THE IMPACTS OF DIGITAL ECONOMY AND INNOVATION ON EXPORTS IN REGIONAL COMPREHENSIVE ECONOMIC PARTNERSHIP COUNTRIES

BAI CONGHUI

UNIVERSITI SAINS MALAYSIA

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THE IMPACTS OF DIGITAL ECONOMY AND INNOVATION ON EXPORTS IN REGIONAL COMPREHENSIVE ECONOMIC PARTNERSHIP COUNTRIES

by

BAI CONGHUI

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With the utmost appreciation,

Conghui Bai August 2025

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LIST OF SYMBOLS

a	Value weights of component, called loadings
D_{ij}	The geographical distance between importing country i and exporting country
DIG_{it}	The digital economy development level of country i in year t
DIS_{ij}	The market distance between country i and country j
EX_{ijt}	The export volume of country i to country j in year t
EXE_{ijt}	The electrical export volume of country i to country j in year t
EXM_{ijt}	The machinery export volume of country i to country j in year t
EXV_{ijt}	The vehicle export volume of country i to country j in year t
$INNOV_{it}$	The patent application quantity of country i in year t
k	Number of samples
n_i	Size of samples
N	Number of groups or individuals
$OPEN_{jt}$	Openness level of j country in year t
$\mathcal{P}_{ij}$	The sample estimates of the pairwise correlation of the residuals or
GDP_{jt}	The real GDP of country j in year t
POP_{jt}	The population of country j in year t
R_i^2	Unadjusted coefficient of determination for regressing the i^{th} independent variable on the remaining ones
S_i^2	Sample variances
T	Number of time series observations
TAR_{jt}	Average tariff level of all commodities in importing country in year t
X_{ij}	Bilateral trade volume between importing country i and exporting country j in a certain period of time
Y_i	The economic aggregates of importing country i

Y_j	The economic aggregates of exporting country j
ε_{jt}	A random error item

LIST OF ABBREVIATIONS

ACFTA	ASEAN-China Free Trade Area
ADB	Asian Development Bank
ADF	Augmented Dickey-Fuller DF
AI	Artificial Intelligence
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BEA	Bureau of Economic Analysis
B2B	Business-to-Business
B2C	Business-to-Consumer
CADF	Cross-sectional Augmented ADF
CAICT	China Academy of Information and Communications Technology
CD	Cross-sectional Dependence
CIDI	Composite I-distance Indicator
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
CS-ARDL	Cross-section Augmented Autoregressive Distributed Lag
DE	Digital Economy
DESI	Digital Economy and Society Index
DID	Difference-in-Difference
EU	European Union
FA	Factor Analysis
FDI	Foreign Direct Investment
GB	Gigabytes
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GI	Green Innovation
GMM	Generalized Method of Moments
H-O	Heckscher-Ohli
ICT	Information and Communications Technology
IDI	ICT Development Index
IMF	International Monetary Fund

IoT	Internet of Things
IPS	Im, Pesaran and Shin
IT	Information Technology
ITU	International Telecommunication Union
KMO	Kaiser-Meyer-Olkin
MEMI	Marine Equipment Manufacturing Industry
NAFTA	North American Free Trade Agreement
NRI	Networked Readiness Index
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
POLS	Pooled Ordinary Least Squares
PPML	Poisson Pseudo Maximum Likelihood
P2P	Peer-to-Peer
RCEP	Regional Comprehensive Economic Partnership
RE	Random Effect
REER	Real Effective Exchange Rate
R&D	Research and Development
SDG	Sustainable Development Goals
SPSS	Statistical Product and Service Solutions
SITC	Standard International Trade Classification
TFP	Total Factor Productivity
UNCTAD	United Nations Conference on Trade and Development
VIF	Variance Inflation Factor
WEF	World Economic Forum
WITS	World Integrated Trade Solutions
WIOD	World Input-Output Database
WTO	World Trade Organization
2SLS	Two-stage Least Squares Regression

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KESAN EKONOMI DIGITAL DAN INOVASI TERHADAP EKSPORT DI NEGARA-NEGARA KAWASAN PERKONGSIAN KOMPREHENSIF EKONOMI SERANTAU

ABSTRAK

Perkembangan pesat ekonomi digital mengubah corak perdagangan global dan mendorong transformasi industri, dengan inovasi memainkan peranai sebagai pemangkin utama melalui peningkatan kapasiti teknologi. Rantau Perkongsian Ekonomi Komprehensif Serantau (RCEP) memainkan peranan penting dalam proses transformasi ini. Kajian ini bertujuan mencapai tiga objektif penyelidikan dengan menggunakan data panel dari tahun 2010 hingga 2022. Pertama, tingkat pembangunan ekonomi digital di negara-negara RCEP dinilai dengan menggunakan satu Indeks Pembangunan Ekonomi Digital yang dibangunakan khususnya untuk negara-negara RCEP dengan menggunakan analisis komponen utama. Kedua, kesan pembangunan ekonomi digital terhadap prestasi eksport dianalisis dengan menggunakan model kesan tetap. Ketiga, kajian ekonomi digital ke atas eksport untuk industry-industri elektronik, mesin dan automotif di negara-negara RCEP dan peranan pemoderasi inovasi dalam mempengaruhi kesan teresbut dinilai melalui model pemoderasian. Hasil penemuan empirikal menunjukkan bahawa wujudnya pertumbuhan ketara dalam pembangunan ekonomi digital di negara-negara RCEP antara tahun 2010 dan 2022, walaupun terdapat ketidakseimbangan antara negara. Pembangunan ekonomi digital meningkatkan prestasi eksport secara signifikan. Dari sudut analisis mengikut industri, ekonomi digital meningkatkan eksport dalam ketiga-tiga industri tersebut, tetapi kekuatan kesannya berbeza antara industri. Inovasi didapati dapat meningkatkan hubungan tersebut dengan ketara dalam industri elektronik dan mesin, manakala kesan

pemoderasi tersebut adalah tidak signifikan dalam sektor automotif. Keterbukaan perdagangan dan skala ekonomi jula dikenal pasti sebagai pemacu utama pertumbuhan eksport, manakala kesan saiz populasi dan jarak geografi adalah berbeza mengikut industri. Hasil dapatan ini menekankan keperluan bagi penggubal dasar di negara-negara RCEP untuk menyepadukan strategi ekonomi digital dengan dasar inovasi yang disasarkan serta mempromosikan keterbukaan perdagangan. Secara khususnya, pemerkasaan infrastruktur digital, tadbir urus digital, integrasi digital, dan modal insan, disertai dengan galakkan inovasi khusus industri, dapat memperkukuh daya saing perdagangan serantau.

THE IMPACTS OF DIGITAL ECONOMY AND INNOVATION ON EXPORTS IN REGIONAL COMPREHENSIVE ECONOMIC PARTNERSHIP COUNTRIES

ABSTRACT

The rapid advancement of the digital economy is reshaping global trade patterns and driving industrial transformation, with innovation serving as a key catalyst by enhancing technological capacity. The Regional Comprehensive Economic Partnership (RCEP) region plays a pivotal role in this transformation. This study aims to achieve three research objectives using panel data from 2010 to 2022. First, the level of digital economy development in RCEP countries is assessed using a multidimensional Digital Economy Development Index constructed using principal component analysis. Second, the impact of the digital economy on export performance within RCEP is investigated through a fixed effects model. Third, the impact of the digital economy on exports of electronics, machinery, and automotive in RCEP countries and the role of innovation in affecting these impacts are examined using moderation models. The empirical findings reveal substantial growth in digital economy development across RCEP members between 2010 and 2022, albeit with cross-country disparities. Digital economy development significantly improves export performance. Regarding industry-level analysis, the digital economy boosts exports in all three industries, but the strength of the effect varies. Importantly, innovation significantly enhances this relationship in the electronics and machinery industries, but its moderating effect is not significant in the automotive sector. Trade openness and economic scale consistently support export growth, whereas the impact of population and distance effects differ across industries. These insights underscore the need for RCEP policymakers to integrate digital economy strategies with targeted innovation

policies and efforts to promote trade openness. Specifically, enhancing digital infrastructure, digital governance, digital integration, and human capital, alongside promoting sector-specific innovation, can strengthen regional trade competitiveness.

CHAPTER 1

INTRODUCTION

1.1 Introduction of the Study

The global economy is undergoing a profound transformation, driven by the rapid adoption of digital technologies, a trend that has been significantly accelerated during the COVID-19 pandemic (UNCTAD, 2019). This digitalisation process reshapes the interactions among individuals, businesses, and governments, fostering new models of value creation (UNCTAD, 2019). The characteristic became increasingly prominent during the pandemic as the online platforms usage and digital activities experienced a dramatic increase (UNCTAD, 2021).

In light of the increasing complexities of globalisation and the rapid advancement in science and technology, comprehending the digital economy and its potential implication becomes crucial, as it plays a growing role in shaping trade patterns, expanding market access, and redefining competitive advantage (UNCTAD, 2019; WTO, 2023; Haddoud et al., 2023). Nevertheless, a universally accepted definition or standardised framework for the digital economy remains absent (OECD, 2014; UNCTAD, 2019). Consequently, evaluating its actual contribution to export performance continues to remain challenging (BEA, 2018; WEF, 2021). Moreover, the impact of the digital economy on export performance varies considerably across countries or industries, as its effectiveness typically depends on an industry's

innovation capacity to absorb and apply digital technologies (Cassiman & Golovko, 2007; Ghanbari et al., 2017; Kim & Chuang, 2024).

The Regional Comprehensive Economic Partnership (RCEP) provides an ideal framework for examining how the digital economy development and innovation shape export performance. As the world's largest trading agreement, RCEP encompasses a diverse combination of advanced and developing economies displaying considerable differences in technological readiness and innovation capabilities. Although the region has witnessed steady export growth recently, this growth has primarily focused on low value-added products, while exports from key manufacturing industries have experienced a decline in export market share. Consequently, RCEP member countries must identify new drivers for sustainable export growth in the context of rapid digital transformation.

1.2 Background of Study

1.2.1 Background of Digital Economy and Innovation

The concept of the digital economy has evolved over time, with scholars offering varied perspectives on its definition and scope. It is initially defined as an interconnected networked system (Tapscott, 1996). It was later expanded by scholars who viewed digitalisation as a process of transforming information into digital formats, reshaping industries, and creating new business opportunities (Terry, 2008; Grey, 2015).

The G20 broadened the concept of the digital economy, describing the digital economy as diverse economic activities where digitised information and knowledge act as fundamental production factors, with modern information networks serving as the core activity space. Given varied interpretations, this study adopts the G20's definition, which captures the broad scope of the digital economy and its pivotal role in driving economic digitalisation.

However, determining the exact size of the digital economy remains challenging due to the lack of a universal definition and comprehensive data. Various institutions propose different frameworks (OECD, 2014; BEA, 2018; UNCTAD, 2019; EU, 2022; ITU, 2017; WEF, 2021), generally classified into three approaches. First, the direct measurement approach, used by the U.S. Bureau of Economic Analysis (BEA), estimates the digital economy's value-added through a supply-use framework aggregating output from digital infrastructure, e-commerce activities, and digital services (BEA, 2018). While providing detailed estimates, implementation often faces data gaps and sectoral inconsistencies. Second, comparative approaches include the Organisation for Economic Co-operation and Development (OECD) and the United Nations Conference on Trade and Development (UNCTAD). OECD (2014) uses 38 sub-indicators from multiple dimensions evaluating the digital economy from both technological and socioeconomic perspectives but targets advanced economies, while UNCTAD (2019) uses ICT-centric measurement focusing on the ICT sector and digital trade activities. The third approach evaluates digital economy development by aggregating multiple indicators into a single composite score that reflects overall

performance across key dimensions. Notable examples include the Digital Economy and Society Index (DESI) by the European Union, the ICT Development Index (IDI) by the International Telecommunication Union (ITU), and the Networked Readiness Index (NRI) by the World Economic Forum (WEF) (EU, 2022; ITU, 2017; WEF, 2021). DESI focuses on policy areas like connectivity and digital public services, while IDI measures ICT readiness and skills. NRI adopts a broader scope, including governance and societal impact. Although informative, indexes are shaped by context-specific priorities, limiting their comparability and generalisability across diverse economic settings (EU, 2022; ITU, 2017; WEF, 2021).

Differences in definitions and measurement methodologies result in significant discrepancies in the digital economy size estimates. A narrow definition, encompassing information and communications technology (ICT) infrastructure, the ICT-producing sector, and platform-based services, accounted for 4.5% of global gross domestic product (GDP) in 2018 (UNCTAD, 2019). In contrast, a broader definition including all economic activities that utilise digital technologies positioned it at 15.5% of global GDP, growing at a rate two and a half times faster than overall global GDP over the past 15 years (UNCTAD, 2019). By 2020, ICT advances, including the internet, big data, cloud computing, and artificial intelligence, propelled the digital economy's value to $32.6 trillion (CAICT, 2021). These figures underscore the pivotal role of the digital economy as a catalyst for economic growth while revealing the challenges in defining and measuring its scale.

As digital technologies continue to advance, their impact on trade has become increasingly pronounced. They have become a key enabler of trade by lowering costs, enhancing innovation, and expanding export capacity (WTO, 2023; WTO, 2024; Haddoud et al., 2023). Increasingly, the digital economy facilitates the exchange of both physical and digital goods and services among firms, consumers, and governments (Rahman, 2022; UNCTAD, 2023). According to WTO (2023) estimates, digital services traded across borders have emerged as the most rapidly expanding sector in global commerce, with the value of digital services increasing nearly fourfold since 2005, at an average annual growth rate of 8.1%. This growth has outpaced that of goods (5.6%) and other services (4.2%), with digital services now accounting for 54% of total services exports.

The digital economy plays a transformative role in reshaping traditional economic activities and driving global trade growth by optimising processes across transaction stages: pre-transaction, in-transaction, and post-transaction processes (Nagle et al., 2024; Albshaier et al., 2024). Global digital platforms such as Facebook, Alibaba, and Amazon have reshaped international trade by reducing search costs and enhancing transaction efficiency, enabling a shift towards platform-based, digitally driven models (Gagulina et al., 2020). These platforms also empower small and medium-sized enterprises (SMEs) to expand cross-border sales and better understand targeted marketing (Marti & Kayal, 2017).

The digital economy has given rise to digital trade, which encompasses all cross-border trade activities that are either ordered digitally or delivered digitally (WTO,

2023). Enabled by the Internet, digital trade facilitates the exchange of both physical and digital goods and services through digital transactions (OECD, 2020). Cross-border e-commerce, as a key component of digital trade, reduces geographical and temporal barriers, lowers transaction costs, simplifies trade processes, and enhances transaction efficiency (Gomez-Herrera et al., 2014).

The digital economy drives new trade forms and accelerates the digital transformation across traditional industries, fostering greater export product diversity. The integration of ICT and new technologies has transformed global manufacturing industries by enhancing efficiency within global value chains (Li et al., 2020). These developments have particularly benefited industries like electronics, where innovations such as smartphones, tablets, and 3D printers have driven the growth of ICT exports. Furthermore, digital transformation has significantly influenced the automotive sector, reshaping business models and boosting export competitiveness (Gromova, 2019; Ili et al., 2010). The adoption of artificial intelligence has enabled innovations like autonomous driving and improved voice recognition. These innovations have enhanced operational efficiency and established new benchmarks for the global automotive industry in the digital economy (Teece, 2018; Ciriello et al., 2018).

While the digital economy reshapes trade dynamics, their effectiveness in driving sustained export growth increasingly depends on firms' capacity to innovate. Innovation, as originally defined by Schumpeter (1934), involves the creation of new combinations—including new products, production methods, markets, and organisational forms. In the digital era, this concept has expanded to include digital

innovation, which refers to the application of technologies such as AI, big data, and digital platforms to create new value in products, services, and business models (Nambisan et al., 2017; Yoo et al., 2010).

Innovation has long been recognised as a key driver of export performance, enabling firms and countries to strengthen their competitiveness in the global marketplace. At the firm level, innovation enhances productivity, facilitates product differentiation, and supports market diversification, allowing businesses to overcome barriers to entry in international markets (Cassiman and Golovko, 2007; Bıçakcıoğlu-Peynirci et al., 2019). Through product innovation, firms can introduce goods tailored to the preferences of foreign consumers, while process innovation contributes to efficiency gains and cost reductions. At the macro level, national innovation capacity plays a vital role in export upgrading by enabling the transition from low-value to high-value-added activities, thereby supporting structural transformation and sustained integration into global value chains (Hoang et al., 2024). In this regard, innovation functions not merely as an outcome of development but as a strategic asset in driving export-led growth. Recent empirical evidence suggests that innovation plays a dual role in this process. On one hand, it moderates the relationship between digitalisation and exports by strengthening firms' ability to integrate and utilise digital technologies (Kim & Chuagn, 2024). On the other hand, it mediates this relationship by enabling digital inputs to be transformed into export-orientated outputs, such as differentiated products or new market access strategies (Haddoud et al., 2023; Mallinguh et al., 2020; Albshaier et al., 2024). Accordingly, innovation does not merely complement digitalisation, it is

a strategic enabler that shapes how the digital economy contributes to export performance.

The impact of the digital economy and innovation on exports differs markedly across industries due to variations in absorptive capacity and technological orientation. In agriculture, structural constraints and reliance on external innovation limit the ability to leverage digital tools (Malinga et al., 2020; Haddoud et al., 2023). Service sectors, while more digitally connected, tend to rely on incremental, user-orientated innovations that do not necessarily translate into export competitiveness (Luo et al., 2025). In contrast, manufacturing—particularly machinery and electronics—combines stronger internal R&D with greater digital integration, making it more responsive to the trade-enhancing potential of digitalisation and innovation (Cassiman and Golovko, 2007; Ghanbari et al., 2017). Such responsiveness reflects the underlying relationship between innovation and the digital economy in jointly shaping export performance.

The digital economy leverages advanced technological tools to reduce transaction costs, streamline trade processes, and enhance operational efficiency. These advancements significantly improve trade facilitation, enabling smoother cross-border transactions, while strengthening trade competitiveness by empowering businesses to adapt to global market demands. However, it is innovation that unlocks the full potential of these digital tools, maximising their impact on export performance. First, innovation transforms digital advancements into high-value-added products by enabling firms to incorporate cutting-edge technologies into their production processes (Li et al., 2020; Sultana et al., 2021; Gault, 2019). For example, in the machinery sector, innovation

facilitates the creation of smart manufacturing equipment, such as advanced robotics, which significantly boosts export competitiveness. Second, innovation strengthens market adaptability by empowering firms to respond to evolving global demand with customised products and services (Garnov et al., 2020; Veselovsky et al., 2018). This adaptability is particularly evident in the electronics industry, where continuous innovation drives the rapid commercialisation of products like high-performance chips and 5G devices. Third, innovation serves as a link between the digital economy and compliance with international trade standards, enabling firms to leverage digital technologies to comply with environmental, technical, and quality regulations (Burinskiene, 2013). In the automotive industry, innovations in electric vehicles have enabled firms to meet global sustainability standards, thereby increasing export opportunities. Lastly, innovation strengthens firms' ability to use digital trade platforms and e-commerce channels, increasing export opportunities and reducing barriers for small and medium-sized enterprise firms (Bhat & Momaya, 2020; Yan & Liu, 2024; Higón & Bonvin, 2024). Innovation not only magnifies the direct impact of digital economy tools on exports, but it also ensures that industries remain competitive in a rapidly changing global trade landscape (Morrar et al., 2017).

1.2.2 Background of RCEP

The Regional Comprehensive Economic Partnership (RCEP) provides a unique setting for examining the transformation impact of the digital economy on exports due to its diverse member countries and varying levels of digitalisation. Signed in 2020 and

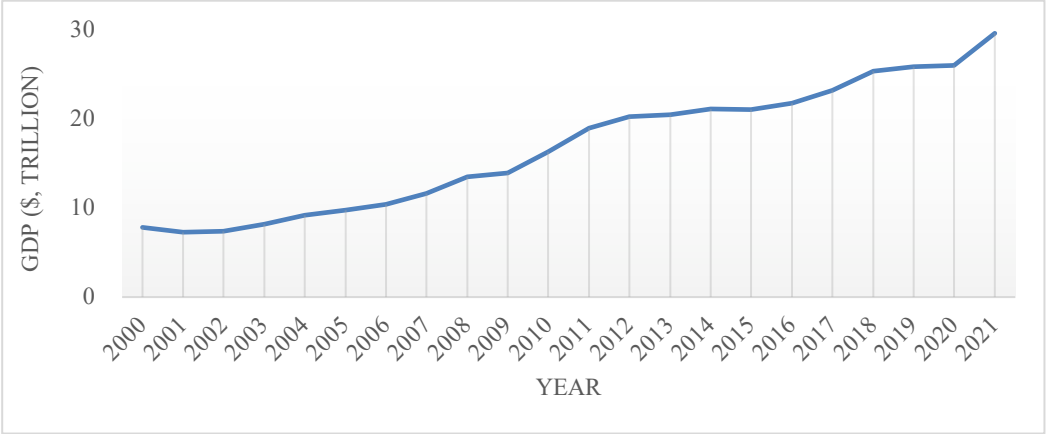
implemented in 2022, the RCEP agreement brings together 15 countries—Australia, Brunei, Cambodia, China, Indonesia, Japan, South Korea, Laos, Malaysia, Myanmar, New Zealand, the Philippines, Singapore, Thailand, and Vietnam—forming a free trade zone that is larger than both the United States-Canada-Mexico Agreement and the European Union (World Bank, 2021). The RCEP region demonstrates significant economic diversity, encompassing developed and developing nations across income levels. High-income countries such as Japan, South Korea, and Australia lead in technological innovation, industrial development, and digital infrastructure, contributing substantially to global value chains (United Nations, 2015). Upper-middle-income nations such as China, Malaysia, and Thailand have undergone rapid economic modernisation, leveraging digital technologies to enhance competitiveness and expand their roles in international trade (World Bank, 2021). Lower-middle-income countries like Cambodia, Laos, and Myanmar are gradually transitioning toward economic diversification and modernisation, fostering industrial upgrading and economic growth (WTO, 2024).

1.2.2(a) Economic Performance

The Regional Comprehensive Economic Partnership (RCEP) holds a significant share of the global economy. In 2020, the 15 member countries accounted for approximately 31% of global gross domestic product (GDP) based on Figure 1.1. Following the 2008 global financial crisis, the region has exhibited sustained growth, with GDP reaching USD 30 trillion by 2021.

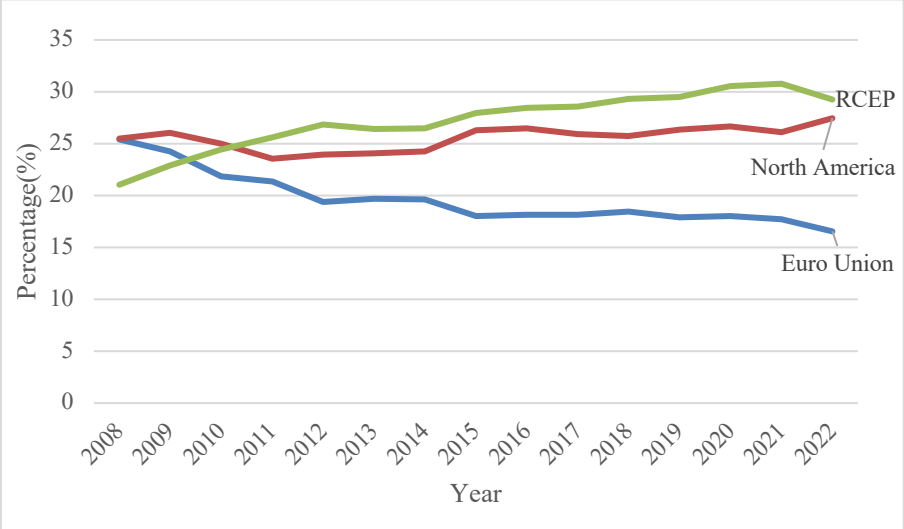
As shown in Figure 1.2, RCEP surpassed the North America Free Trade

Agreement (NAFTA) and the European Union (EU) in terms of share of global GDP, reaching nearly 30% in 2019. Within the region (Figure 1.3), China contributed over 50% of RCEP's GDP in 2020, followed by Japan (20%), while South Korea, Australia, and Indonesia collectively accounted for 15.5%. Meanwhile, smaller countries such as Brunei, Laos, Cambodia, and Myanmar each contributed less than 1%.



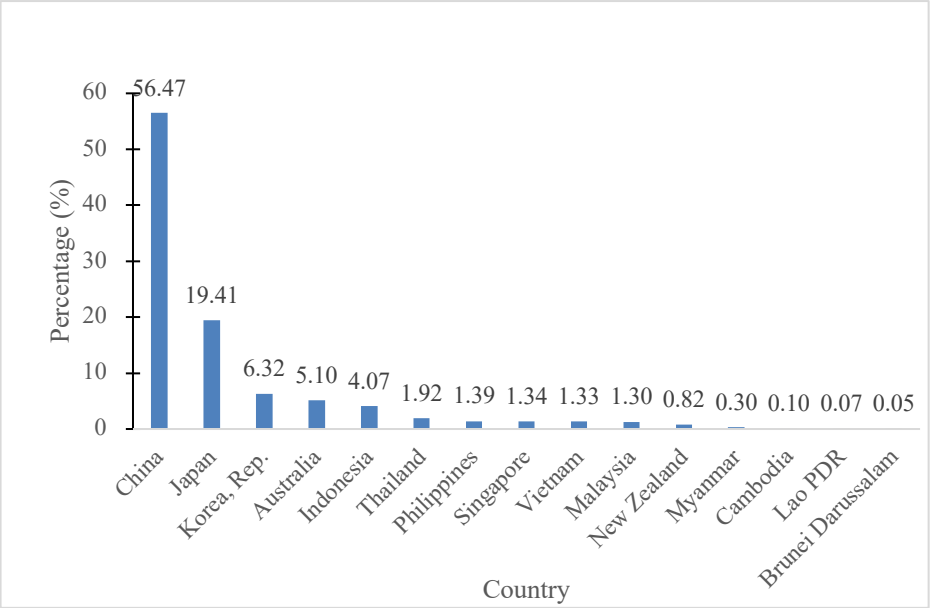
Source: World Bank (2023)

Figure 1.1 Total GDP of RCEP Region (US$, trillion), 2000-2021



Source: World Development Indicators (2023)

Figure 1.2 GDP of RCEP Countries (as % of World GDP), 2008-2022

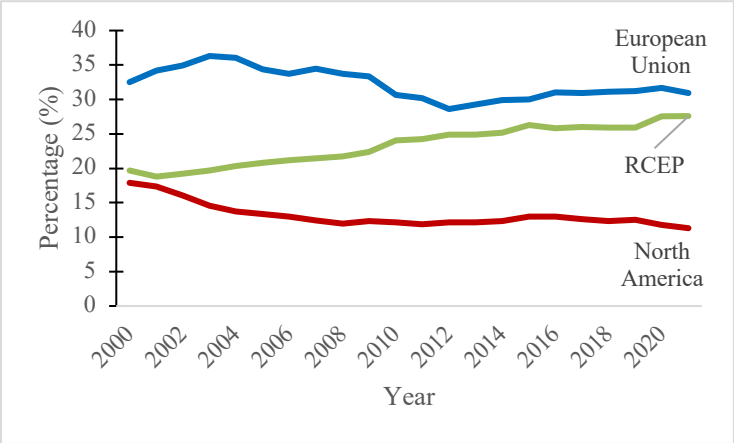


Source: World Development Indicators (2023)

Figure 1.3 GDP of RCEP countries (as % of Total GDP of RCEP), 2020

1.2.2(b) Trade Performance

In terms of trade performance, RCEP member countries accounted for nearly 29% of global merchandise trade (Figure 1.4). Notably, their shares in global trade have increased from 20% in 2000 to 27.5% in 2020. This demonstrates significant growth potential under the provisions of RCEP's trade liberalisation, facilitation policies, and commitments to regulatory harmonisation (Asian Development Bank, 2022). Projections by the Peterson Institute for International Economics (2020) suggest that RCEP could contribute an additional US$209 billion annually to global income and increase global trade by US$500 billion by 2030 (Cheah et al., 2020). During the period 2020 to 2021, RCEP maintains an overall upward trend in goods and services exports compared to the North America Free Trade Agreement (NAFTA) and the European Union (Figure 1.4).

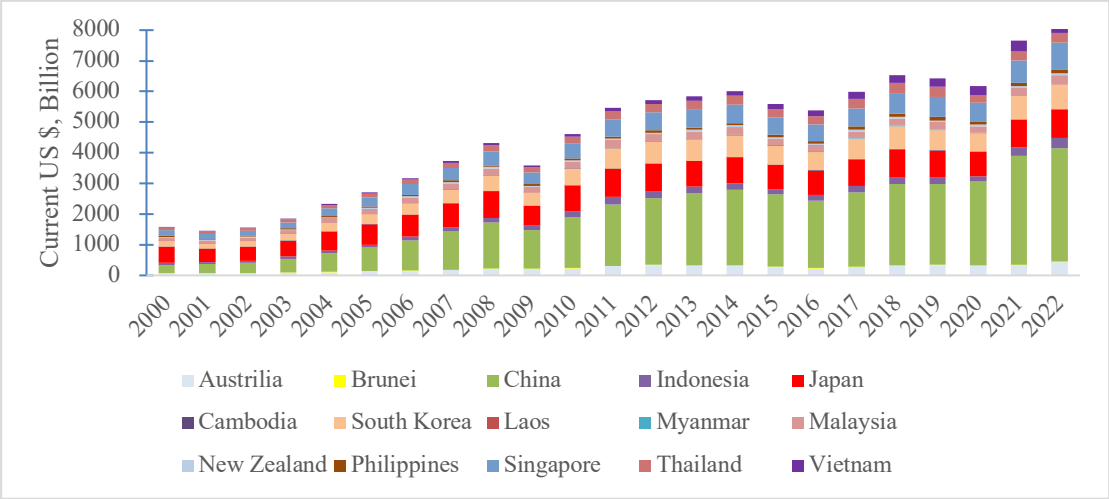


Source: World Development Indicators (2022)

Figure 1.4 Proportion of Trading Blocs in World Goods and Services Exports (%)

1.2.2(c) Export Performance

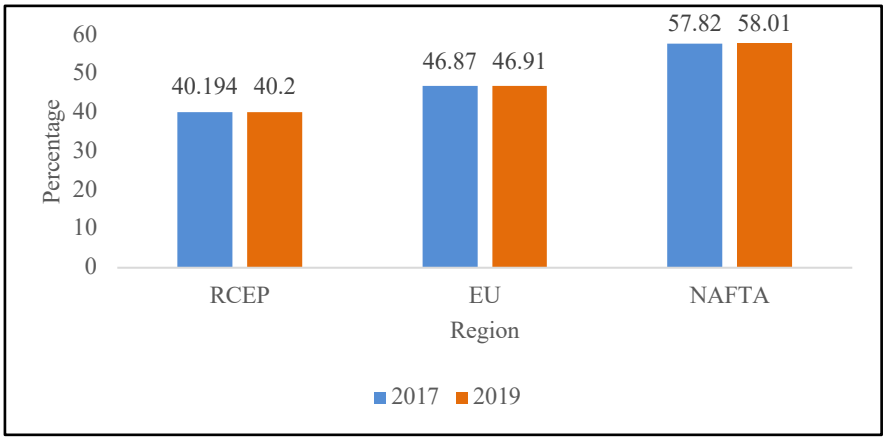
Figure 1.5 shows exports of goods and services in RCEP countries. Exports from RCEP member countries have experienced significant export expansion, increasing from less than US$2 trillion in 2000 to over US$8 trillion in 2022, approximately four times the value in 2000 (excluding missing data from Myanmar and Laos). While exports experienced fluctuation during the global financial crisis and the COVID-19 pandemic, they rebounded strongly, reaching US$8.3 trillion in 2022, marking a 34.2% increase from 2020. China, Japan, and South Korea have maintained their positions as the regions' three largest exporters of goods and services, playing leading roles in driving RCEP's trade growth.



Source: World Bank (2023)

Figure 1.5 Exports of Goods and Services in RCEP Countries, 2000-2022 (Current US $, Billion)

Despite RCEP member countries having experienced significant export growth, their value-added structure remains less competitive compared to the EU and NAFTA regions. Figure 1.6 reveals that the domestic value-added share in RCEP's gross exports constituted merely 40% in both 2017 and 2019, contrasting with 47% in the EU and 58% in NAFTA. The Trade in Value Added (TiVA) statistics from the OECD in 2020 indicate that foreign value added embedded in gross exports was substantially higher in the RCEP region compared to the EU and NAFTA. Specifically, the RCEP's foreign value added reached USD 1.18 trillion, while the EU and NAFTA recorded USD 437.1 billion and USD 112.3 billion, respectively (OECD, 2023). The pattern of export growth, characterised by high reliance on foreign-sourced intermediate goods and a low share of domestic value added, suggests that RCEP economies remain concentrated in low-value-added segments of global production chains (OECD, 2019; Asian Economic Bank, 2021).

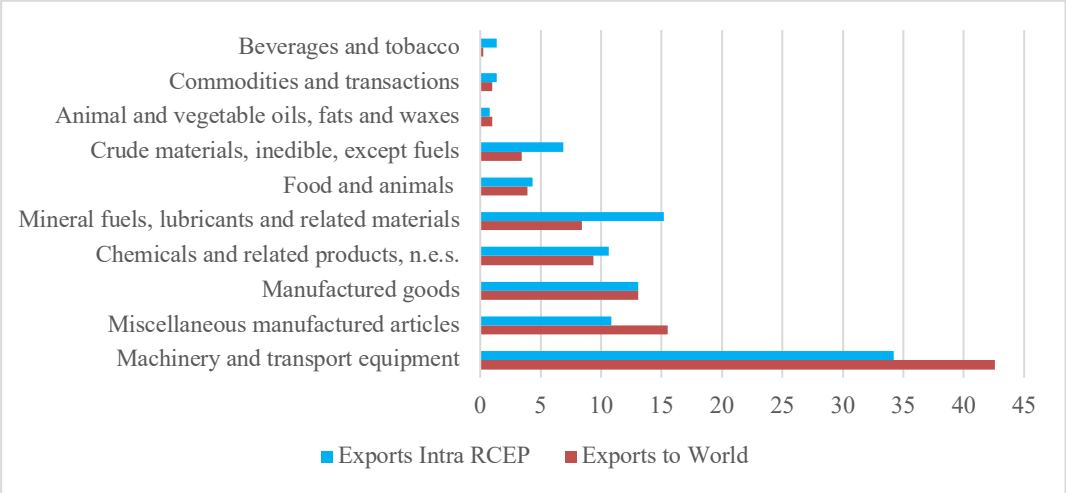


Source: OECD (2023)

Figure 1.6 Domestic Value-Added Share in Gross Exports to World (2017 & 2019)
(Current US $, Billion)

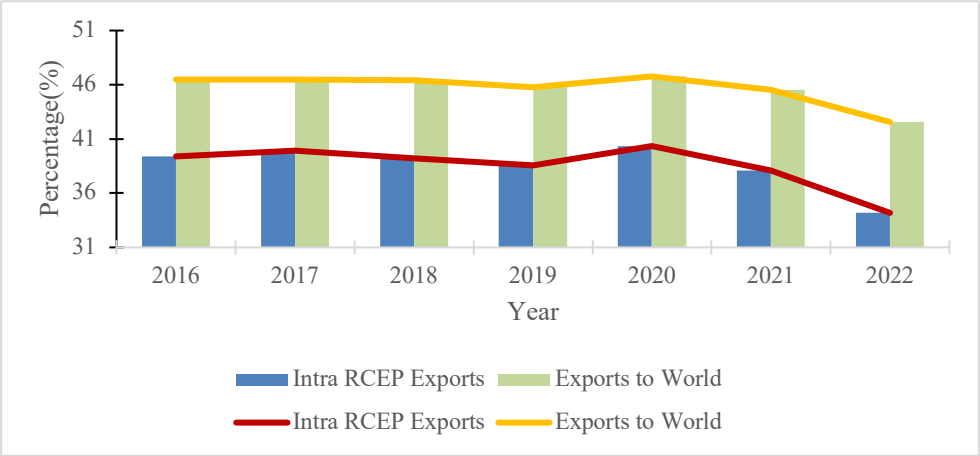
Machinery and transport equipment constitute the core of RCEP's export structure, playing a key role in both intra-regional and global trade. In 2022, intra-RCEP and exports from RCEP countries to the rest of the world were predominantly concentrated in machinery and transport equipment, manufactured goods, and mineral fuels (Figure 1.7). Machinery and transport equipment emerged as the leading sector, encompassing machinery, electronics, and automotive industries, accounting for approximately 35% of intra-RCEP exports and around 40% of global exports. These trends highlight the critical role of machinery and transport equipment in driving trade within the RCEP region and its importance for both regional and global markets. However, despite its dominance, machinery and transport equipment exports have exhibited fluctuations in recent years (Figure 1.8). Intra-RCEP exports in this sector have declined from approximately 37% to 33% from 2020 to 2022. Similarly, exports to the world showed a modest decrease, dropping from 46% to 42% over the same period. As a major export

sector, machinery and transport equipment has experienced a decline in exports in recent years, highlighting the need to explore new directions and opportunities, particularly through the integration of digital technologies and innovation.



Source: UNCTAD

Figure 1.7 Exports to the World and Intra Exports within RCEP (% of Total Exports) by STIC Classification in 2022



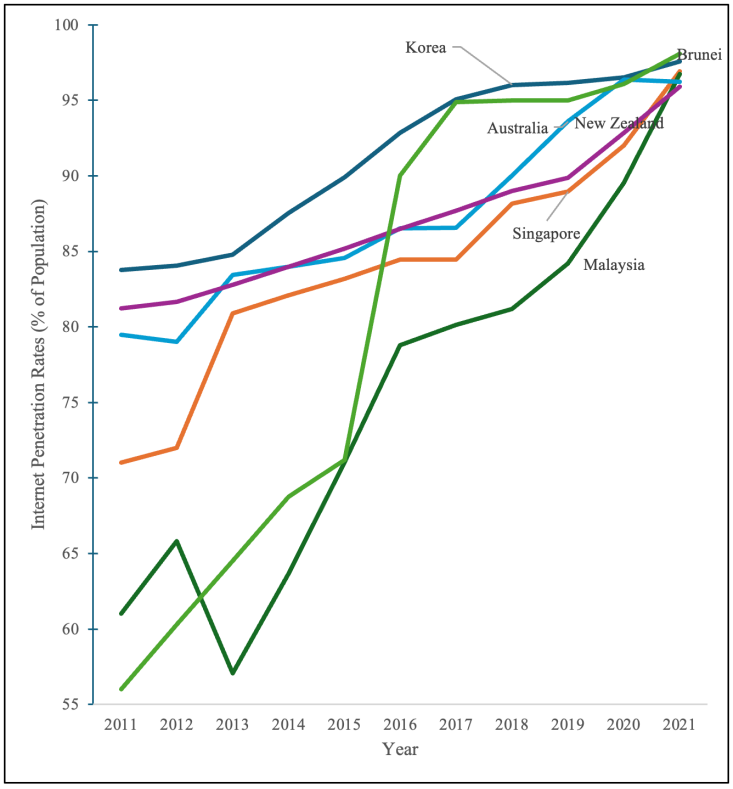
Source: World Bank

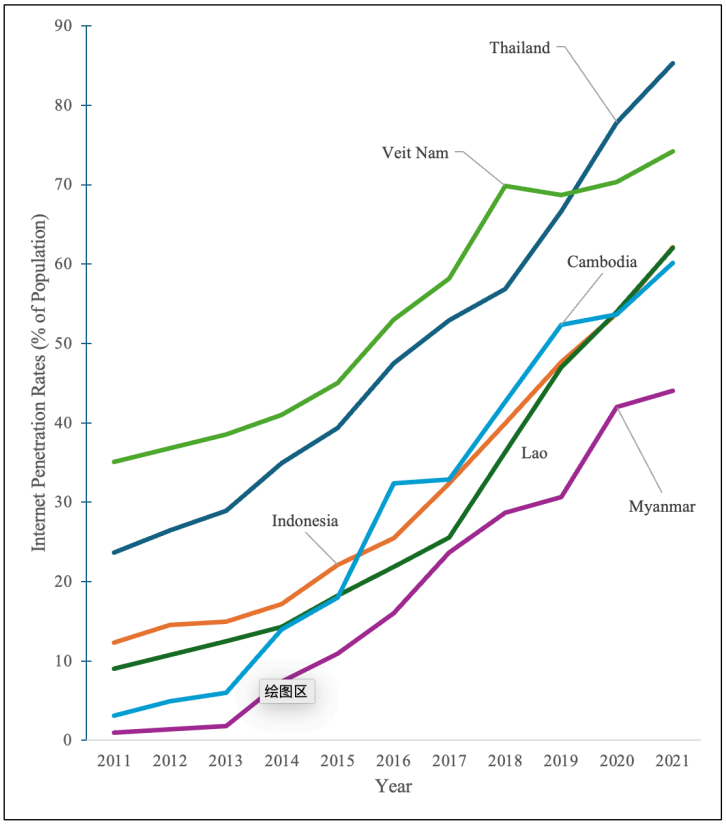
Figure 1.8 Machinery and Transport Equipment: Exports to the World and Intra Exports within RCEP (% of Total Exports)

1.2.2(d) Digitalisation Performance

The digital landscape across RCEP member countries has undergone remarkable transformation over the past decade, with internet connectivity emerging as a key indicator of technological progress. Three key indicators, namely, internet penetration rates, fixed broadband subscriptions, and ICT exports, will be used to assess the digital infrastructure development and economic integration.

With the exception of Japan, all RCEP countries have experienced significant growth in the internet penetration rate since 2011 (Figure 1.9), demonstrating widespread digital transformation across the region. By 2021, the proportion of internet users had exceeded 80% in eight countries, exceeded 70% in two countries, exceeded 50% in four countries, and exceeded 40% in one country with the lowest proportion. Among them, Thailand, Indonesia, Laos, Cambodia, and Myanmar have increased by as much as four times in ten years, from less than 10% to more than 40%. Brunei's internet users accounted for 56% in 2011 and reached 98% in 2021, becoming the first position in RCEP. However, there is still a certain gap in the proportion of internet users among RCEP countries. High-income and upper-middle-income countries such as Korea, Australia, New Zealand, Singapore, and Brunei achieved early and sustained increases in internet penetration, with most exceeding 90% by 2021. In contrast, the lower-middle-income and developing economies, such as Myanmar, Lao PDR, and Cambodia started from significantly lower baselines and have only recently begun to approach moderate penetration levels (40–60%).

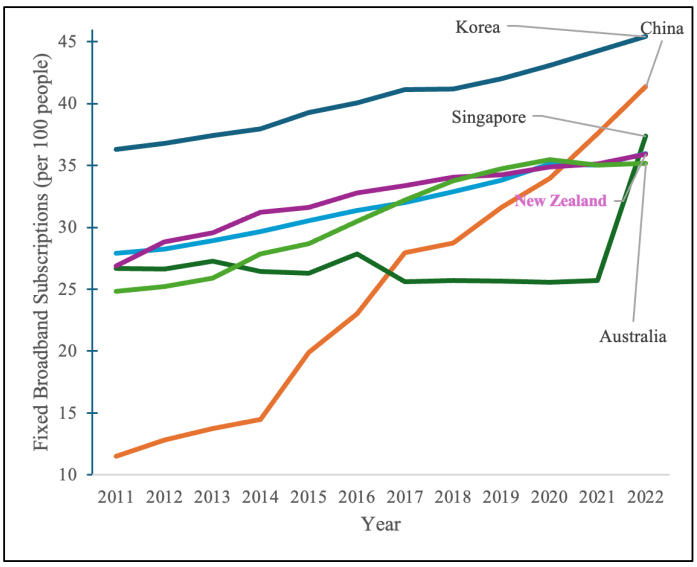


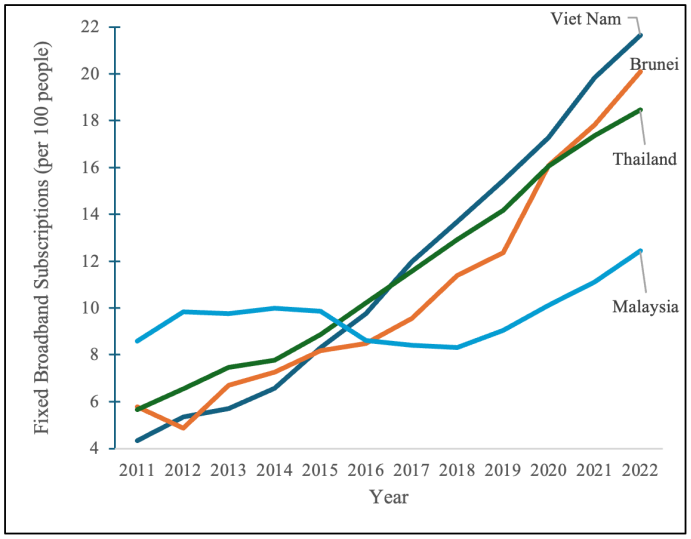


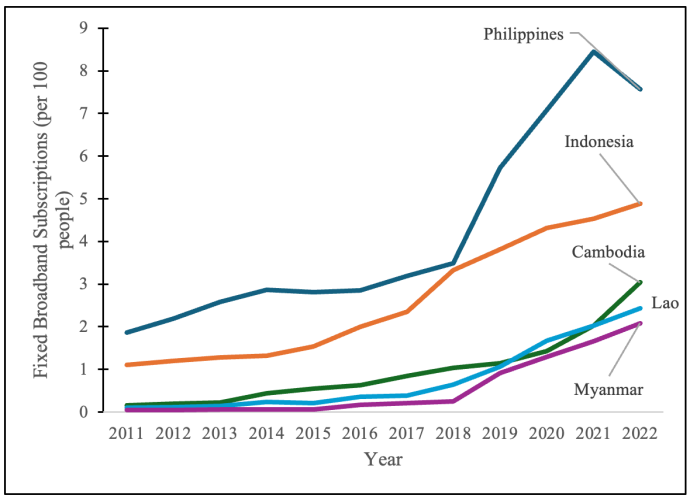
Source: World Bank

Figure 1.9 Internet Penetration Rates (% of Population) among RCEP Countries, 2011-2022

The number of fixed broadband users in RCEP countries experienced a consistent increase between 2011 and 2022 (Figure 1.10). Unlike Internet users, the gap of fixed broadband users' proportion between RCEP countries is relatively obvious. South Korea has consistently ranked first in the number of fixed broadband users per 100 people since 2011, growing from 36% to 45% in 2022. Countries in the first tier with South Korea include China, New Zealand, Australia, Japan, and Singapore. Among them, China has the largest growth rate, from 11% in 2011 to 41% in 2022. In the second-tier countries (Vietnam, Brunei, Thailand, and Malaysia), fixed broadband users per 100 people can exceed 10%. Although the proportion is low, they all show an upward trend. The proportion of fixed broadband users in Indonesia, Laos, Cambodia, and Myanmar is relatively low, less than 5%. The gap of fixed broadband users between the third-tier countries and the first-tier countries is obvious that nearly 8 times.



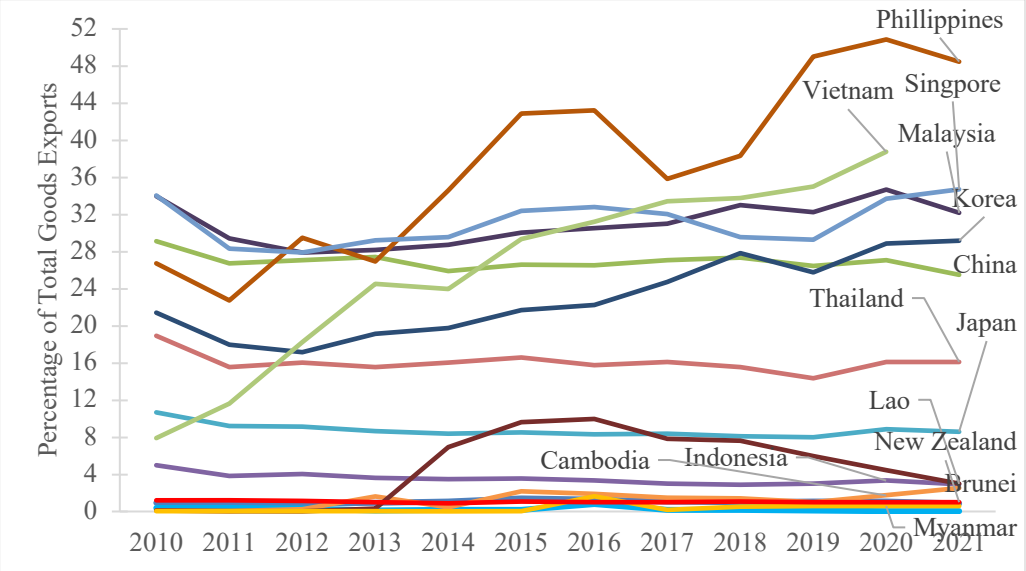




Source: World Bank

Figure 1.10 Fixed Broadband Subscriptions (per 100 people) of RCEP Countries, 2011-2022

As the foundation of the digital economy, ICT has become an essential component of the digital development process. ICT exports from most RCEP countries have shown a growth trend in the past 10 years, with some countries showing a stable trend (Figure 1.11). The growth momentum in the Philippines and Vietnam is particularly rapid, especially in the Philippines. In 2020, the Philippines' ICT product exports accounted for 51% of total exports, while Vietnam's ICT product exports accounted for 39%. In addition, the exports of ICT goods from Singapore, Malaysia, South Korea, and China all accounted for more than a quarter of the total exports of goods in 2021. However, the proportion of ICT goods exports in New Zealand, Brunei, Indonesia, Cambodia, and Myanmar is relatively low, accounting for less than 4% of total goods exports.



Source: World Bank

Figure 1.11 ICT Goods Exports (% of Total Goods Exports), 2010-2021

1.2.2(e) Innovation Performance

Innovation performance across the RCEP region demonstrates considerable disparity. Figure 1.12 reveals that despite substantial growth in total patent applications over the past decade, this increase is predominantly driven by a small number of

technologically advanced economies. China alone dominates regional innovation output, with patent applications increasing from 293,000 in 2010 to over 1.4 million in 2021, followed by Japan and Korea, with consistently high but relatively stable figures. In contrast, most remaining member countries, including Australia, Singapore, and ASEAN countries, register less than 3,000 applications annually, with limited growth over time. This concentration underscores a persistent innovation divide within the region. Such innovation capacity disparities may influence how effectively countries leverage digital economy benefits for export performance, as nations with superior innovation ability are better positioned to translate the digital economy into sustained export growth.

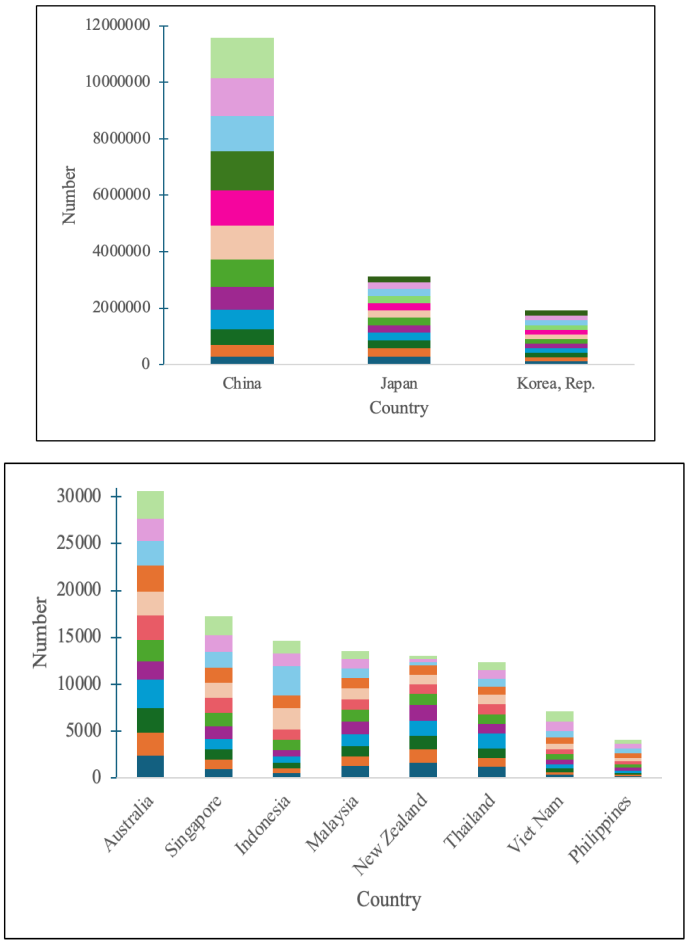


Figure 1.12 Patent Applications of RCEP Countries, 2010-2021

Given the rapid expansion of the digital economy and its profound impacts, it has become crucial for RCEP countries to critically assess their current digital economy development progress and strategically leverage its potential to enhance international trade and strengthen their global competitiveness. RCEP, as the world's largest free trade agreement, provides a unique platform for analysing how digital economy advancements interact with diverse economic structures to drive export growth.

1.3 Problem Statement

The RCEP region, encompassing both developed and developing economies, plays a pivotal role in global trade, with the rise of the digital economy enhancing its trade, innovation, and competitiveness. However, the lack of a standardised and regionally adapted framework for measuring digital economy development across RCEP member countries remains a significant challenge. Significant economic and digital development disparities between high-income and lower-middle-income members further complicate comparative evaluation, highlighting the need for a robust and region-specific framework to assess digital economy development.

RCEP economies have recorded notable export growth in recent years, while their export structure remains less competitive than that of other major trade blocs. In particular, RCEP countries exhibit a high reliance on foreign-sourced intermediate goods and a relatively low share of domestic value added, reflecting a concentration in low-value-added segments of global value chains. This structural weakness undermines

the ability of the region to extract value from international trade and restricts its long-term competitiveness. To achieve sustained export growth under increasing global competition, it is necessary for RCEP economies to identify new drivers of export performance. The RCEP region offers a unique setting to examine the impact of the digital economy on export performance, given the diverse levels of digitalisation and economic development among its member countries.

Manufacturing industries such as machinery, electronics, and automotive products contribute substantially to region trade. However, the export share of these three industries has shown a consistent decline between 2016 and 2022. This raises concerns about their long-term global competitiveness. This downward trend, compounding by intensifying international competition and rapid technological change, underscores the urgency of enhancing their competitiveness and strengthening their position in the global markets. The digital economy holds transformative potential to support the transformation of these industries by optimising processes, lowering costs, and improving market access. Nevertheless, the precise pathways through which the digital economy influences export performance, particularly in these key industries within RCEP countries, remain unclear.

While the digital economy may offer considerable productivity gains, their impact is often contingent upon sector-specific capabilities and absorptive capacity. Innovation, as a key driver of industrial competitiveness, plays an essential role in determining how firms leverage the digital economy. In the context of manufacturing, innovation not only facilitates product development and process upgrading but also enhances firms'