesia (IDN) shows variability, with an average value of 0.9899, reaching its highest potential score in 2021-2022 (1.1724). Japan (JPN) has consistently low potential scores, with an average of 0.6914, indicating higher trade potential. South Korea (KOR) displays a similar trend, with an average value of 0.6883, peaking in the 2021-2022 period (0.7161). Laos (LAO) exhibits the highest potential scores among all countries, with an average of 1.5605 and the peak in 2017-2018 (1.7603). Malaysia (MYS) shows an increasing trend, with an average value of 1.019, reaching its highest in 2019-2020 (1.1222). New Zealand (NZL) maintains high potential scores with an average of 1.7106, indicating lower trade potential. The Philippines (PHL) has an average potential score of 0.9422, with a slight decrease in the later years. Singapore (SGP) displays moderate

potential scores with an average of 1.1163, peaking in 2019-2020 (1.2015). Thailand (THA) has an average value of 1.0085, with its highest potential score in 2015-2016 (1.1325). Vietnam (VNM) shows lower potential scores with an average of 0.8109, indicating higher trade potential compared to other countries.

4.3.6 Classification of CBEC Trade Potentials

Based on the classification framework previously introduced in Section 3.6, this section categorizes the CBEC trade potential between China and RCEP partner countries into three broad types — significant potential, exploratory potential, and reconstructive potential—with further sub-categorization for exploratory potential into under-trade, ideal trade, and sufficient trade (Liu, 2022). The specific classification is shown in Figure 4.3.

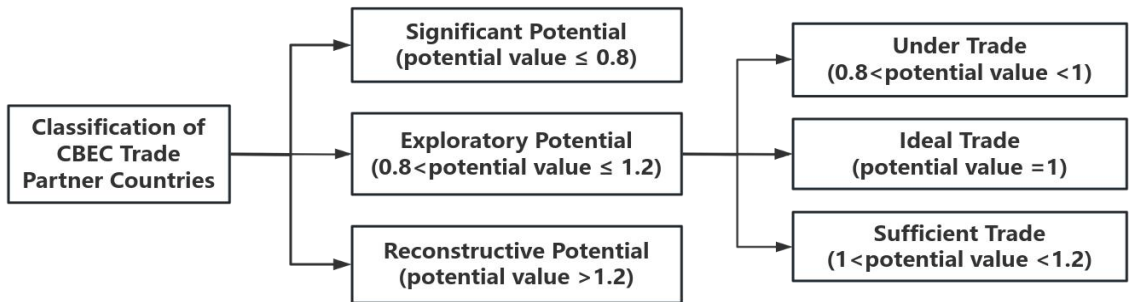


Figure 4.3: Classification of CBEC Trade Potential among RCEP Countries

According to the classification standard in Figure 4.3, the trade potential of CBEC imports, exports, and total trade between China and RCEP partner countries can be categorized as follows:

Table 4.21: China's CBEC Trade Potential Scores and Classifications with RCEP Partners

Country Name	Potential Score (Average)					
	Import	Classification	Export	Classification	Total Trade	Classification
AUS	1.0088	Sufficient Trade	1.1102	Sufficient Trade	1.2296	Reconstructive Potential
IDN	0.893	Under Trade	0.9928	Under Trade	0.9899	Under Trade
JPN	1.0284	Sufficient Trade	0.8809	Under Trade	0.6914	Significant Potential
KOR	1.1161	Sufficient Trade	0.9268	Under Trade	0.6883	Significant Potential
LAO	1.1426	Sufficient Trade	0.9582	Under Trade	1.5605	Reconstructive Potential
MYS	0.9935	Under Trade	1.0361	Sufficient Trade	1.019	Sufficient Trade
NZL	1.0561	Sufficient Trade	1.0707	Sufficient Trade	1.7106	Reconstructive Potential
PHL	0.8163	Under Trade	1.0579	Under Trade	0.9422	Under Trade
SGP	1.2137	Reconstructive Potential	1.0307	Sufficient Trade	1.1163	Sufficient Trade
THA	1.0686	Sufficient Trade	1.03	Sufficient Trade	1.0085	Sufficient Trade
VNM	0.8516	Under Trade	1.0463	Sufficient Trade	0.8109	Under Trade

Note: Classifications are based on the benchmark rules described in Section 3.6, where $TPS \leq 0.8$ = significant potential, $0.8 < TPS \leq 1.2$ = exploratory potential (with subtypes), $TPS > 1.2$ = reconstructive potential.

Table 4.21 summarizes the average trade potential scores across import, export, and total CBEC trade for each RCEP partner country during the study period (2013 – 2022), along with their corresponding classifications.

Based on this classification, we can further analyze the findings and discuss the implications. Specially,

1) Classification of Import Trade Potential

Singapore is classified as having reconstructive potential in CBEC import trade, while Indonesia, Malaysia, the Philippines, and Vietnam are classified as under trade. Singapore, with its efficient internet infrastructure and high economic development level, is considered a country with reconstructive potential in CBEC import trade. Studies have shown that Singapore displays high trade volumes in CBEC with China, mainly due to its economic factors and high internet penetration rate (Wang & Cao, 2021). Despite Indonesia's large population and market, inadequate infrastructure and regulatory frameworks limit the development of its CBEC import trade. Vietnam, while having a high internet coverage rate and an active e-commerce market, still needs improvements in regulatory enforcement and infrastructure to fully realize its CBEC import trade potential (Bich & Nguyen, 2020). Malaysia's CBEC trade shows a positive trend influenced by GDP and exchange rates, but its overall trade potential still requires further development and optimization (Apriani et al., 2022). The Philippines shows some trade potential in electronic information products, but overall CBEC import trade remains insufficient, requiring enhanced infrastructure and policy support (Wu & Li, 2020).

2) Insufficient CBEC Export Trade in Laos

Laos exhibits insufficient CBEC export trade. A study using the stochastic frontier gravity model analyzed Laos's export potential and found that only half of its export potential has been realized, mainly due to domestic hidden barriers (Sayavong, 2015). To unlock this potential, Laos should prioritize infrastructure investment through regional initiatives such as the Belt and Road Initiative (BRI), establish bonded logistics parks to improve customs efficiency, and implement digital trade facilitation policies such as single-window systems and simplified cross-border payment procedures. Additionally, capacity-building programs aimed at supporting e-commerce SMEs and digital literacy could strengthen Laos's participation in regional CBEC value chains (Sayavong, 2015; Wang & Cao, 2021).

3) Untapped CBEC Trade Potential between China and Japan, and China and South Korea

Studies indicate that despite significant potential for cooperation in CBEC between China and South Korea, traditional trade structures and methods limit the development space. Suggestions include activating more trade entities through the Electronic World Trade Platform (eWTP), improving logistics efficiency, and enhancing consumer experiences to tap into CBEC trade potential (Mou, 2020). Research on the Belt and Road Initiative shows that improving infrastructure and logistics, enhancing the e-commerce environment, and strengthening financial services can significantly boost export efficiency in CBEC between China, Japan, and South Korea (Haohan Shen & Jun Chen, 2020).

4) Reconstructive Trade Potential for Australia, New Zealand, and Laos

Research indicates that although the Chinese market offers unprecedented CBEC opportunities for Australian SMEs, many enterprises have not fully realized this potential and need to seek new growth factors (Fan, 2019). CBEC platforms provide opportunities for New Zealand enterprises to enter international markets, particularly in agriculture and manufacturing, but limitations in infrastructure and logistics services require new trade promotion measures to further unlock potential (Duan et al., 2022). Laos, with a smaller economic scale, can significantly enhance its CBEC trade capacity by improving logistics and infrastructure within the Belt and Road Initiative context (Wang & Cao, 2021).

These findings reveal significant heterogeneity in CBEC trade potential across RCEP partner countries. Despite a unified analytical framework, the differences in trade potential scores — ranging from under-trade (e.g., Indonesia, Vietnam, Philippines) to reconstructive potential (e.g., New Zealand, Laos) — reflect varied levels of digital infrastructure, institutional readiness, trade openness, and policy coordination. For instance, Japan and South Korea, both with advanced economies, exhibit significant potential gaps in total trade, suggesting untapped CBEC opportunities despite their technological maturity. In contrast, countries like Singapore and Australia, with relatively balanced or surplus trade, indicate that future growth lies more in quality optimization than volume expansion.

This country-level divergence underscores that CBEC trade potential is not solely determined by economic scale or proximity, but also by structural factors such as e-payment adoption, cross-border logistics performance, and digital policy compatibility. Therefore, targeted strategies — such as improving bilateral digital trade agreements, enhancing infrastructure investment, and fostering e-commerce SMEs — should be

customized to each partner's development stage and trade potential type, rather than applying a one-size-fits-all approach. Recognizing and leveraging this heterogeneity is key to maximizing the RCEP region's CBEC cooperation outcomes.

4.4 Summary of Findings

This chapter employed STATA software to conduct a Principal Component Analysis (PCA) to identify the principal components with the highest weights in CBEC development levels and formulated a scoring method to calculate and evaluate these levels among RCEP countries. The results indicate that China has consistently led in CBEC development, primarily due to its advanced logistics, robust network infrastructure, and efficient customs procedures. Conversely, countries like Laos rank lower, reflecting significant disparities in infrastructure and economic development among RCEP member states.

Building on this analysis, the study utilized an extended gravity model to estimate the import, export, and total trade volumes of CBEC between China and its RCEP partners, and calculated the corresponding trade potential scores. The findings reveal that China's CBEC development level significantly positively impacts import volumes, although this positive effect can be weakened or even reversed under the moderating influence of the Digital Economy Development Index. Additionally, the classification of import trade potential indicates that Singapore holds reconstructive potential, with China's CBEC actual import trade volume exceeding the theoretical value, suggesting a need to explore new growth avenues such as cross-border live streaming. In contrast, countries like Indonesia, Malaysia, the Philippines, and Vietnam exhibit significant potential for import trade growth and are classified as "under-trade."

Regarding export trade, the study finds that China's CBEC development negatively affects export volumes. This suggests that while CBEC can optimize export structures in certain contexts, its overall development has not significantly boosted export volumes. Conversely, the development of CBEC in RCEP partner countries positively influences export volumes, particularly in regions with high internet penetration and well-developed electronic payment environments. Furthermore, China's per capita GDP positively correlates with export volumes, indicating that as per capita GDP increases, rising domestic market demand and enhanced production and export capacities positively influence CBEC export supply. Meanwhile, countries like Laos, Indonesia, Japan, South Korea, and the Philippines are identified as having insufficient CBEC export trade.

In analyzing total CBEC trade volumes, the study finds that the development of CBEC in RCEP partner countries significantly drives overall trade growth, especially in regions with higher levels of economic development. China's per capita GDP also positively impacts total trade volumes by reducing trade barriers and costs, encouraging more enterprises to engage in international trade and thereby promoting overall trade growth. However, despite the rapid growth of China's CBEC, its sustained impact on total trade volumes is limited and may even have negative effects. Finally, the study highlights significant CBEC trade potential among China, Japan, and South Korea, suggesting that enhancing logistics efficiency and improving consumer experiences could activate more trade entities, thereby unlocking further cooperation potential in CBEC. Additionally, Australia, New Zealand, and Laos need to focus on improving logistics and infrastructure, particularly with support from the Belt and Road Initiative, to enhance their CBEC trade capabilities.

Based on the analysis, Table 4.22 reviews the hypotheses proposed at the beginning of the study:

Table 4.22: Summary of Hypotheses Testing and Results

Hypothesis No.	Hypothesis Statement	Analysis Result	Supporting Literature	Analytical Method
H1	The level of CBEC development in China has a significant positive impact on the import trade volume between China and RCEP member countries.	Accepted	Li et al. (2022b); Shen & Chen (2020)	PCA, GMM, Extended Gravity Model
H2	The level of CBEC development in RCEP member countries has a significant positive impact on the export trade volume from China to these countries.	Accepted	Han & Lee (2022); Li, Wang, and Whalley (2016)	PCA, GMM, Extended Gravity Model
H3	The total trade volume between China and RCEP member countries is positively influenced by the CBEC development levels in both China and the partner countries.	Accepted	Peng (2021); Han & Lee (2022); Wang (2019); Liu, Lu, & Wang (2020).	GMM, Extended Gravity Model
H4	The geographical distance between China and RCEP member countries has a significant negative impact on the total CBEC trade volume.	Accepted	Kim, Dekker, & Heij (2017); Wang, Wang, & Lee (2017); Llano-Verduras, Minondo, and Requena-Silvente (2011)	GMM, Extended Gravity Model
H5	The Digital Economy Development Index (TIMG) of RCEP member countries significantly moderates the relationship between CBEC development and import trade volumes, with a negative effect when TIMG is high.	Accepted	Gurumurthy, Vasudevan, and Chami (2017); Zainuddin, Sarmidi, and Khalid (2020); Liao & Yu (2023); Hao, Chen, Wang, & Hung (2023)	GMM, Moderation Analysis, Extended Gravity Model
H6	The per capita GDP level of RCEP partner countries has a significant positive impact on China's CBEC export trade volume.	Rejected	Qiaomin Li, R. Scollay, & J. Gilbert (2017); H. Khan & Sajid Ali (2022); Ding et al. (2023); Wang & Cao (2021)	GMM, Extended Gravity Model

These findings provide a comprehensive understanding of the dynamics and potential for enhancing CBEC trade relationships between China and RCEP countries, aligning with the objectives of study to offer strategic insights for policy and decision-making in fostering sustainable economic growth.

Overall, the empirical findings directly correspond to the study's objectives and hypotheses. Objectives related to identifying the determinants of CBEC import and export performance (Objective 1 and 2) are addressed through the significant roles of CBEC development levels in China and partner countries (H1, H2, H3). Objective 3, which concerns external factors such as distance and economic development, is reflected in the support for H4 and rejection of H6. Moreover, the moderating role of digital infrastructure (H5) responds to Objective 4, emphasizing the need to consider digital readiness when formulating trade strategies. These outcomes validate the extended gravity model approach and offer targeted insights for enhancing CBEC cooperation under the RCEP framework.

CHAPTER 5

CONCLUSION AND POLICY IMPLICATIONS

5.1 Introduction

This chapter aims to summarize the conclusions of this study, provide policy recommendations, and discuss future research directions. Firstly, it will detail the main research findings presented in the previous chapters and analyze the contributions of this study. Based on these conclusions, the chapter will then propose several policy recommendations to support the enhancement of CBEC trade between China and RCEP partner countries. Finally, the chapter will discuss the limitations of the study and suggest potential directions for future research to further advance academic understanding and practical applications in this field.

5.2 Conclusion

This study investigated multiple research objectives, each linked to distinct research content and corresponding findings, as outlined in Table 5.1.

By analyzing the levels of CBEC development, import and export trade potential, and total trade potential between China and RCEP partner countries, the study effectively addresses the initial research questions and fulfills the established research objectives. Table 5.1 provides a concise overview of the research objectives, methodologies, and findings, illustrating the comprehensive approach taken to understand CBEC trade dynamics.

Table 5.1: Research Objectives and Findings

Objectives of Study	Research Content	Findings
To construct an index to assess the level of CBEC trade development between China and RCEP partner countries.	Utilizing Principal Component Analysis (PCA) to construct a CBEC Development Index, analyzing differences in CBEC development levels among RCEP countries.	The CBEC development level is heavily influenced by supporting species, with logistics performance and information flow playing critical roles. China's leading position in CBEC development is driven by advanced logistics and network infrastructure, while countries like Laos lag due to significant disparities in infrastructure and economic development.
To gauge the import potential score of CBEC between China and RCEP partner countries and classify it accordingly.	Calculating import potential scores using an extended gravity model and system GMM regression, incorporating the moderating effect of the Digital Economy Development Index (TIMG) to examine its impact on the relationship between CBEC development and import volumes and performing classification analysis.	The CBEC import potential analysis indicates that the development level of CBEC positively impacts import volumes. However, the moderating effect of the Digital Economy Development Index can reverse this impact. Traditional gravity model variables like GDP and distance costs do not significantly affect import volumes. Singapore, classified as having reconstructive potential, shows limited growth space in import trade, while countries like Indonesia, Malaysia, the Philippines, and Vietnam exhibit substantial growth potential.
To gauge the export potential score of CBEC between China and RCEP partner countries and classify it accordingly.	Calculating export potential scores using an extended gravity model and system GMM regression, classifying the export potential into categories to understand the trade dynamics and opportunities for growth between China and RCEP partner countries.	The CBEC export potential analysis reveals that China's CBEC development negatively affects export volumes, while partner countries' development levels positively impact them. China's per capita GDP positively influences export volumes, but partner countries' per capita GDP and distance costs do not. Laos, Indonesia, Japan, South Korea, and the Philippines shows insufficient CBEC export trade, indicating room for improvement through infrastructure and logistics development.
To gauge the total trade potential score of CBEC between China and RCEP partner countries and classify it accordingly.	Calculating total trade potential scores using an extended gravity model and system GMM regression, categorizing the total trade potential to provide a comprehensive overview of trade relationships and opportunities for enhancing trade flows.	The total CBEC trade analysis shows that China's development level has limited effects on increasing total trade volumes. However, partner countries' development levels significantly enhance their total trade volumes with China. While partner countries' per capita GDP does not significantly promote total trade volumes, China's per capita GDP has a positive effect. Distance costs negatively impact total trade volumes at the 10% significance level. Untapped trade potential exists between China and South Korea, Japan, and other RCEP partners, suggesting the need for new trade promotion measures.

In addition to the tabulated summary in Table 5.1, each research objective has been empirically addressed through corresponding analytical procedures. Objective 1 was realized via the construction of a CBEC Development Index using principal component analysis, enabling comparative assessments across RCEP countries. Objectives 2, 3, and 4 were fulfilled through the calculation of import, export, and total trade potential using system GMM estimations grounded in the extended gravity model. These analyses provided empirical validation of the six proposed hypotheses (H1 – H6), with five supported and one rejected. The results also clarified the differentiated impacts of CBEC-related variables and revealed the heterogeneity of trade potential across RCEP countries. Overall, the research questions were adequately answered, and the study's analytical framework was validated.

5.3 Contribution of the Study

This study focuses on the CBEC trade potential between China and RCEP member countries, providing a comprehensive evaluation of their development levels and trade potential. By exploring how to promote and enhance CBEC cooperation among these nations more effectively, the research makes several significant contributions.

Firstly, the study builds on the CBEC ecosystem theory by constructing a novel index to assess the development levels of CBEC between China and RCEP member countries. This index not only extends the existing theoretical framework of e-commerce but also offers a practical and scientifically sound tool for future research. Moreover, the integration of the extended gravity model with CBEC, along with the analysis of the moderating effect of digital economy development levels on import potential, provides a

richer theoretical perspective on international trade potential, thereby contributing to the body of knowledge in this area.

Secondly, the study employs advanced methodologies, including PCA and the system GMM regression, to empirically analyze the CBEC trade potential between China and RCEP member countries. This empirical investigation into the import, export, and total trade potential identifies key factors influencing CBEC development, such as logistics performance, information flow, and cash flow. These findings not only validate existing theoretical predictions but also reveal new pathways of influence, laying the groundwork for further empirical research.

In addition to its theoretical and empirical contributions, the study has practical implications. It offers specific decision-support tools for policymakers and businesses by quantifying the competitiveness and development potential of different countries in CBEC. This provides a foundation for more targeted policy formulation, such as optimizing logistics infrastructure, enhancing information flow efficiency, and fostering digital economy development. Furthermore, the research provides strategic guidance for CBEC enterprises, enabling them to better understand and leverage market potential in various countries, and develop more effective market entry and expansion strategies.

In conclusion, this study not only expands the theoretical understanding of the CBEC ecosystem and trade potential but also provides new empirical evidence and insights, offering valuable references for policy formulation and business decision-making in practice. By bridging the gap between theory and practice, the study enhances the understanding of CBEC dynamics and supports the sustainable growth of trade relationships among RCEP member countries.

5.4 Policy Implications and Recommendations

Based on the findings and conclusions of this study, the following policy implications and recommendations are proposed to enhance CBEC development and trade potential between China and its RCEP partners. These suggestions are tailored to address varying levels of CBEC development among partner countries, ensuring actionable and differentiated strategies for policymakers and businesses.

5.4.1 Enhancement of Logistics and Digital Infrastructure in Less Developed RCEP Countries

For RCEP member countries with underdeveloped CBEC environments — such as Laos, Cambodia, and the Philippines — weaknesses in logistics networks and digital infrastructure constrain trade growth. Priority should be given to investing in cross-border logistics hubs, customs digitalization, and electronic payment systems. China could support these efforts through bilateral infrastructure cooperation and the expansion of its digital platforms to these markets.

5.4.2 Facilitation of Institutional Alignment and Platform Integration in Moderately Developed RCEP Countries

Countries like Malaysia, Thailand, and Vietnam demonstrate growing CBEC activity but lack unified standards in digital authentication, taxation, and customs clearance. Efforts should be made to align trade policies, promote mutual recognition of digital credentials, and facilitate integration of local enterprises into regional e-commerce platforms such as JD, Lazada, or Shopee.

5.4.3 High-End Supply Chain Collaboration and Digital Rule Harmonization with Advanced RCEP Partners

Developed countries such as Japan, South Korea, and Singapore already exhibit mature CBEC systems. To deepen cooperation, policy efforts should focus on high-end supply chain collaboration (e.g., electronics, pharmaceuticals), joint development of cross-border data governance frameworks, and establishing mutual trust mechanisms for digital trade and e-signatures. Enhancing intellectual property protection and platform interoperability will be critical.

5.4.4 Addressing the Moderating Role of the Digital Economy on Import Flows

The moderating effect of China's Digital Economy Development Index suggests that higher digitalization may reduce CBEC import reliance. Policymakers should anticipate this structural shift and explore complementary policy tools—such as targeted tariff reductions or import facilitation incentives—to retain a balanced import-export flow under high digitalization conditions.

5.4.5 Leveraging China's Economic Scale to Stimulate Export Supply and SME Participation

Given the significant positive effect of China's per capita GDP on CBEC exports, continued support should be extended to domestic innovation and SME digitization programs. Export-oriented enterprises should be encouraged to build independent brands, adopt customized packaging strategies, and use overseas warehouses to improve delivery efficiency and consumer trust.

5.4.6 Reducing Distance-Related Transaction Costs through Regional Connectivity Initiatives

Distance costs remain a barrier to CBEC trade despite digital advancements. Policymakers should continue to promote regional transportation corridors, invest in CBEC pilot zones, and subsidize logistics providers operating in less connected RCEP markets. In parallel, participation in multilateral logistics cooperation platforms (e.g., ASEAN Smart Logistics Network) should be deepened to reduce last-mile delivery obstacles.

5.5 Limitations of the Study

While the study yields valuable empirical insights, several limitations must be acknowledged to appropriately contextualize the findings and guide future improvements..

Data Limitations: The study primarily relies on statistical data from 2013 to 2022. Given that CBEC is a relatively new trade modality, there is a limited amount of historical data available, which may affect the generalizability of the conclusions. The timeliness and completeness of the data may not fully capture the most recent developments and trends in CBEC.

Model Limitations: Although the dynamic panel system GMM method was used, some uncontrolled variables might still influence the accuracy of the study's results. The model assumptions and inherent limitations may not fully reflect the complexities of real-world scenarios.

Selection of Sample Countries: The study focuses mainly on RCEP member countries, potentially omitting other countries that might impact China's CBEC trade. This limited scope may restrict the general applicability of the findings to other regions.

Complexity of Moderating Effects: The moderating effects of the Digital Economy Development Index might involve more complex mechanisms that were not thoroughly explored in this study. The interactions and influences of the digital economy on CBEC trade require deeper investigation.

5.6 Future Research Directions

Building on the identified limitations, future research should explore the following directions to deepen the understanding of CBEC trade potential within the RCEP region and globally.

Expand Data Scope: Future studies should include more recent and longer time-span data to improve the timeliness and reliability of the conclusions. Incorporating data from a broader range of years can help identify long-term trends and effects more accurately.

Improve Models: Employing more complex and refined economic models can better control for potential influencing variables and enhance the accuracy of the study's results. Advanced modeling techniques can provide deeper insights into the dynamic and multifaceted nature of CBEC.

Broaden Sample Countries: Extending research to include more countries and regions, especially other significant trading partners, can provide more comprehensive conclusions. Comparative studies with other global regions can yield valuable insights into the universal and unique aspects of CBEC trade.

In-depth Exploration of Moderating Effects: Further exploration of the moderating effects of the Digital Economy Development Index can uncover its internal mechanisms

and reveal its deeper impacts on CBEC trade. Understanding these mechanisms can help tailor strategies to enhance trade efficiency.

Investigate Other Influencing Factors: Beyond logistics and the digital economy, future research should investigate other potential influencing factors such as policy environments, market demand, and consumer behavior. This broader perspective can provide a more holistic understanding of the elements driving CBEC development and trade potential.

By addressing these areas, future research can build on the findings of this study, providing deeper insights and more effective strategies for enhancing CBEC between China and its RCEP partners.

5.7 Chapter Summary

This chapter has synthesized the findings of this study, drawn conclusions, and provided policy recommendations to enhance CBEC trade between China and RCEP partner countries. The main insights of the research emphasize the significant impact of supporting factors such as logistics and digital infrastructure, the varying effects of CBEC development levels on import, export, and total trade volumes, and the need for targeted policy interventions to fully realize trade potential. The study also outlined limitations and future research directions, highlighting the need for more comprehensive data, refined models, broader sample countries, and in-depth exploration of influencing factors. Addressing these aspects in future research can further enhance the understanding and development of CBEC.

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APPENDICES

Appendix A: Journal Publications

1. Zhang, L. L., Bin Abdullah, M. A., Huang, M., & Dai, L. H. (2025). Constructing an index for cross-border e-commerce development levels based on ecosystem theory: Empirical insights from RCEP countries. *International Journal of Business and Society*, 26(1), 101–116. <https://doi.org/10.33736/ijbs.9553.2025>