Asia-Pacific Sustainable Development Journal

Vol. 33, No. 2, October 2026

Editorial

Advancing digital trade and cross-border e-commerce in Asia and the Pacific
Jong Woo Kang, Sanchita Basu Das, Rupa Chanda

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

Can economies leapfrog to digital success? Evidence from global e-commerce development pathways
Homer Pagkalinawan

Digital trade for macroeconomic development: Evidence from Asean's e-commerce integration
John Paolo R. Rivera

The role of digital platforms and cross-border trade in Cambodian firm performance
Dina Chhorn, Sivly Houy, and Kean Muny Nhim

Connected for growth: Analyzing the impact of e-commerce adoption on firm performance and labour outcomes in the Philippines through peer effects
Ma. Kristina P. Ortiz and Mark Carmelo R. Manguera

Unlocking economic gains: How e-commerce enhances efficiency, productivity, and market access in Indonesia (evidence from the 2024 e-commerce survey)
Sri H. Rachmad, Andri Yudhi Supriadi, Kennith G.C. Dillena, Devi Asiati, Roosganda Elizabeth, Haning Romdiati, Okki Navarone Wibisono

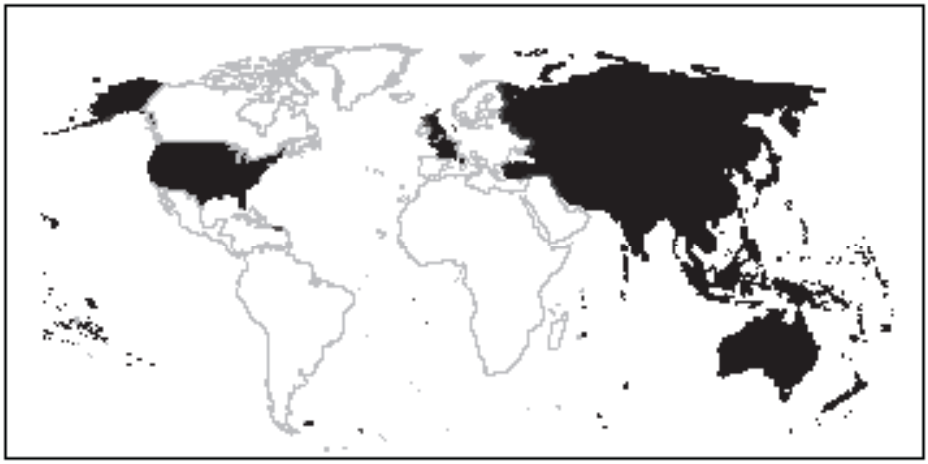
An analytical framework to establish convergence in cross-border digital trade rules
Paul R. Baker and Loan Le

Trade agreements and digitally delivered services: The varied evidence from emerging Asia
Dr. Avik Ghosh

Building inclusive economic growth in Asia with mode 1 finance and insurance service exports: Role of digital trade provisions in free trade agreements
Deeparghya Mukherjee



ESCAP
Economic and Social Commission for Asia and the Pacific



*The shaded areas of the map indicate ESCAP members and associate members.**

The Economic and Social Commission for Asia and the Pacific (ESCAP) serves as the United Nations' regional hub, promoting cooperation among countries to achieve inclusive and sustainable development. As the largest regional intergovernmental platform with 53 member States and 9 associate members, ESCAP has emerged as a strong regional think-tank, offering countries sound analytical products that shed light on the evolving economic, social and environmental dynamics of the region. The Commission's strategic focus is to deliver on the 2030 Agenda for Sustainable Development, which it does by reinforcing and deepening regional cooperation and integration in order to advance connectivity, financial cooperation and market integration. The research and analysis undertaken by ESCAP coupled with its policy advisory services, capacity building and technical assistance to governments aims to support countries' sustainable and inclusive development ambitions.

**The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.*

Asia-Pacific Sustainable Development Journal

United Nations
New York, 2026

ASIA-PACIFIC SUSTAINABLE DEVELOPMENT JOURNAL

Vol. 33, No. 2, October 2026

United Nations publication
Sales No. E.26.II.F.10
Copyright © United Nations 2026
All rights reserved
Printed in Thailand
ISBN: 9789211579451
e-ISBN: 9789211552188
ISSN (print): 2617-8400
ISSN (online): 2617-8419

Cover design: Nina Loncar

This publication may be reproduced in whole or in part for educational or non-profit purposes without special permission from the copyright holder, provided that the source is acknowledged. The ESCAP Publications Office would appreciate receiving a copy of any publication that uses this publication as a source.

No use may be made of this publication for resale or any other commercial purpose whatsoever without prior permission. Applications for such permission, with a statement of the purpose and extent of reproduction, should be addressed to the Secretary of the Publications Board, United Nations, New York.

Editorial Board

Chief Editor

Armida Salsiah Alisjahbana,
Under-Secretary-General of the United Nations and Executive Secretary of ESCAP

Managing Editor

Anis Chowdhury, Emeritus Professor, Western Sydney University, Australia

Editorial Advisory Board

Anne Booth, School of Oriental and African Studies, University of London, United Kingdom
Hal Hill, Australian National University, Australia
Roman Mogilevskii, Asian Development Bank
M.N. Murthy, Institute of Economic Growth, Delhi University, India
Biman Prasad, Adjunct Professor, Cairns Institute, James Cook University, Australia
Jeffrey Sachs, Columbia University, USA
Ravi Shankar, Indian Institute of Technology, India
Abid Qaiyum Suleri, Sustainable Development Policy Institute, Pakistan
Lan Xue, Tsinghua University, China
Muhammad Yunus, Grameen Bank, Bangladesh

Editorial Board

Gulnaz Alibekova, Institute of Economics, Kazakhstan
Lisa Bersales, University of the Philippines, Philippines
Rupa Chanda, Trade, Investment and Innovation Division, ESCAP
Rukmani Gounder, Massey University, New Zealand
Sabine Henning, Social Development Division, ESCAP
Tae Yong Jung, Yonsei University, Republic of Korea
Kamalbek Karymshakov, Kyrgyz-Turkish Manas University, Kyrgyzstan
Prakash Loungani, John Hopkins University, USA
Mia Mikic, Asia Pacific Research and Training Network, New Zealand
Oliver Paddison, Countries in Special Situation, ESCAP
Satya Paul, Australian National University, Australia
Richard Pomfret, University of Adelaide, Australia
Vladimir Popov, Russian Academy of Sciences, Russian Federation
Sweta Saxena, Chief of Staff, UNECA
Hermanto Siregar, Bogor Agricultural University, Indonesia
Vatcharin Sirimaneetham, Macroeconomic Policy & Financing for Development Division, ESCAP
Milika Naqasmia Sobey, The Asia Foundation, Fiji
Erinc Yeldan, Kadir Has University, Turkey

ABOUT ASIA-PACIFIC SUSTAINABLE DEVELOPMENT JOURNAL

The Asia-Pacific Sustainable Development Journal (APSDJ) is published twice a year by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). It is the continuation of UNESCAP's Asia Pacific Development Journal (APDJ) with an explicit recognition of sustainable development in line with the United Nations Agenda 2030 for Sustainable Development Goals (SDGs).

APSDJ welcomes submissions of original contributions on themes and issues related to sustainable development that are policy-oriented and relevant to Asia and the Pacific. Articles should be centred on discussing challenges pertinent to one or more dimensions of sustainable development, policy options and implications and/or policy experiences that may be of benefit to the region. Editorial policy is to maintain a sound balance between theoretical and empirical studies, and to highlight policy relevance.

APSDJ particularly welcomes papers that deal with sustainable development issues using a multi-disciplinary approach. Submissions may range from overviews spanning the region or parts of it, to papers with a detailed focus on issues facing individual countries.

APSDJ encourages submissions from researchers residing in countries in special situations, such as Small Island Developing States (SIDS), Least Developed Countries (LDCs) and economies in transition, as well as submissions that deal with challenges of such economies.

APSDJ provides a platform for policymakers to share their experiences. It also offers opportunities to academics and researchers in their early careers to develop their capacity for policy-oriented and applied research.

APSDJ publishes short notes, reflecting experiences in policy and practices, comments, and book reviews – not exceeding 3,000 words – in addition to full length research articles. From time to time, it also publishes special issues on matters of importance to economies in the Asia Pacific region.

All manuscripts will undergo a rigorous double-blind peer-review process.

Manuscripts should be sent by e-mail to the Managing Editor of the Asia-Pacific Sustainable Development Journal: escap-apsdj@un.org

For more details, please visit www.unescap.org/publication-series/APSDJ.

ASIA-PACIFIC SUSTAINABLE DEVELOPMENT JOURNAL
Vol. 33, No. 2, October 2026

CONTENTS

		Page
Editorial		viii
Jong Woo Kang, Sanchita Basu Das, Rupa Chanda	Advancing digital trade and cross-border e-commerce in Asia and the Pacific	1
	Special theme: Enabling accessibility and inclusion through digital trade and e-commerce	
Homer Pagkalinawan	Can economies leapfrog to digital success? Evidence from global e-commerce development pathways	30
John Paolo R. Rivera	Digital trade for macroeconomic development: Evidence from Asean's e-commerce integration	57
Dina Chhorn, Sivly Houy, and Kean Muny Nhim	The role of digital platforms and cross-border trade in Cambodian firm performance	93
Ma. Kristina P. Ortiz and Mark Carmelo R. Manguera	Connected for growth: Analyzing the impact of e-commerce adoption on firm performance and labour outcomes in the Philippines through peer effects	136
Sri H. Rachmad, Andri Yudhi Supriadi, Kennith G.C. Dillena, Devi Asiati, Roosganda Elizabeth, Haning Romdiati, Okki Navarone Wibisono	Unlocking economic gains: How e-commerce enhances efficiency, productivity, and market access in Indonesia (evidence from the 2024 e-commerce survey)	169
Paul R. Baker and Loan Le	An analytical framework to establish convergence in cross-border digital trade rules	200

Dr. Avik Ghosh	Trade agreements and digitally delivered services: The varied evidence from emerging Asia	240
Deeparghya Mukherjee	Building inclusive economic growth in Asia with mode 1 finance and insurance service exports: Role of digital trade provisions in free trade agreements	278
	Acknowledgements	313

EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.
References to “tons” are to metric tons, unless otherwise specified.
A solidus (/) between dates (e.g. 1980/81) indicates a financial year, a crop year or an academic year.
Use of a hyphen between dates (e.g. 1980-1985) indicates the full period involved, including the beginning and end years.

The following symbols have been used in the tables throughout the journal:
Two dots (..) indicate that data are not available or are not separately reported.
An em-dash (—) indicates that the amount is nil or negligible.
A hyphen (-) indicates that the item is not applicable.
A point (.) is used to indicate decimals.
A space is used to distinguish thousands and millions.
Totals may not add precisely because of rounding.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Where the designation “country or area” appears, it covers countries, territories, cities or areas.

Bibliographical and other references have, wherever possible, been verified. The United Nations bears no responsibility for the availability or functioning of URLs belonging to outside entities.

The opinions, figures and estimates set forth in this publication are the responsibility of the authors and should not necessarily be considered as reflecting the views or carrying the endorsement of the United Nations. Mention of firm names and commercial products does not imply the endorsement of the United Nations.

EDITORIAL

I am pleased to introduce the second issue of the Asia-Pacific Sustainable Development Journal (APSDJ), Volume 33, No 2 (2026), a special issue titled, "Enabling Accessibility and inclusion through digital trade and e-commerce." The issue examines how digital trade and cross-border e-commerce are transforming economies and societies across the region. While these developments are creating new opportunities for market access, trade integration and innovation, they are also posing new challenges relating to regulation, governance and inclusion. Understanding these opportunities and challenges, and identifying appropriate policy responses, is increasingly important for ensuring that digitalization contributes to sustainable and inclusive development.

This special issue is the outcome of a research and capacity building partnership between the Asian Think Tank Network (ATTN) of the Asian Development Bank (ADB), the Asia Pacific Research and Training Network (ARTNeT) of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Asian Development Bank Institute (ADBI). It has been coordinated and edited by Jong Woo Kang, Director of the Regional Cooperation and Integration Division at the Economic Research and Development Impact Department (ERDI) of ADB, Sanchita Basu-Das, Economist at the ADB, and Rupa Chanda, Director of the Trade, Investment and Innovation Division at ESCAP. The issue brings together the expertise of two major regional institutions around a topic of growing importance for the region. It draws in particular on discussions at the ATTN Forum 2025, held at ADBI in Tokyo, which explored the role of digital trade and cross-border e-commerce in promoting inclusion and strengthening the capacity of researchers and think tanks to address emerging areas in the digital economy.

The topic is particularly timely given the rapid pace of digital transformation in Asia and the Pacific. The region is at the forefront of digital trade and e-commerce, with its economies accounting for a substantial share of global e-commerce activity. Rapid smartphone adoption, expanding digital payments systems and growth of regional digital platforms are facilitating cross border trade, data flows and innovations, while contributing to the emergence of regional and bilateral digital economy frameworks and agreements to reduce regulatory frictions and deepen economic integration.

Yet the benefits of this transformation are far from evenly distributed. Significant disparities persist both across and within countries in digital connectivity, affordability, digital capabilities and institutional capacity. Large segments of the population continue to face barriers to meaningful participation in the digital economy, while small and medium-sized businesses often face high costs and complex regulations when engaged in cross-border e-commerce. Governments are also confronted with rapidly evolving governance challenges, including those relating to data governance, cybersecurity, taxation and consumer protection, among others. At the regional level, regulatory fragmentation can increase costs of cross-border digital transactions and

impede the interoperability of systems and markets. This makes regulatory cooperation and harmonization efforts all the more critical.

These challenges have important implications for sustainable development. Digital trade and cross border e-commerce can expand market access, support entrepreneurship, increase productivity and facilitate regional integration, thereby accelerating the region's progress towards the 2030 Agenda for Sustainable Development. But without appropriate policies and institutions, they can reinforce existing inequalities and create new forms of exclusion. The policy challenge is therefore not simply how to expand digital trade, but to ensure that its benefits are broadly accessible and contribute to inclusive, sustainable and resilient development.

The nine papers in this thematic issue examine these opportunities and challenges from a range of perspectives. Collectively, they provide an overview of the current status of digital trade and cross border e-commerce in Asia and the Pacific and examine their implications for trade, growth, productivity and market access. At the same time, the papers draw attention to important constraints, including uneven distribution of benefits across countries, sectors and firms; regulatory fragmentation; limited trust in digital transactions and systems; and the continued under-representation of micro, small and medium-sized enterprises (MSMEs), despite their considerable potential to benefit from digital markets.[1]

A key message from the volume is the need to bridge digital divides and to move towards a more integrated digital ecosystem. Expanding physical connectivity remains essential, but needs to be complemented by affordable access, digital skills and capabilities, improved interoperability, and appropriate digital trade rules and e-commerce rules and frameworks. Digital trade and digital economy agreements can help reduce regulatory frictions and facilitate cross-border transactions, while effective e-commerce regulations can help build trust and protect consumers. Together, these elements can help ensure that digital trade and e-commerce contribute to inclusive and sustainable growth.

These findings are closely aligned with ESCAP's broader work on digitalization and sustainable development. As reflected in ESCAP's 2024 theme study Leveraging digital innovation for sustainable development in Asia and the Pacific, realizing the development potential of digitalization requires a comprehensive and coordinated policy framework. This includes investment in digital infrastructure, improving digital skills and literacy; strengthening institutional and regulatory capacity; ensuring regulatory alignment with best practices and international standards, and establishing effective

[1] Please note that given the complexity of the issue each paper deals with, the Editorial Board relaxed the word limit of 8,000 words and allowed an extra 2,000 words.

governance, cybersecurity and consumer protection frameworks, among others.

The volume also points to the need for a multi-dimensional approach that moves beyond an access-driven strategy towards an integrated, ecosystem-based strategy that addresses infrastructure, capabilities, cost barriers and trust. Such an approach should be underpinned by the guiding principles of availability, accessibility and affordability. As digital trade and cross-border e-commerce are facets of the broader digital economy, their growth needs to be addressed as part of this wider ecosystem rather than in isolation. At the same time, given large variations in digital readiness across the region, differentiated pathways are needed rather than a one-size-fits-all model.

The volume also underscores the importance of regional cooperation. As the expansion of digital trade and cross-border ecommerce is outpacing the ability of many countries to adapt their regulatory frameworks and mitigate associated risks, national policy responses alone are insufficient to address many emerging challenges. Regional cooperation is key to aligning regulatory frameworks, developing common standards, promoting interoperability across customs, payments and logistics systems; sharing knowledge and good practices; and strengthening institutional capacity. It can also help countries with different levels of digital readiness participate more effectively in the evolving regional digital economy. Together, institutions such as ADB and ESCAP have an important role to play in supporting such cooperation through their regional platforms, capacity building activities and knowledge products such as this special thematic issue.

In keeping with the objectives of the Asia-Pacific Sustainable Development Journal, this special issue brings together diverse perspectives on an important and rapidly evolving dimension of sustainable development. The papers contribute to the growing academic literature on digital trade, e-commerce and the digital economy while also drawing practical implications for policymakers. More broadly, they highlight a fundamental policy imperative: digital transformation should not be judged solely by the scale or speed of its expansion, but by its ability to create opportunities that are accessible to people, firms and countries across the region.

I hope that this special issue will contribute to further research and policy dialogue on how digital trade and cross-border e-commerce can be harnessed to advance inclusive and sustainable development in Asia and the Pacific. I also hope that it will provide policymakers and researchers with useful insights into both the opportunities presented by the digital economy and the policy challenges that must be addressed to realize them.

I would like to thank the editors, authors, reviewers and all colleagues involved in bringing this special issue to publication, as well as the partners whose collaboration made this initiative possible.

Armida Salsiah Alisjahbana

Under-Secretary-General of the United Nations and Executive Secretary,
United Nations Economic and Social Commission for Asia and the Pacific
Editor-in-Chief, Asia Pacific Sustainable Development Journal

SPECIAL THEME: ENABLING ACCESSIBILITY AND INCLUSION THROUGH DIGITAL TRADE AND E-COMMERCE

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

ADVANCING DIGITAL TRADE AND CROSS-BORDER E-COMMERCE IN ASIA AND THE PACIFIC

Jong Woo Kang, Sanchita Basu Das, Rupa Chanda

Corresponding author: Sanchita Basu Das
Email: Sbasudas@adb.org

Digital trade and cross-border e-commerce are transforming economic structures in Asia and the Pacific, expanding market access, productivity and inclusion. While rapid digital adoption and platform expansion offer significant opportunities, persistent digital divides, regulatory fragmentation, and trust deficits constrain inclusive participation. This overview introduces the Special Theme on Enabling Accessibility and Inclusion through Digital Trade and E-commerce, featuring papers from the Asian Think Tank Network Forum 2025. The papers highlight the need for strengthening coordinated policies, interoperable regulations and capacity-building to support progress toward the Sustainable Development Goals, particularly Sustainable Development Goals 8, 9, 10 and 17.

Keywords: Asia and the Pacific, inclusive digital economy, digital trade, cross-border e-commerce, digital public infrastructure, trade facilitation

JEL classification: F13, F15, L81, O33, O14

I. INTRODUCTION

Digitalization is reshaping trade and commerce across Asia and the Pacific. Digitally delivered services now account for more than half of all services trade, while foreign direct investment in the digital economy has tripled since 2020 (UNESCAP, 2024a; ADB, 2026). In the Association of Southeast Asian Nations (ASEAN) alone, the digital economy is projected to triple by 2030, with every 1% increase in digital growth associated with a 0.8% rise in gross domestic product (GDP) per capita (UNESCAP, 2024a). At the core of this transformation is the expansion of cross-border e-commerce, where goods and services are exchanged across jurisdictions through digital platforms that integrate ordering, payments, and logistics (OECD, 2025).[1]

Globally, e-commerce sales across 43 economies grew by nearly 60% between 2016 and 2022, reaching $27 trillion (UNCTAD, 2024). Of the 10 fastest-growing e-commerce economies across the globe, seven are in Asia and the Pacific (ADB, 2023). In ASEAN, e-commerce rose by 16% in 2025 alone (Nikkei Asia, 2025), reflecting the rapid adoption of digital platforms and online payments.

Cross-border e-commerce is reshaping production and consumption patterns, expanding market access, and reshaping value chains. However, realizing its full potential requires strong enabling ecosystems, including domestic digital infrastructure, interoperable payment systems, efficient logistics, trade facilitation measures, regulatory harmonization and greater digital capabilities among businesses and consumers.

Asia and the Pacific is particularly well positioned to benefit from cross-border e-commerce. The region accounts for nearly two-thirds of global e-commerce sales, with online transactions forming over 60% of retail sales—far higher than in Europe or North America (ADB, 2024). Mobile payments facilitate around 70% of transactions (McKinsey Global Institute, 2024).

Major economies such as the People's Republic of China and India play a central role in global e-commerce, while emerging economies such as Indonesia, the Philippines, and Viet Nam lead in financial technology (fintech) adoption (ICRIER, 2024; ASEAN, 2023). Strong fundamentals support these trends, including a doubling of internet access since 2012, deepening trade integration, and a growing share in global manufacturing (East Asia Forum, 2025; Eastspring Investments, 2024; ADBI, 2025).

Despite these advantages, significant challenges persist. Digital divides remain pronounced in the region, with about one-third of the population still unconnected

---

[1] This paper builds on the discussion in ADB Policy Brief xxx and benefits from presentation materials from the Asian Think Tank Network Forum 2025, themed Enabling Accessibility and Inclusion through Digital Trade and E-Commerce. The authors thank all paper authors of this special issue. The authors also thank James Correia (consultant, ADB), Angel Love A. Roque (analyst, ADB), and Katherine Firmeza (consultant, ADB) for their valuable inputs and support.

and half of those in rural areas (ITU, 2021). Market concentration is high, with a handful of economies accounting for the majority of digital exports, while least developed countries lag far behind (UNCTAD, 2024). Micro, small and medium-sized enterprises (MSMEs) often lack the capabilities and resources to fully participate in cross-border e-commerce. Regulatory fragmentation, rising trade restrictions and limited interoperability across national digital frameworks create significant structural barriers (ADBI, 2025; ITU, 2025). Increasing cyber risks and gaps in data protection and consumer trust further constrain growth (Aon, 2024).

This volume of the Asia-Pacific Sustainable Development Journal presents a collection of empirical and qualitative papers on the special theme, Advancing Digital Trade and Cross-Border E-commerce in Asia and the Pacific, which were presented at the Asian Think Tank Network Forum 2025. Drawing on these papers, the volume examines emerging trends, impacts, and regulatory challenges related to digital trade and cross-border e-commerce in the region. Paper 1 reviews these issues and summarizes the key findings of the eight thematic papers featured in this volume.

II. TRENDS AND IMPACT IN DIGITAL TRADE AND CROSS-BORDER E-COMMERCE

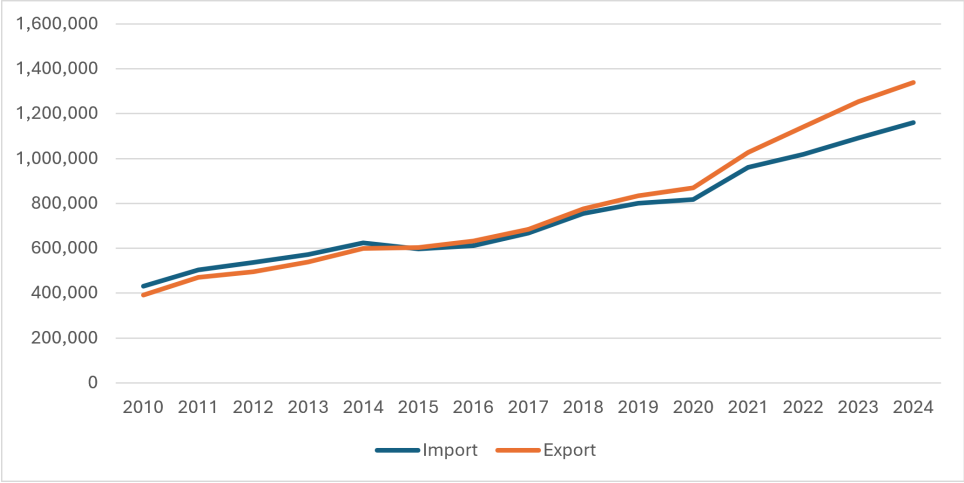
Global e-commerce sales have expanded significantly, and the growth trajectory of cross-border e-commerce has been strong and sustained. Digital exports in Asia and the Pacific have nearly quadrupled since 2010 as illustrated in figure 1, and e-commerce has doubled since 2016 (Rahman and Rahman, 2022; CSIS, 2024). This has been supported by a rapidly evolving digital ecosystem encompassing online marketplaces, digital payments, logistics providers and digitally enabled supply chains.

New forms of commerce, such as social commerce, live-stream shopping, gamification, and app-based retail, are gaining traction, particularly among younger consumers (KPMG, 2024). These developments reduce information asymmetries by efficiently matching buyers and sellers, streamline administrative processes such as customs and compliance and lower transaction costs by expanding market access and scale (Lopez Gonzalez and Ferencz, 2018; ADB, 2025a).

Cross-border e-commerce is rapidly transforming the scale and direction of trade across Asia and the Pacific and accounts for a higher share of the total than in other regions (Rahman and Rahman, 2022). Its importance varies significantly across countries, reflecting differences in levels of economic development, digital readiness, and institutional capacity. Advanced economies tend to derive greater value from the digital economy, with contributions to GDP reaching 6.1% in Taipei,China; 5.8% in the Republic of Korea; and 5.4% in Singapore, compared to just 2.5% in the Philippines and 1.8% in the Lao People's Democratic Republic and Cambodia (Ortiz and Manguera, 2025).

A significant growth potential remains for e-commerce in emerging economies. In Indonesia, e-commerce already accounts for 72% of the digital economy and is projected to reach $146 billion, or 9%–10% of GDP, by 2025 (Supriadi et al., 2025). In the Philippines, e-commerce adoption expanded dramatically from 14% of firms in 2013 to 31.2% in 2021 (Ortiz and Manguera, 2025). These variations highlight the central role of infrastructure, digital literacy and regulatory systems in shaping cross-border e-commerce outcomes across the region.

Figure 1: Trade in digitally delivered services in Asia and the Pacific, 2010–2024



Source: UNCTAD Statistics, 2026.

Sectoral composition further illustrates these differences. Emerging economies tend to specialize in information and communications technology goods and basic electronics, while advanced economies are increasingly oriented toward higher-value, digitally delivered services, including finance, information technology, and cultural industries (Ghosh, 2025; Ortiz and Manguera, 2025). As a result, digitally delivered services trade is more prominent in advanced economies, whereas goods-based digital trade remains dominant in countries such as Malaysia, Thailand and Viet Nam (Ortiz and Manguera, 2025; Ghosh, 2025). However, in recent years, there's a structural shift towards service-led growth and digital transformation, with knowledge-intensive services emerging as the fastest growing segment across the region (Ghosh, 2025; Baker and Le, 2025).

Trade agreements are critical in providing an enabling regulatory environment for cross-border e-commerce. Multilateral and regional frameworks have increasingly shaped the governance of digital trade. The WTO Joint Statement Initiative (JSI) on E-commerce has advanced negotiations on global rules for e-commerce, while agreements, such as the Regional Comprehensive Economic Partnership (RCEP),

and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), have incorporated e-commerce chapters and provisions on cross-border data flows, digital trade facilitation, and regulatory cooperation (Baker and Le, 2025; WTO, 2023).

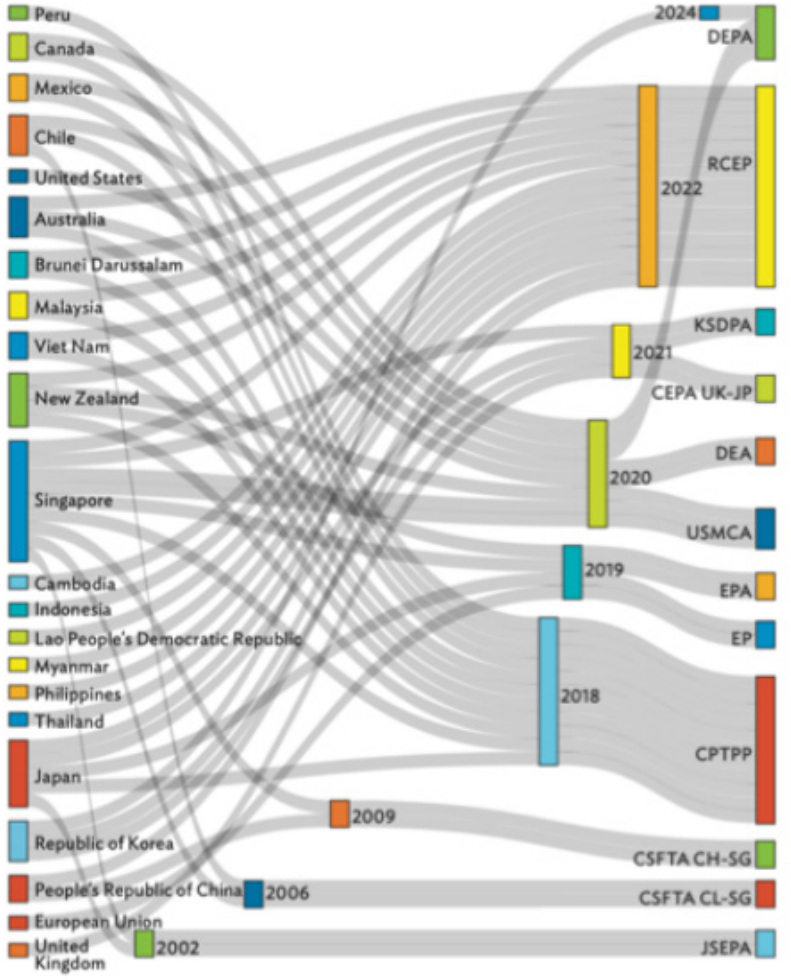
While these agreements have facilitated cross-border e-commerce, more can be done. For example, the RCEP provides broad regional coverage and significant scope for deepening digital trade commitments, while the CPTPP incorporates more advanced and comprehensive rules but continues to face implementation challenges among its members. (CSIS, 2024; KPMG, 2021; Baker and Le ,2025).

Nonetheless, empirical evidence suggests that such agreements significantly boost digitally delivered services trade, particularly in finance, IT, and cultural services (Ghosh, 2025). Singapore is pursuing a multifaceted approach to tap into the varied strengths of available trade channels, adopting six bilateral digital economy agreements while participating in the broader ASEAN, RCEP, and CPTPP processes (Ministry of Trade and Industry 2026). The rise and role of digital trade agreements and provisions in Asia and the Pacific is illustrated in figure 2.

Despite these positive trends, the benefits of cross-border e-commerce remain unevenly distributed across firms, sectors, and geographies. Larger firms are generally better positioned to participate due to greater access to finance, technology and skilled labour, while smaller firms, especially those in rural, remote or less-developed areas, face persistent barriers of connectivity, capabilities and scale (Chhorn et al., 2025; Ortiz and Manguera, 2025). This is particularly significant given the prevalence of MSMEs, which are concentrated in the services sector and account for 97% of enterprises, 69% of employment and 41% of GDP in the region (UNESCAP, 2024b; Nikkei Asia, 2025).

Targeted interventions demonstrate that these constraints can be overcome. In the People's Republic of China, the development of Taobao villages has generated over RMB 1 trillion in transactions, enabling small-scale rural producers to access national and global markets and diversify their economic activities (Cai and Tian, 2025) (box 1). Azerbaijan's export promotion portal has upgraded local firms' participation in international platforms and trade, with 3,500 companies reaching 122 countries (Huseyn and Gadashov, 2025). These examples underscore the potential of cross-border e-commerce to advance inclusive growth when supported by appropriate policies and infrastructure.

Figure 2: Timeline of digital trade agreements and provisions in Asia and the Pacific



Notes: Neither the list of countries nor the list of agreements is comprehensive. The diagram serves only illustrative purposes of the relatively active countries in digital regulatory cooperation, focusing on Asia and the Pacific, as well as post-COVID-19 spike in the importance of digital regulatory cooperation and digital trade agreements. Effective 1 February 2021, ADB placed a temporary hold on sovereign project disbursements and new contracts in Myanmar. CEPA UK–JP = United Kingdom–Japan Comprehensive Economic Partnership Agreement, CSFTA CH–SG = China–Singapore Free Trade Agreement, CSFTA CL–SG =Chile—Singapore Free Trade Agreement, EPA = economic partnership agreement, JSEPA = Japan—Singapore Economic Partnership Agreement, KSDPA = Korea—Singapore Digital Partnership Agreement, USMCA = United States–Mexico–Canada Agreement

Source: ADB (2025a).

Box 1. Taobao villages—a decentralized ecosystem for rural e-commerce in the People's Republic of China

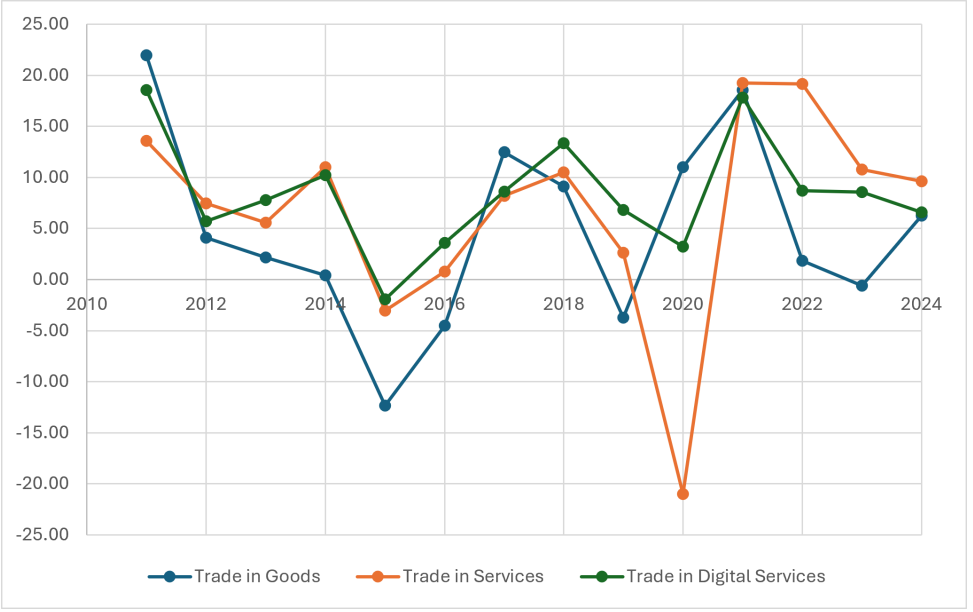
Taobao villages are localized rural e-commerce hubs that demonstrate the interplay between micro, small and medium-sized enterprises and largescale online providers. These include 29,600 active online shops across 5,425 villages. Alibaba provides a platform and logistics network for connecting these firms to new consumers and markets, expanding the reach of their commercial activities while lowering transaction costs. This initiative has fostered rural development, boosted productivity and innovation and improved community resilience, including by reducing agricultural sector dependence and shifting local economies toward higher-value manufacturing and services. These benefits have been particularly pronounced in economically disadvantaged areas.

Source: Cai and Tian (2025).

Fintech is another critical enabler of cross-border e-commerce, particularly cross-border payments and expanding financial inclusion. These rates are high in emerging economies such as Viet Nam and the Philippines, often exceeding those in more mature markets (PCMI, 2023). Platforms like MBANK in the Kyrgyz Republic illustrate how digital finance can broaden access to payment systems, facilitate cross-border transactions and novel services, and has rapidly expanded to cover 80% of the adult population in the country (PR Newswire, 2024). However, the rapid expansion of fintech also introduces risks, including cybersecurity threats, fraud and over-indebtedness. Moreover, significant disparities persist, with fintech usage in urban areas far exceeding that in rural regions, reflecting underlying inequalities in access and digital literacy (Morgan, 2022).

At a macroeconomic level, cross-border e-commerce is contributing to structural transformation by shifting the balance of economic activity toward services and digital trade (Bernardo, 2025). Trade in services has expanded rapidly since COVID-19, while the relative share of goods trade has declined (UNCTAD, 2024). These trajectories are displayed in figure 3. Services now account for more than half of employment in the region, driven by the growth of sectors closely linked to cross-border e-commerce such as finance, technology, and logistics (IMF, 2024). These offer substantial productivity gains. For example, financial services are, on average, four times more productive than manufacturing in Asia and the Pacific (IMF, 2024). Cross-border e-commerce also enhances economic resilience by diversifying sources of growth and reducing dependence on primary commodities, which are often vulnerable to price volatility and climate risks (Cai and Tian, 2025).

Figure 3. Annual growth in goods, services, and digitally deliverable services trade, Asia and the Pacific 2010–2024 (%)

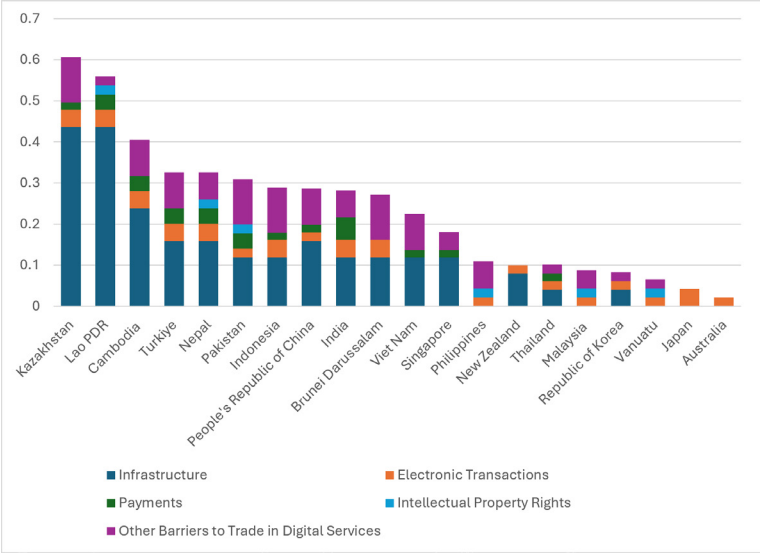


Source: UNCTAD Statistics, 2026.

At the same time, the rise of large digital platforms introduces new challenges. Market concentration, driven by network effects, can limit competition and create asymmetric dependencies between platforms and smaller firms. Four in five MSMEs in Asia and the Pacific view large platforms as critical infrastructure, and their role in sustaining operations, broadening customer bases and market access, and reducing costs can be a double-edged sword (Nikkei Asia, 2025; As'ad et al., 2022; ADB, 2024; ADB, 2025b). The expansion of the gig economy, that now account for a significant share of the labour force in some countries, raises concerns about job quality, income stability, and social protection (WEF, 2025). These dynamics highlight the need for balanced policy approaches that support innovation while addressing emerging risks.

Realizing the full potential of cross-border e-commerce requires a comprehensive and coordinated policy framework. Insufficient infrastructure continues to loom large as a barrier to digital trade (figure 4), alongside interoperable payments, regulatory alignment, digital skills, strong data, cybersecurity and consumer protection frameworks. Investing in it is essential for inclusive and sustained cross-border e-commerce growth. The following section discusses these issues.

Figure 4: Infrastructural and Regulatory Hurdles to Digital Trade in Asia and the Pacific, 2025



Source: OECD Digital Services Trade Restrictiveness Index (Digital STRI), 2025 (OECD Data Explorer • Digital Services Trade Restrictiveness Index).

III. CROSS-BORDER E-COMMERCE REGULATIONS AND CHALLENGES

Regulatory deficits, fragmentation and restrictions remain major barriers to the expansion of cross-border e-commerce in Asia and the Pacific. These challenges stem from the absence of comprehensive and binding regulatory frameworks, narrow and outdated legislation with gaps in coverage, overlapping existing laws and the largely "soft" nature of existing rules for e-commerce, the fragmentation of institutional responsibilities across government agencies, and a lack of regulatory interoperability and cooperation across borders (ADB, 2021).

According to a survey of 210 firms, nearly half reported facing high levels of regulatory uncertainty, while compliance costs averaged 18.7% of revenues and consumer trust remained low (Farooq et al., 2025). Establishing clear, predictable, and enforceable regulatory frameworks is therefore a critical first step toward unlocking the benefits of cross-border e-commerce while mitigating associated risks. Greater adoption of international practices and standards, including those developed by the World Trade Organization (WTO) and the United Nations Commission on International Trade Law (UNCITRAL), can help improve regulatory interoperability and facilitate cross-border digital trade.

Some countries have made progress in developing dedicated frameworks for cross-border e-commerce. Tajikistan and Uzbekistan have adopted Laws on Electronic Commerce (2022), requiring firm registration and combining consumer protection

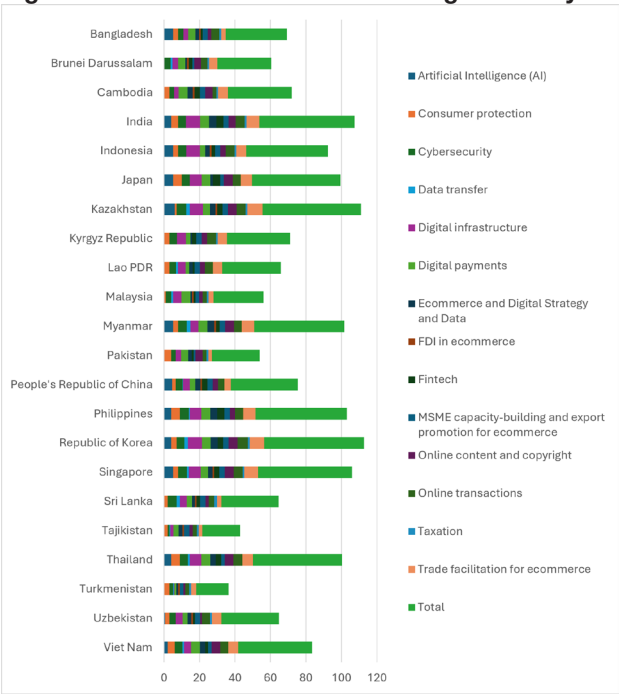
with innovation support (Enikeeva, 2025; Times of Central Asia, 2025). Kazakhstan has implemented the E-commerce Development Plan to promote MSME participation, enhance digital literacy and strengthen international partnerships.

This enabled a joint venture with Alibaba and the national postal operator, driving a 50% rise in orders from the People's Republic of China in 2023–2024 (Enikeeva, 2025). However, many countries rely on short-term, broad and non-binding digital strategies and struggle to keep pace with rapid technological change.

As a result, comprehensive, adaptive regulatory frameworks remain the exception rather than the norm. An increasingly diverse suite of digital policy measures has evolved to create an enabling environment for e-commerce, though this is predominantly focused on payments and often outstripped by the pace of technological change. The substantive composition of measures is outlined in Figure 5.

Domestic readiness and digital public infrastructure form the foundation for effective cross-border e-commerce regulation. This includes interoperable systems for digital identity, payments, and data governance (box 2). India's digital public infrastructure ecosystem illustrates the potential of an integrated approach. Aadhaar enables biometric identification and authentication, the unified payments interface supports instant and interoperable transactions, electronic signatures facilitate contracting, and the Data Empowerment and Protection Architecture strengthens data governance (Desai and Manoharan, 2024; Alonso et al., 2023).

Figure 5: MSME E-commerce and Digital Policy Index, Asia and the Pacific 2024



Source: Alliance for E-Trade Development, 2024.

A vast expansion of digital infrastructure underpins this. The country has laid 4.2 million kilometres of fibre-optic cables, achieving 82% 5G coverage, 1.2 billion mobile subscriptions and a 97% drop in data costs during 2014–2025 (ADB, 2025c). Together, these systems enhance domestic readiness and support cross-border integration.

Box 2: Digital public infrastructure: Bhutan

The Bhutan case also illustrates common structural challenges facing many countries across emerging Asia and the Pacific in digital public infrastructure adoption. This is constrained by infrastructural deficits in data centres and fibre-optic cables, shortfalls in technical capacity among policymakers and practitioners and limited private sector participation. However, Bhutan has made significant strides in forging the foundational elements of its digital public infrastructure in recent years. These include:

- **Legal anchor and framework:** The country's digital public infrastructure approach is anchored in the National Digital Strategy.
- **Coverage and integration:** The digital identity system has expanded to cover half the population and is integrated across 100+ services and sectors.
- **Data protection and exchange:** The National Data Exchange enables data flows and mitigates risk through decentralized storage and privacy safeguards.
- **Digital payments ecosystem:** The Bhutan Financial Switch and BhutanQR payments systems account for 43.27% of digital transactions.
- **International interoperability:** Bhutan has adopted several data protocols from India's unified payments interface and established cross-border digital corridors with payment systems in Japan, Singapore and Thailand.

Source: ADB (2025).

Regulatory innovation and regional cooperation offer promising pathways forward. Indonesia's Financial Sector Development and Reinforcement Law (2023), for example, integrates fintech into the broader financial regulatory framework, balancing innovation with oversight and consumer protection (Global Legal Insights, 2025) (see box 3).

More broadly, deeper regional cooperation and integration, particularly through trade agreements, regulatory alignment, and knowledge sharing, will be essential to addressing regulatory fragmentation and ensuring that cross-border e-commerce contributes to inclusive, sustainable and resilient economic development across Asia and the Pacific (Baker and Le, 2025). In Central Asia, shared customs and trade facilitation systems have improved efficiency, while ASEAN's efforts to standardize e-signatures and payment systems have contributed to a 28% increase in cross-border e-commerce (Enikeeva, 2025; Farooq et al., 2025).

Despite this progress, cross-border e-commerce continues to face significant barriers to deeper regional integration, as shown in Figure 6 on the Regional Digital Trade Integration Index (RDTII). The RDTII measures regulatory alignment and the costs of conducting digital business across economies.

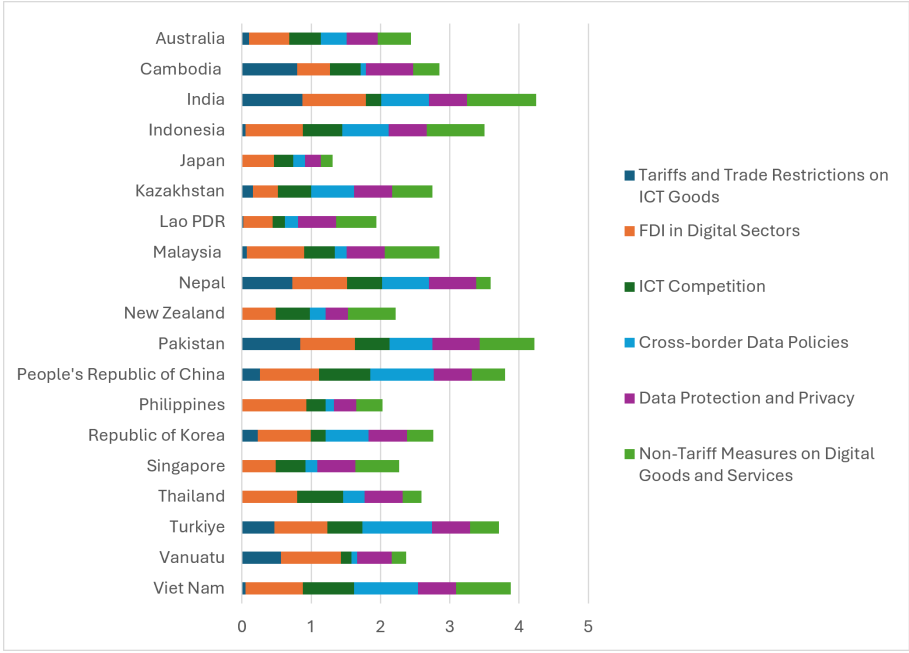
Box 3: Indonesia's financial sector development and reinforcement law

Indonesia's Law No. 4 on Financial Sector Development and Reinforcement, introduced in 2023, is accompanied by a range of enabling regulations. This establishes a dedicated licensing, governance and consumer protection framework for fintech through new rules for emerging technologies and their integration within core financial services regulations. The law assigns responsibility for managing fintech to the Financial Services Authority and was developed in consultation with private sector providers. It aims to balance productivity and protection by promoting digital financial innovation through regulatory "sandboxes" that facilitate the piloting of novel products and services, while tightening regulations for licensing operators and debt collectors who use fintech and creating data protection protocols. This has contributed to a dramatic expansion in fintech use among micro, small and medium-sized enterprises and rural communities.

Source: Global Legal Insights (2025).

Restrictive factors and costs are assessed through tariffs, non-tariff measures, and foreign investment restrictions, while enabling factors and regulatory harmonization are evaluated through domestic data protection frameworks, e-transaction regulations, and telecom competition.

Figure 6: Digital Trade Integration Index: Regulatory Restrictions and Enablers, 2025



Source: UNESCAP Regional Digital Trade Integration Index (RDTII), 2025. (Regional Digital Trade Integration Index (Version 1): A Guide)

Consumer trust is another critical constraint, particularly amid rising cybersecurity risks. Cyber incidents in Asia and the Pacific have increased by 134% over the past 4 years, exacerbated by fragmented regulatory environments that hinder cross-border enforcement and information-sharing (Aon, 2024). In Bangladesh, weak regulatory oversight and limited regional cooperation have enabled widespread consumer fraud affecting hundreds of thousands of users, particularly youth and unemployed graduates (Barua, Correia and Abdullah, 2025). Even in less severe cases, trust deficits shape consumer behaviour. In Indonesia, for example, reliance on cash-on-delivery and informal platforms such as WhatsApp reflects limited confidence in formal systems and digital public infrastructure gaps (Supriadi et al., 2025).

Governments are responding with initiatives to strengthen trust and consumer protection, nationally and regionally. Malaysia pioneered a national trust-mark in 2011, followed by a similar scheme in the Philippines in 2025, while Uzbekistan has streamlined e-commerce firm registration (Enikeeva, 2025). Regionally, the ASEAN Working Group on E-commerce is exploring a common trust-mark framework, and the Asia-Pacific Economic Cooperation Cross-Border Privacy Rules offer a voluntary mechanism to facilitate data flows while protecting consumer rights (Ortiz and Manguera, 2025; Malaysian Reserve, 2024). Although non-binding, these frameworks establish interoperable standards, assign accountability to firms and provide certification mechanisms that can enhance trust.

Digital trade agreements and e-commerce chapters have proliferated but remain limited in scope and ambition. Despite notable progress in transparency, consumer protection, cross-border data flows, and electronic authentication, less attention has been devoted to deeper measures to align regulatory procedures, logistics, and payment systems, support MSMEs, and address emerging areas such as fintech and AI (Baker and Le, 2025).

Strengthening these agreements requires moving along a spectrum of ambition from adopting common digital principles and standards toward “single windows” and electronic certification, mutual recognition arrangements and, ultimately, digital market integration (OECD, 2021; Rahman and Rahman 2022). Advancing trade facilitation—from transparency measures to paperless trade and integrated digital customs systems—will be particularly important (UNCTAD, 2024). ASEAN’s evolving approach, including the ASEAN Agreement on Electronic Commerce (2019), a dedicated working group, and ongoing negotiations toward a Digital Economy Framework Agreement, reflect progress toward more comprehensive regional alignment (Ing et al., 2023; Rivera, 2025; Correia et al., 2025) (see box 4).

Finally, persistent digital divides continue to limit the inclusiveness of cross-border e-commerce. Gaps in internet access, affordability, infrastructure, and digital skills remain widespread. In several developing economies, mobile subscription rates are

below 50%, while internet costs can be up to four times higher as a share of income than in advanced economies (UNCTAD, 2023; ITU, 2021).

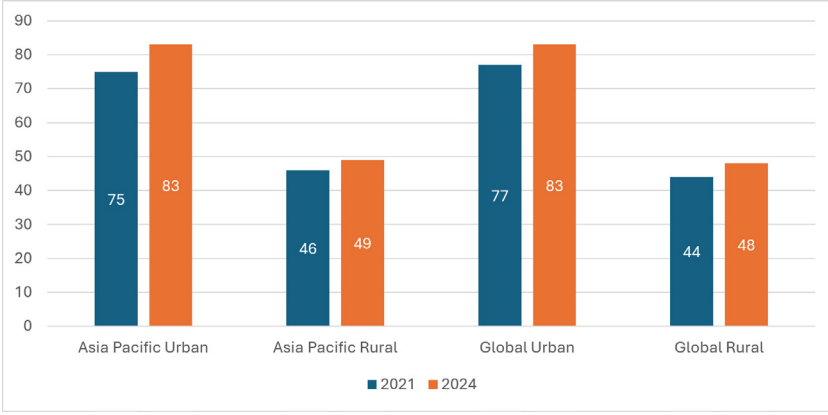
Box 4. ASEAN Digital Economy Framework Agreement

The ASEAN Digital Economy Framework Agreement (DEFA) carries considerable promise in forging a regionally integrated approach to cross-border e-commerce, expanding digitally delivered services, and catalysing the digital transformation to advance economic growth and development. While the Association of Southeast Asian Nations' (ASEAN) digital economy is due to triple from $300 billion to $1 trillion by 2030, DEFA is projected to double this contribution (ASEAN, 2023). The key pillars of DEFA encompass digital payments, data governance, and logistics and skills. ASEAN DEFA is nested within a broader ecosystem of technical dialogues through the Working Group and Work Programme on E-commerce, a dedicated framework in the ASEAN Agreement on Electronic Commerce (2019), and the recent shift toward a "negative list" approach in the ASEAN Trade in Services Agreement.

Sources: Ing et al. 2023; Rivera 2025.

More than one-third of those in Asia and the Pacific remain offline, and rural internet usage is significantly lower than in urban areas (figure 7) (ITU, 2025; Business Times, 2025). Around 40% of people in the region lack basic digital skills, increasing vulnerability to cyber risks and limiting participation in digital trade. Least developed countries account for only 1% of the region's digital economy (UNCTAD, 2023; UN News 2024b).

Figure 7: Internet use in urban and rural areas in Asia and the Pacific and globally, 2021–2024



Source: ITU (2025).

Addressing these interconnected challenges—regulatory fragmentation, weak trust frameworks, limited digital readiness, and inequalities within and between countries—will be essential to realizing the full potential of cross-border e-commerce as a driver of inclusive and sustainable growth in Asia and the Pacific. This overview concludes with a set of recommendations aligned with these objectives.

IV. ABOUT THE SPECIAL THEME

The papers in this special theme issue have been clustered around two sub-themes- (a) State and Challenges for Inclusive Digital Trade and E-commerce; (b) Policy and Regulatory Enablers for Inclusive Digital Trade and E-commerce. The first cluster on the state and challenges consists of five papers focusing on factors, such as digital infrastructure, platform economy, e-commerce adoption, and digital trade integration, to enhance productivity, inclusion, competitiveness, and macroeconomic development across Asia. The second cluster consists of three papers that examine how digital trade rules, regional trade agreements, and e-commerce regulations can promote inclusive and interoperable digital trade ecosystems across emerging Asian economies.

Sub-theme 1: State and challenges for inclusive digital trade and e-commerce.

In paper 2 – **Can economies leapfrog to digital success? Evidence from global e-commerce development pathways** – Homer Pagkalinawan examines whether an infrastructure-first approach is the only route to success in e-commerce and digital trade. The paper challenges the conventional assumption that high-quality digital infrastructure must precede meaningful participation in the digital economy. While traditional development models emphasize large-scale investments in broadband connectivity and network coverage, the study highlights the growing importance of Digital Public Infrastructure, including digital identity systems, digital payment platforms and data exchange frameworks, as potential drivers of inclusive digital transformation.

The study analyses data from 149 economies using a cross-country quantitative framework that combines indicators of physical digital infrastructure, digital public infrastructure quality, and e-commerce performance. To capture differences in national development strategies, the study classifies economies into five pathways: digital leaders, infrastructure advantage, digital public infrastructure innovators, emerging digital, and pre-digital foundations.

The findings, while confirming that physical digital infrastructure remains a key driver of e-commerce performance, shows that strategic deployment of digital public infrastructure can provide an alternative or complementary route to digital development. Countries categorized as digital public infrastructure innovators achieve meaningful e-commerce outcomes despite infrastructure gaps, suggesting that institutional and

platform-level investments can partially compensate for weaker connectivity.

The paper thus concludes that infrastructure-first approaches are not the sole pathway to digital success. Although the strongest outcomes emerge when robust infrastructure and digital public infrastructure systems develop together, strategic investment in such infrastructure can enable countries to leapfrog and participate meaningfully in digital trade despite existing infrastructure constraints.

In paper 3—**Digital trade for macroeconomic development: Evidence from ASEAN's e-commerce integration**—John Paolo R. Rivera examines whether participation in cross-border e-commerce can drive macroeconomic development. The study explores which digital trade enablers most strongly influence cross-border e-commerce participation and whether greater engagement contributes to improved macroeconomic outcomes, particularly real GDP growth and current account performance. Focusing on digitally delivered services, the paper positions digital trade as both a trade facilitation mechanism and a tool for inclusion and structural transformation. The analysis categorizes digital trade enablers into three pillars: digital trade and logistics, digital skills and talent, and institutional and infrastructural readiness, allowing detailed assessment of how these factors shape cross-border e-commerce participation and broader economic development.

The findings show that digital skills and talent are the strongest determinants of digitally delivered services exports, highlighting the critical role of human capital in enabling firms and workers to participate effectively in cross-border digital markets. In contrast, digital trade and logistics efficiency emerges as the most important driver of digitally delivered services imports, underscoring the importance of interoperable customs systems, logistics networks and digital payment infrastructure. Institutional and infrastructural readiness alone do not guarantee stronger cross-border e-commerce participation, suggesting that connectivity must be complemented by broader ecosystem readiness.

Importantly, the study finds that greater cross-border e-commerce participation through both digitally delivered services exports and imports has a strong positive effect on real GDP growth, especially in emerging economies, although impacts on current account balances are more limited and uneven. Overall, the paper concludes that targeted investments in digital skills, institutional coherence, and ecosystem trust can enable ASEAN economies to leverage digital trade and e-commerce as pathways toward inclusive and sustainable macroeconomic development.

Dina Chhorn, Sivly Houy, Kean Muny Nhim, in paper 4—**The role of digital platforms and cross-border trade in Cambodian firm performance**—examine whether digital platform adoption improves firm performance and facilitates participation in cross-border trade in Cambodia. The paper also investigates how structural constraints and gender-related barriers shape firms' ability to benefit from digital transformation.

The study addresses a central policy question: can digital platforms function as inclusive drivers of productivity, formalisation and market integration, or do existing inequalities limit their effectiveness?

The analysis is based on firm-level data from the Cambodia Economic Census 2022, covering more than 700,000 establishments nationwide. This extensive dataset allows the authors to assess patterns of digital adoption across different firm sizes, ownership structures and geographic locations.

The findings show that firms adopting digital platforms perform better than non-adopters in revenues, formal registration and labour productivity. By reducing information asymmetries and transaction costs, digital platforms help firms access wider markets and participate more effectively in cross-border trade, particularly benefiting small and medium-sized enterprises. However, these gains are unevenly distributed. Firms in Phnom Penh and other urban areas benefit more than those in provincial and border regions due to disparities in digital infrastructure and market access. Women-owned firms also face barriers such as limited access to finance, lower digital literacy and greater care responsibilities, highlighting that digital platforms alone cannot overcome deeper structural inequalities.

The paper concludes that while digital platforms hold substantial potential to improve firm performance and strengthen Cambodia's integration into regional digital trade, digital transformation must be accompanied by complementary investments in infrastructure, digital skills, finance, and regulatory coordination. Targeted support for women-owned enterprises and underserved regions is particularly important to ensure that the benefits of digitalisation contribute to inclusive and sustainable private sector development.

Maria Kristina P. Ortiz and Mark Carmelo R. Manguera, in paper 5—**Connected for growth: Analyzing the impact of e-commerce adoption on firm performance and labour outcomes in the Philippines through peer effects**—examine the firm-level impacts of e-commerce adoption in the Philippines. The study highlights how rapid digitalization, particularly during the COVID-19 pandemic, has generated uneven outcomes across firms and industries. Using matched firm-level data from the Philippine Statistics Authority's Annual Survey of Philippine Business and Industry and the Survey on Information and Communications Technology, the authors assess how e-commerce adoption affects revenues, costs, profits, employment, female employment and labour productivity. The analysis distinguishes between pre-pandemic, pandemic and extended periods to capture how impacts evolve over time.

The findings show that the effects of e-commerce adoption are dynamic and evolve over time as firms adjust to digitalization. Before the pandemic, adoption supported employment growth, including higher female employment, indicating inclusive and labour-absorbing effects, although revenues and profitability remained limited. During

the pandemic, firms relied on digital channels to sustain operations, leading to revenue growth but also rising operating costs and limited employment gains. Over the longer term, firms experienced improvements in labour productivity, while profitability weakened as costs increased faster than revenues. The study also highlights strong peer effects in e-commerce adoption, showing that firms are influenced by the digital practices of competitors and business networks.

The paper emphasizes the need for sustained policy support to help firms manage the costs and challenges of digital integration. The authors call for ecosystem-based policies that strengthen digital infrastructure, improve digital skills, expand support for MSMEs, and reinforce trust, competition, consumer protection and data governance. Such measures can help e-commerce contribute more effectively to inclusive growth, gender equality, firm resilience and sustainable digital transformation.

In paper 6—**Unlocking economic gains: how e-commerce enhances efficiency, productivity, and market access in Indonesia: Evidence from the 2024 e-commerce survey**—Andri Yudhi Supriadi, Sri H. Rachmad, Kennith G.C. Dillena, Hadi Kardoyo, Devi Asiati, and Roosganda Elizabeth examine how e-commerce adoption affects MSMEs in Indonesia. The study focuses on economic efficiency, labour absorption and market access, while addressing whether digital adoption alone is sufficient to improve firm outcomes. It also evaluates the role of complementary factors such as financial management practices, digital capabilities and institutional readiness in translating digital participation into measurable economic gains.

The analysis draws on nationally representative secondary data from the 2024 E-commerce Survey conducted by Statistics Indonesia, covering 39,736 e-commerce businesses across all 38 provinces and 365 districts and cities. The findings reveal that while e-commerce can generate economic benefits, these gains are uneven across firms and regions. Firms that maintain formal financial records are significantly more likely to experience stable or increasing revenues, underscoring the importance of sound financial management. Conversely, participation in digital marketing training and exclusive reliance on non-cash payment systems are negatively associated with revenue growth, suggesting limitations in the design, effectiveness, or trust in these digital interventions. Additionally, e-commerce activity remains heavily concentrated in Java, highlighting persistent regional disparities driven by differences in infrastructure, logistics, and institutional support.

Overall, the study concludes that managerial capacity and institutional readiness are more critical than technology adoption alone in improving MSME performance. While e-commerce can lower entry barriers and expand market access, its productivity impacts remain constrained without strong capabilities and supportive ecosystems. From a policy perspective, the authors emphasize shifting focus from mere access to effectiveness: strengthening financial literacy and recordkeeping, redesigning training

programs to be practical and sector-specific, expanding trustworthy digital payment systems, and addressing regional inequalities through targeted infrastructure and logistics improvements.

Sub-theme 2: Policy and regulatory enablers for digital trade and e-commerce

In paper 7—**An analytical framework to establish convergence in cross-border digital trade rules**—Paul R. Baker and Loan Le examine the widening gap between the rapid digitalization of economies and the fragmented evolution of international digital trade governance frameworks. The paper explores how economies with differing regulatory priorities and levels of digital readiness can identify common ground while preserving legitimate domestic policy objectives.

Baker and Le develop a three-dimensional analytical framework based on negotiation theory, particularly the Zone of Possible Agreement, to assess areas of convergence and divergence in digital trade negotiations. Their analysis identifies strong convergence in foundational areas such as customs duties on electronic transmissions, personal data protection frameworks, and cross-border data flows, often accompanied by safeguards that maintain regulatory autonomy. However, the authors find moderate to high divergence in transactional and emerging policy areas, including electronic contracts, treatment of digital products, artificial intelligence, fintech regulation, and MSME-focused provisions. Inclusion-related commitments remain limited and largely non-binding, revealing a persistent disconnect between digital trade liberalization and inclusive development objectives.

Despite these challenges, the findings suggest that meaningful negotiation space exists even in sensitive areas through flexible commitments, regulatory dialogue, capacity-building measures and transitional arrangements that support interoperability while preserving domestic policy space. Baker and Le conclude that Zone-of-Possible-Agreement-based analytical tools can help negotiators identify feasible convergence areas early in negotiations. They recommend combining binding rules with cooperation-based provisions, incorporating transitional arrangements and capacity-building support for economies with differing digital readiness, and strengthening regional and bilateral cooperation to advance interoperable and inclusive digital trade governance.

Avik Ghosh in paper 8—**Trade agreements and digitally delivered services: The varied evidence from emerging Asia** —examines how digital trade provisions embedded in regional trade agreements (RTAs) influence the growth of digitally delivered services exports in emerging Asian economies. While RTAs are increasingly viewed as important instruments for promoting digital trade integration, their effectiveness in supporting services-led growth remains debated. The paper addresses this gap by analysing whether RTAs directly stimulate digitally delivered services exports or whether their effects depend on broader trade structures, macroeconomic stability, and domestic preparedness. The study focuses on digitally delivered services across sectors such

as financial services, computer services, and intellectual property-related activities.

The findings show that RTAs containing digital trade provisions significantly enhance digitally delivered services exports, particularly in economies that are already well integrated into global services trade and maintain higher levels of export and import openness. Economies with stronger external balances, greater export dynamism, and more developed trade ecosystems experience the largest gains, as RTAs reinforce existing comparative advantages in digitally deliverable services. However, the positive effects are highly conditional. In countries with weaker trade orientation, fragile macroeconomic fundamentals, or limited structural readiness, RTAs alone do not lead to meaningful expansion in digitally delivered services exports.

From a policy perspective, the study argues that digital RTAs are necessary but insufficient instruments for advancing services-led growth. While RTAs provide an enabling legal and institutional framework, their benefits materialize fully only when complemented by domestic reforms in digital regulation, infrastructure, skills development, and institutional quality. Ghosh therefore advocates a dual-track strategy that combines rule-based digital trade integration through RTAs with stronger domestic digital ecosystems to improve competitiveness, inclusiveness, and sustainable digital trade development across emerging Asia.

In paper 9—**Building inclusive economic growth in Asia with mode 1 finance and insurance service exports: Role of digital trade provisions in free trade agreements** —Deeparghya Mukherjee examines how digital trade and e-commerce-related provisions in trade agreements influence Mode 1 cross-border services exports in Asia, with particular attention to financial services and insurance and pension services. The study investigates whether specific digital commitments, beyond the existence of FTAs, effectively promote services exports, how these impacts differ across ASEAN and East Asia and whether the effects have strengthened in the post-2018 period characterized by accelerated digitalization.

The findings show that digital trade provisions significantly affect services exports, although the impacts vary across sectors, regions and time periods. For financial services, FTAs positively influence Mode 1 exports in ASEAN and Asia overall, but not in East Asia. More importantly, targeted digital provisions rather than aggregate measures of digital depth emerge as the key drivers of export growth. These include commitments on data protection, consumer protection in e-commerce, safeguards for intellectual property rights in digital transactions, prohibitions on mandatory source code disclosure, and clear rules for conflict resolution across services, investment, and e-commerce chapters. In contrast, insurance and pension services respond more strongly to digital trade facilitation measures such as paperless trading arrangements, provisions supporting cross-border data flows, and operational e-commerce facilitation commitments. These effects are particularly pronounced in ASEAN economies.

The study also finds that the estimated effects of digital provisions became stronger after 2018, reflecting the growing importance of digital delivery channels during and after the COVID-19 pandemic. Mukherjee concludes that carefully designed and targeted digital provisions within FTAs can significantly support Mode 1 services exports, strengthen post-pandemic trade resilience, and promote sustained long-term growth. The findings highlight that different service sectors require different policy instruments, while regional differences shape the effectiveness of digital trade commitments across Asia.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

Digitalization and cross-border e-commerce are transforming trade and development across Asia and the Pacific, creating new opportunities for growth, productivity and inclusion. The rapid expansion of digital platforms and digitally delivered services has improved market access and enabled firms to participate in global value chains at lower cost. Evidence from countries such as the Philippines, Indonesia and Cambodia shows that digital adoption is linked to higher revenues, improved efficiency, and greater formalization. Strong and integrated regional fundamentals, including rising connectivity, mobile adoption, and digital ecosystems further support this growth.

However, these benefits remain unevenly distributed. Differences in digital readiness and infrastructure continue to shape outcomes, with advanced economies specializing in higher-value digital services while emerging economies remain concentrated in lower-value segments. Despite their economic importance, MSMEs remain underrepresented in cross-border e-commerce due to capability, resource, and financing constraints. In addition, large and persistent digital divides across income groups, firm sizes, and rural–urban areas risk limiting the inclusiveness of digital transformation.

Regulatory fragmentation remains a major constraint on the growth of cross-border e-commerce. Weak, fragmented and often non-binding regulatory frameworks increase uncertainty, raise compliance costs, and undermine consumer and business trust. While progress has been made through investments in digital public infrastructure, trust-building mechanisms, and regional digital agreements, significant gaps in interoperability, regulatory alignment, and enforcement persist. Addressing these challenges will require greater harmonization of regulations and standards, particularly in areas such as electronic invoicing, digital tax payments, and other trade facilitation measures that can streamline customs clearance and cross-border transactions. Such efforts would complement ongoing paperless trade initiatives across Asia and the Pacific, including the ASEAN Single Window and the ASEAN Customs Transit System. At the same time, rising cybersecurity risks and concerns over data protection continue to pose additional challenges.

The policy recommendations emerging from the papers in this volume converge on a common theme: that promoting inclusive e-commerce and digital trade in Asia and

the Pacific requires moving beyond access-driven approaches toward integrated, ecosystem-based strategies that simultaneously address infrastructure, capabilities, cost barriers, and trust. Across studies, a consistent finding is that digital inclusion is multi-dimensional that is anchored in availability, accessibility, and affordability of digital infrastructure, connectivity, and digital services, and that effective policy must address all three in a coordinated manner. Some of the key findings and policy ideas are listed below:

- **Integrated digital strategies combining infrastructure and digital public infrastructure (DPI):** For Asia and the Pacific region, key priority is the adoption of integrated digital strategies that combine physical infrastructure with digital public infrastructure (DPI), including digital identity systems, interoperable payments, and data exchange frameworks. While connectivity remains a dominant driver of e-commerce growth, evidence shows that DPI has strong independent effects and can significantly enhance outcomes when combined with infrastructure. Policymakers are therefore encouraged to develop cohesive national digital ecosystems while promoting regional interoperability, particularly through shared platforms and digital corridors. Such approaches not only reduce transaction costs but also expand cross-border participation, especially for micro, small, and medium-sized enterprises (MSMEs).

- **Pursuing growth and innovation with inclusive outcomes:** Digital trade policies should pursue growth and innovation while ensuring that the benefits of digitalization are broadly shared. Beyond aggregate indicators such as GDP growth or trade volumes, policy frameworks should encourage innovation while advancing inclusion objectives, such as MSME participation, gender equality, and rural access. Complementary measures such as digital skills development, affordable devices, and improved last-mile connectivity are essential to expand participation, reduce access gaps, and ensure that digital trade contributes to inclusive and sustainable development.

- **Differentiated and pathway-specific approaches:** The papers in the volume unanimously recommend the need for differentiated and pathway-specific policy approaches. Countries in Asia and the Pacific exhibit wide variations in digital readiness, ranging from advanced digital leaders to pre-digital economies. A one-size-fits-all model risks exacerbating exclusion. Instead, governments should tailor strategies to their starting conditions, i.e. leveraging infrastructure in advanced economies, scaling DPI in digitally strong countries, and adopting balanced or leapfrogging approaches in emerging contexts. The evidence also suggests that economies lacking adequate digital infrastructure should begin developing DPI early, as building such systems is often complex and time-consuming, and their absence can hinder digital trade and transactions even after digital infrastructure is established.

- **Strengthening the foundational ecosystem:** More particularly for cross-border e-commerce and digital trade, strengthening the foundational ecosystem is critical. Beyond connectivity, effective participation depends on digital skills, logistics, financial access, and institutional capacity. Studies consistently highlight that skills are among the most important determinants of export performance, while logistics systems are key enablers of cross-border trade. Policy interventions should therefore target specific enablers. In parallel, ecosystem-based approaches, which combine infrastructure, skills, trust frameworks, and platform access, are necessary to translate digital access into meaningful economic outcomes.
- **Addressing affordability and trust barriers:** Addressing affordability and trust barriers is equally important for inclusive e-commerce trade. High transaction costs, cybersecurity risks, and weak consumer protection frameworks continue to limit participation, particularly for MSMEs and vulnerable populations. Policy recommendations emphasize the adoption of open and interoperable DPI systems to reduce costs, alongside stronger consumer protection, dispute resolution mechanisms, and secure payment infrastructures. Building trust is especially critical, as evidence shows that lack of confidence in digital platforms and payment systems can significantly constrain adoption and usage.
- **Regional cooperation and interoperability:** The importance of regional cooperation emerges strongly across all the papers. Fragmented regulatory frameworks, inconsistent standards, and limited interoperability continue to pose significant barriers to cross-border digital trade. To address these challenges, countries are encouraged to harmonize digital trade rules, supporting e-commerce, operationalize regional initiatives such as the ASEAN Single Window, and develop interoperable systems for customs, payments, and logistics. Regional platforms can also support capacity building, knowledge sharing, and the diffusion of best practices, enabling countries to leverage complementary strengths. Advanced economies can provide technological backbones, while emerging economies can contribute innovative, scalable solutions.
- **Cross-border digital trade facilitation and market integration:** Strengthening cross-border digital trade facilitation and market integration is important. Despite growing domestic e-commerce activity, many firms, particularly MSMEs, remain largely disconnected from global markets. Simplifying export procedures, improving logistics, enhancing digital customs systems, and providing market intelligence are essential to unlocking export potential. Equally, integrating informal digital channels into formal economic systems can support MSME upgrading, enabling them to scale operations and improve productivity.
- **Regulatory reform and governance frameworks:** Finally, regulatory reform and governance frameworks must evolve to keep pace with the digital economy.

This includes reducing regulatory fragmentation through mutual recognition and harmonization of standards, advancing data governance interoperability, and embedding inclusion provisions within digital trade agreements. Flexible, development-oriented approaches, such as phased commitments and capacity-building provisions, are particularly important to ensure participation by lower-capacity economies. Emerging areas such as fintech, artificial intelligence, and digital identity also require cooperation-first approaches, including pilot initiatives and regulatory sandboxes, to build convergence over time.

That said, the policy agenda for inclusive digital trade in Asia and the Pacific requires a holistic and coordinated approach that integrates infrastructure, capabilities, affordability, and trust, while leveraging regional cooperation to scale impact. By aligning domestic reforms with regional frameworks and tailoring strategies to diverse country contexts, policymakers can unlock the full potential of digital trade as a driver of equitable and sustainable economic development.

NOTE ON AUTHORS

Jong Woo Kang is Director of Regional Cooperation and Integration Division at the Economic Research and Development Impact Department of the Asian Development Bank (ADB). As director, he plays a role as an interface between ADB's internal and external stakeholders on regional cooperation and integration. He was director at the Ministry of Finance and Economy of the Republic of Korea. He obtained a Bachelor's in Economics and Master's in Public Administration from Seoul National University and Ph.D. in Economics from the University of Washington.

Sanchita Basu Das is a Senior Economist at the Asian Development Bank, specializing in regional cooperation, trade, tourism and clean energy. Prior to this, she served as the Lead Researcher for Economic Affairs at the ASEAN Studies Centre of ISEAS-Yusof Ishak Institute in Singapore. She holds a Ph.D. in International Political Economy from Nanyang Technological University, Singapore, a Master's in Economics from the University of Delhi and a Master's in Business Management from the National University of Singapore.

Rupa Chanda is the Director of Trade, Investment, and Innovation at UNESCAP. She was Professor of Economics at the Indian Institute of Management Bangalore and Economist at the IMF in Washington, DC. She holds a PhD from Columbia University and BA from Harvard University. Her research interests include the World Trade Organization, international trade in services, regional integration, health services, and migration. She has served on national and international committees and advisory boards in these areas and has undertaken research for several international organizations and think tanks.

REFERENCES

Allen, J.G. and Q.X.M. Liao (2025). Digital Economy Innovation and Implementation in the Indo-Pacific: Towards a 'Singapore Effect'? Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/uploads/3_ch_3-Digital-Economy-Singapore-Effect.pdf

Alliance for E-Trade Development (2024). MSME E-Commerce and Digital Policy Index. https://www.allianceforetradedevelopment.org/ecommerce-and-digital-policy-index

Alonso, C., T. Bhojwani, E. Hanedar, D. Prihardini, G. Una, and K. Zhabska (2023). Stacking Up the Benefits: Lessons from India's Digital Journey. IMF Working Paper No. 23/78. Washington, DC: International Monetary Fund.

Aon (2024). Asia Pacific's Commitment to Cyber Security. https://www.aon.com/cyber-risk-report/asia-pacifics-commitment-to-cyber-security-pays-off

As'ad, A.I., Muhammad Alwi, B. Anitasari, A.A.J. Sinlae, F. Nugroho, and K. Anwar (2022). The Implementation of E-Commerce for Micro, Small and Medium Enterprises (MSMEs) in the COVID-19 Pandemic Era. Advances in Economics, Business and Management Research, vol. 205, pp. 42–45.

Asia Foundation (2024). Digital Trade Agreements in Asia and the Pacific. https://asiafoundation.org/wp-content/uploads/2024/05/Digital-Trade-Agreements-in-Asia-and-the-Pacific_Tech-Policy.pdf

Asian Development Bank (2021). E-Commerce in CAREC Countries: Laws and Policies. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/725671/e-commerce-carec-laws-policies.pdf

Asian Development Bank (2024). E-Commerce Evolution in Asia and the Pacific: Opportunities and Challenges. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/922086/e-commerce-evolution-asia-pacific-opportunities-challenges.pdf

Asian Development Bank (2025a). The Role and Future of Digital Economy Agreements in Asia and the Pacific. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/1053791/digital-economy-agreements-asia-pacific.pdf

Asian Development Bank (2025b). Harnessing Digital Transformation for Good: Asian Development Policy Report 2025. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/1050686/asian-development-policy-report-2025.pdf

Asian Development Bank (2025c). Digital Public Infrastructure: Landscape and Opportunities in South Asia. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/1114321/digital-public-infrastructure-south-asia.pdf

Asian Development Bank (2025d). The Other Half of the Internet: Closing Asia's Digital Gap. ADB Blog, 20 October. https://blogs.adb.org/blog/other-half-internet-closing-asia-s-digital-gap

Asian Development Bank (2026). Global Value Chains and Inclusive Development: Asian Development Policy Report. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/1143716/adpr-2026-main-report.pdf

Asian Development Bank Institute (2024). Transforming ASEAN for Sustainability: The Role of Regional Integration in Advancing ASEAN's Green Transition. Tokyo: Asian Development Bank Institute. https://www.adb.org/publications/transforming-asean-for-sustainability-the-role-of-regional-integration-in-advancing-asean-s-green-transition

Asian Development Bank Institute (2025). Transforming Industry for a Greener Future in Asia and

the Pacific. Asia Pathways. https://www.asiapathways-adbi.org/2025/09/transforming-industry-for-a-greener-future-in-asia-and-the-pacific/

Association of Southeast Asian Nations (2023). ASEAN Digital Economy Framework Agreement (DEFA): Concept and Policy Direction. Jakarta: ASEAN Secretariat.

Baker, P.R., and L. Le (2025). An Analytical Framework to Establish Convergences in Cross-Border Digital Trade Rules. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Barua, S., J. Correia, and T. Abdullah (2025). Regulating E-Commerce for Consumer Protection: Lessons from Bangladesh and Global Best Practices. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Bernardo, I.C. (2025). Trade in Transition: The Prospects of Developing Asia Towards Digital Trade. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Business Times (2025). Bridging the Digital Divide in Asia-Pacific. https://www.businesstimes.com.sg/opinion-features/bridging-digital-divide-asia-pacific

Cai, M. and S. Tian (2025). Can Digital Platforms Boost Economic Growth? Evidence from the Taobao Villages. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Center for Strategic and International Studies (2024). CPTPP 2.0: E-Commerce and Digital Trade Rules. By K. Suominen. Washington, DC: Center for Strategic and International Studies. https://csis-website-prod.s3.amazonaws.com/s3fs-public/2024-02/240213_Suominen_CPTPP2.0_ECommerce.pdf

Chhorn, D., H. Sivly, and K.M. Nhim (2025). The Role of Local-Foreign Platforms and Digital Trade in Shaping SMEs' Development in Cambodia. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Correia, J., J. Tijaja, N. Drury, S.K. Leong, and J.B. Sinay (2025). Transforming ASEAN for Sustainability: The Role of Regional Integration in Advancing ASEAN's Green Transition. ADBI Working Paper. https://doi.org/10.56506/MSKG5757

Desai, A., and A.P. Manoharan (2024). Digital Transformation and Public Administration: The Impacts of India's Digital Public Infrastructure. International Journal of Public Administration, vol. 47, No. 9, pp. 575–578. https://doi.org/10.1080/01900692.2024.2350762

East Asia Forum (2025). Powering the Green Transition through EU–Asia Pacific Partnerships, 23 August. https://eastasiaforum.org/2025/08/23/powering-the-green-transition-through-eu-asia-pacific-partnerships/

Eastspring Investments (2024). 30 Years of Asian Growth: A Story of Resilience and Untapped Potential. https://www.eastspring.com/insights/deep-dives/30-years-of-asian-growth-a-story-of-resilience-and-untapped-potential

Enikeeva, Z. (2025). Emerging Trends in Cross-Border E-Commerce in Central Asia: Towards Regional Cooperation? Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Farooq, M.S., J. Jing, N. Feroze, and C. Tongshun (2025). Comparative Analysis of E-Commerce Regulations across Countries in Subregions and the Path Forward for Cross-Border E-Commerce. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Ghosh, A. (2025). Leveraging Regional Trade Agreements for Digital Trade Acceleration: An

Empirical Analysis of Emerging Asian Economies. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Global Legal Insights (2025). Fintech Laws and Regulations 2025: Indonesia. https://www.globallegalinsights.com/practice-areas/fintech-laws-and-regulations/indonesia/

Gupta, S., P. Ghosh, and V. Sridhar (2022). Impact of Data Trade Restrictions on IT Services Export: A Cross-Country Analysis. Telecommunications Policy, vol. 46, No. 9. https://doi.org/10.1016/j.telpol.2022.102403

Huseyn, R., and A. Gadashov (2025). How Government Leverages Digital Trade and E-Commerce to Boost Economic Growth: A Case Study from Azerbaijan. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Indian Council for Research on International Economic Relations (2024). Towards Greater Regulatory Cooperation in Asia-Pacific for Boosting E-Commerce Trade. Presentation slides. Bangkok. https://www.unescap.org/sites/default/d8files/event-documents/3_PPT%20Slides%20-%20Towards%20Greater%20Regulatory%20Co-operation%20in%20Asia-Pacific%20for%20Boosting%20E-Commerce%20Trade%20%28Bangkok%20Event%29_as%20on%20May%2031%2C%202024.pdf

Ing, L.Y., Y. Vadila, I. Markus, and L. Nazara (2023). ASEAN Digital Community 2045. Singapore: Lee Kuan Yew School of Public Policy, National University of Singapore. https://lkyspp.nus.edu.sg/docs/default-source/cag/1-asean-digital-community-2045.pdf

International Monetary Fund (2024). Asia's Economies Can Embrace Services to Boost Growth and Productivity. IMF Blog, 31 October. https://www.imf.org/en/blogs/articles/2024/10/31/asias-economies-can-embrace-services-to-boost-growth-and-productivity

International Telecommunication Union (2021). Digital Trends in Asia and the Pacific. Geneva: International Telecommunication Union. https://www.itu.int/hub/publication/d-ind-dig_trends_asp-01-2021/

International Telecommunication Union (2025). State of Digital Development and Trends in Asia and the Pacific: Challenges and Opportunities. Geneva: International Telecommunication Union. https://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-SDDT_ASP-2025-PDF-E.pdf

KPMG (2021). Regional Comprehensive Economic Partnership (RCEP). https://assets.kpmg.com/content/dam/kpmg/th/pdf/2021/01/regional-comprehensive-economic-partnership-rcep.pdf

KPMG (2024). Navigating the Future of Seamless Commerce in Asia Pacific. https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2024/06/navigating-the-future-of-seamless-commerce-in-asia-pacific.pdf

López González, J. and J. Ferencz (2018). Digital Trade and Market Openness. OECD Trade Policy Papers. Paris: OECD Publishing. http://dx.doi.org/10.1787/1bd89c9a-en

Malaysian Reserve (2024). Asia Pacific Ecommerce Market Report 2023: Growth Surge Led by Expanding Digital Consumer Base – Forecasts to 2027, 5 March. https://themalaysianreserve.com/2024/03/05/asia-pacific-ecommerce-market-report-2023-growth-surge-led-by-expanding-digital-consumer-base-forecasts-to-2027/

McKinsey Global Institute (2024). Asia on the Cusp of a New Era, 22 September. https://www.mckinsey.com/mgi/our-research/asia-on-the-cusp-of-a-new-era

Ministry of Trade and Industry Singapore. (2026). Digital economy agreements (DEAs). Government of Singapore. https://www.mti.gov.sg/trade-international-economic-relations/agreements/digital-economy-agreements-dea/

Morgan, P.J. (2022). Fintech and Financial Inclusion in Southeast Asia and India. Asian Economic Policy Review, vol. 17, No. 2, pp. 183–208.

Mukherjee, A., K. Gaikwad, and A. Srishti (2024). Towards Greater Regulatory Cooperation in the Asia Pacific for Boosting E-Commerce Trade. ICRIER Working Paper 425. New Delhi: Indian Council for Research on International Economic Relations. https://icrier.org/pdf/Working_Paper_425.pdf

Mukherjee, D. (2025). Digital Provisions in Services Trade Agreements and Mode 1 Export Effects: A Study of Exports of Selected Sectors from Asian Economies. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Natanael, Y. (2025). Beyond Borders and Tangibility: Understanding Trade Restrictions, Institutional Quality and Digital Services Trade. International Journal of Development Issues, vol. 24, No. 3, pp. 396–415. https://doi.org/10.1108/IJDI-11-2024-0294

Nikkei Asia (2025). ASEAN E-Commerce to Grow 16% in 2025 Driven by AI and Video. https://asia.nikkei.com/business/technology/asean-e-commerce-to-grow-16-in-2025-driven-by-ai-video-report

Organisation for Economic Co-operation and Development (2021). OECD Best Practice Principles for International Regulatory Cooperation. Paris: OECD Publishing. https://www.oecd.org/en/publications/2021/07/international-regulatory-co-operation_cf92bc88.html

Organisation for Economic Co-operation and Development (2025). The 2025 OECD Definition of E-Commerce and Guidelines for Interpretation. Paris: OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/10/the-2025-oecd-definition-of-e-commerce-and-guidelines-for-interpretation_3e7e5a61/2254f1de-en.pdf

Ortiz, M.K. and M.C.R. Manguera (2025). Connected for Growth: Analyzing the Impact of E-Commerce Adoption on Firm Performance and Labour Outcomes in the Philippines through Peer Effects. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Payments and Commerce Market Intelligence (2023). Understanding Asia-Pacific: Where the Future of Fintech Is Shaped. PCMI Insights. https://paymentscmi.com/insights/asia-pacific-fintech-industry/

PR Newswire (2024). MBank Transforms Kyrgyzstan's Banking Landscape with Digital Ecosystem and Mobile App Milestones. https://www.prnewswire.com/news-releases/mbank-transforms-kyrgyzstans-banking-landscape-with-digital-ecosystem-and-mobile-app-milestones-302387195.html

Rahman, M.N. and B. Rahman (2022). Exploring Digital Trade Provisions in Regional Trade Agreements in Times of Crisis: India and Asia-Pacific Countries. https://doi.org/10.1016/j.aglobe.2022.100036

Rivera, J.P. (2025). Digital Trade for Macroeconomic Resilience: Evidence from ASEAN's Cross-Border E-Commerce Integration. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Supriadi, A.Y., S. Rachmad, K.G.C. Dillena, H. Kardoyo, D. Asiati, and R. Elizabeth (2025). Unlocking Economic Gains: How E-Commerce Enhances Efficiency, Productivity, and Market Access in Indonesia — Evidence from 2024 Survey. Paper presented at the Asian Think Tank Network Forum 2025, October, Tokyo, Japan.

Tang, M., L. Jiang, Y. Mao, and L. Cao (2025). Does the Depth of Digital Trade Rules Promote

Bilateral Value Chain Cooperation? International Review of Financial Analysis. https://doi.org/10.1016/j.irfa.2025.103952

Times of Central Asia (2025). Uzbekistan Introduces New Rules for E-Commerce Platforms. https://timesca.com/uzbekistan-introduces-new-rules-for-e-commerce-platforms/

United Nations Conference on Trade and Development (2023). Digital Trade Fuels Asia-Pacific's Growth, but Progress Remains Uneven. https://unctad.org/news/digital-trade-fuels-asia-pacifics-growth-progress-uneven

United Nations Conference on Trade and Development (2024). Digital Economy Report 2024. Geneva: United Nations Conference on Trade and Development. https://unctad.org/publication/digital-economy-report-2024

United Nations Conference on Trade and Development (2026). UNCTADstat Data Centre. https://unctadstat.unctad.org/datacentre/

United Nations Economic and Social Commission for Asia and the Pacific (2022a). Asia-Pacific Digital Trade Regulatory Review 2022. Bangkok: United Nations Economic and Social Commission for Asia and the Pacific. https://www.unescap.org/sites/default/d8files/knowledge-products/Asia%20Pacific%20Digital%20Trade%20Regulatory%20Review%202022.pdf

United Nations Economic and Social Commission for Asia and the Pacific (2022b). Asia-Pacific Digital Transformation Report 2022: Shaping Digital Futures for All. Bangkok: United Nations Economic and Social Commission for Asia and the Pacific. https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP-2022-Flagship-Asia-Pacific-Digital-Transformation-Report.pdf

United Nations Economic and Social Commission for Asia and the Pacific (2024a). Trends in Digital Trade and Investment in Asia and the Pacific. https://www.unescap.org/sites/default/d8files/event-documents/reading2.pdf

United Nations Economic and Social Commission for Asia and the Pacific (2024b). Overview of MSMEs in Asia and the Pacific. https://msmepolicy.unescap.org/overview-msmes-asia-pacific-regions

United Nations News (2024a). Digital Trade Can Boost Livelihoods and Economic Growth in Asia-Pacific. https://news.un.org/en/story/2024/09/1153931

UN News 2024b. (2024b). Asia-Pacific nations commit to "visionary blueprint" for inclusive digital world. UN News. https://news.un.org/en/story/2024/09/1153931

World Bank (2025). Individuals Using the Internet (% of Population). World Development Indicators. https://data.worldbank.org/indicator/IT.NET.USER.ZS

World Economic Forum (2025). What We Learned about the Future of Work in Asia. https://www.weforum.org/stories/2025/07/what-we-learned-about-the-future-of-work-in-asia-at-amnc25-and-other-trends-in-jobs-and-skills-this-month/

World Trade Organization (2023). Work Programme on Electronic Commerce. INF/ECOM/87. Geneva: World Trade Organization. https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/INF/ECOM/87.pdf

World Trade Organization (2024). Trade in Services Database. https://data.wto.org

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

CAN ECONOMIES LEAPFROG TO DIGITAL SUCCESS? EVIDENCE FROM GLOBAL E-COMMERCE DEVELOPMENT PATHWAYS

Homer Pagkalinawan

Email: hpagkalinawan@adb.org

This study examines how digital infrastructure and digital public infrastructure (DPI) jointly shape e- commerce performance on revenue generation and user penetration across 149 economies. It compares traditional infrastructure DPI enabled leapfrogging, and integrated synergistic pathways that combine both elements using instrumental variables estimation. The results show that connectivity indicators significantly explain e commerce revenues, while DPI quality has independent causal effects, validating alternative development pathways. Pathway based analysis explains substantial variation in outcomes. The findings demonstrate that countries can achieve digital and inclusive economic outcomes through different, context specific combinations of infrastructure investment and DPI deployment.

Keywords: digital public infrastructure, digital development pathways, e-commerce growth, infrastructure economics, technology leapfrogging

JEL classification: O33, L86, O11, H54.

I. INTRODUCTION

E-commerce has altered global trade dynamics by creating opportunities for businesses to participate in international markets through digital platforms. Effective participation in e-commerce depends on digital capabilities including reliable infrastructure, functional digital public infrastructure (DPI) systems (i.e., digital identity, payments and data exchange) and supportive institutional frameworks. Economies lacking these foundational requirements face barriers to engage in growing digital trade opportunities.

Understanding optimal approaches for building digital capabilities is critical, as closing the global digital infrastructure gap will require hundreds of billions of dollars by 2030 (Wong, 2025). The literature reflects evolving perspectives on optimal approaches to digital development. Established frameworks emphasize robust connectivity infrastructure as foundational for digital economic participation (World Bank, 2024a; UK Government, 2023), while emerging DPI theories propose that strategic public digital systems can serve as alternative foundations for development (Eaves and Rao, 2025, UNDP, 2024a; Gates Foundation, 2024). These approaches are not necessarily mutually exclusive, and they differ in their emphasis on sequencing and resource allocation priorities. This therefore raises important policy questions about optimal development pathways for different economy's contexts.

Many developing economies face gaps in foundational digital requirements, including poor infrastructure, inadequate institutional and policy frameworks, widening digital divides, and severe lags in internet usage (UN, 2021; UN, 2023). Meaningful participation in global e-commerce platforms requires integrated digital ecosystems that many economies have yet to develop. Inclusive digital transformation frameworks identify key components including infrastructure, government, regulation, business operations, and people (UNDP, 2024b). Bridging these gaps carries implications beyond digital trade readiness, touching on whether e-commerce can serve as a broader development channel improving market access for households, small producers, and low-capacity economies.

This study addresses the need for systematic understanding of how these dimensions interact to create prerequisites for economy-wide e-commerce participation by examining four fundamental questions. First, how do digital infrastructure capabilities and DPI systems independently and jointly influence e-commerce development outcomes? Second, what evidence exists for alternative development pathways that enable countrieseconomies to achieve digital capabilities despite infrastructure constraints? Third, which combinations of digital investments prepare countrieseconomies for participation in digital trade? Fourth, what strategic approaches should guide digital development investments across different country contexts and starting conditions?

We conceptualize digital development through three core theoretical pathways that economies may pursue. The infrastructure-first pathway follows traditional development economics, emphasizing connectivity foundations before implementing digital services. The DPI-enabled leapfrogging pathway suggests economies may achieve comparable outcomes despite infrastructure constraints through strategic deployment of digital identity, payment, and data exchange systems. The integrated synergistic pathway combines both approaches, creating amplification effects through coordinated infrastructure and DPI development. These theoretical pathways inform our empirical analysis of how different combinations of digital investments enable e-commerce success across diverse country contexts.

To answer these questions, we analyse digital development patterns across 149 economies using data integration across infrastructure capabilities, DPI system implementation, and e-commerce outcomes. Our methodology combined stepwise regression analysis to identify key predictors with instrumental variables estimation to address endogeneity concerns and comparative pathway analysis using tercile-based classification to test whether different combinations of infrastructure and DPI investments enable alternative routes to digital economic success. Our analysis provides evidence on digital development effectiveness, identifies distinct pathway types, and offers empirical foundations for strategic investment approaches aimed at enhancing digital trade readiness across diverse contexts.

II. LITERATURE REVIEW

The emergence of e-commerce as a driver of economic growth requires digital foundations that enable market participation. To engage in and benefit from digital trade, reliable digital infrastructure and skills to use digital technologies productively are needed. The World Bank and the World Trade Organization (2023) state that improved connectivity reduces trade costs substantially, particularly in economies with enabling regulatory environments.

Infrastructure economics emphasizes connectivity as foundational for digital economic development. The OECD Digital Economy Outlook 2024 estimates that ICT sectors of its members grew approximately three times faster than total economies over the past decade. GSMA's Mobile Economy 2024 reports that mobile technologies generate 5.4 per cent of global gross domestic product. Empirical studies demonstrate infrastructure's impact on economic outcomes. Hjort and Poulsen (2019) find that fast internet arrival increased employment rates by at least 3 per cent in Africa. Atasoy (2013) documents that broadband expansion increased employment by 1.8 percentage points in the United States.

This infrastructure-centric view implies that economies must build foundational connectivity before achieving digital economic success. However, digital divides in developing regions persist due to substantial usage gaps caused by affordability

barriers, skills deficits, and limited mobile internet penetration despite coverage availability (GSMA, 2024b). Infrastructure availability does not automatically translate into digital economic participation, suggesting additional factors beyond physical connectivity may be critical.

DPI represents an emerging theoretical framework conceptualizing foundational digital capabilities as public goods enabling economic activity and innovation. Benefits from successful implementation of DPI components have been documented. World Bank (2024b) examines digital identification's role in development across country contexts. GSMA (2025) documents the role of digital payment and mobile money in financial inclusion. World Economic Forum (2024a) explores DPI trends and their potential to reshape economies.

Case study evidence demonstrates DPI potential through various national implementations. India's integrated digital identity (Aadhaar) and payments systems enabled fintech innovation and financial inclusion, while Estonia's X-Road created interoperable government services providing digital economy foundations. Kenya's M-Pesa provided mobile payment infrastructure as a foundation for broader financial ecosystem development. These cases suggest economies may achieve digital economic outcomes through different pathway combinations. In development contexts, this implies DPI investments might substitute for, or complement, traditional infrastructure in enabling digital economic participation.

The pathway choice for digital development also carries implications for whether participation in e-commerce extends to the broader development objectives of an economy. Studies on mobile money adoption demonstrate that access to digital financial systems can reduce poverty and improve household welfare outcomes, particularly in lower-income contexts (Suri and Jack, 2016; Jack and Suri, 2014). Hjort and Poulsen (2019) provide corroborating evidence, with fast internet access shown to increase employment rates and firm productivity, with larger employment gains for higher-skill occupations than for less-educated workers.

These findings suggest that the infrastructure and DPI investments shaping e-commerce pathways are not neutral choices; they determine who participates in digital economic activity and on what terms. This distributional dimension, encompassing the availability, accessibility, and affordability of digital systems across populations, connects digital development pathway research to the broader sustainable development agenda (UN, 2023; UNDP, 2024b). Understanding which pathways achieve comparable aggregate outcomes, and whether they do so with different distributional profiles, is therefore a development question as much as a technical one.

Systematic empirical evidence testing this pathway hypothesis remains underdeveloped. While case studies demonstrate DPI success in specific contexts (as documented above for India, Estonia, and Kenya), cross-country analysis comparing outcomes

across different infrastructure-DPI pathway combinations is lacking. Existing research examines either infrastructure effects (Hjort and Poulsen, 2019; Atasoy, 2013) or DPI implementation (World Bank, 2023) separately but rarely analyses their joint and interactive contributions to digital economic outcomes. This study addresses these gaps by examining whether economies achieve comparable e-commerce outcomes through different combinations of infrastructure and DPI investments.

III. THEORETICAL FRAMEWORK

We developed a digital development pathway framework conceptualizing digital economic development as interconnected systems where infrastructure capabilities and DPI systems interact to enable economic outcomes. This framework addresses competing theoretical perspectives including infrastructure determinism versus leapfrogging theory, technology-push versus demand-pull approaches, and universal versus context-specific development strategies.

Infrastructure determinism in digital development discourse emphasizes sequential progression through connectivity-dependent stages, where robust digital infrastructure investments must precede other digital capabilities. This perspective suggests that advanced connectivity foundations are prerequisites for digital economic advancement. Hjort and Poulsen (2019) demonstrate that fast internet arrival aided employment and firm creation in Africa, providing contemporary evidence for infrastructure-first approaches. Leapfrogging theory challenges this linear progression, proposing that latecomer economies can bypass traditional development stages through strategic adoption of emerging technologies (Lee, 2019). Jack and Suri (2014) and Suri and Jack (2016) provide evidence for leapfrogging potential in Kenya's mobile banking and digital payment systems' expansions, respectively.

Our framework builds on emerging DPI theory, which conceptualises foundational digital systems as public goods enabling economic activity and innovation (Eaves and Rao, 2025; Mazzucato et al., 2024). The UCL Institute framework (Eaves and Rao, 2025) identifies three core DPI components—digital identity, payments, and data exchange, which serve as foundational layers for digital economic development (figure 1).

Based on Eaves and Rao (2025) and Mazzucato et al. (2024), we suggest that digital infrastructure provides technical foundations for DPI systems through reliable connectivity enabling real-time operations and network effects depending on widespread access. Strategic DPI innovations may overcome constraints in in traditional financial sector infrastructure through mobile-first, as in Kenya's M-Pesa, which expanded financial access by building on existing mobile networks rather than bank branch infrastructure (Ndung'u, 2019). DPI capabilities amplify infrastructure investments by enabling interoperable digital services that boost financial inclusion, economic growth, and market competition (World Economic Forum, 2024b).

Figure 1 illustrates three distinct development pathways our framework proposes:

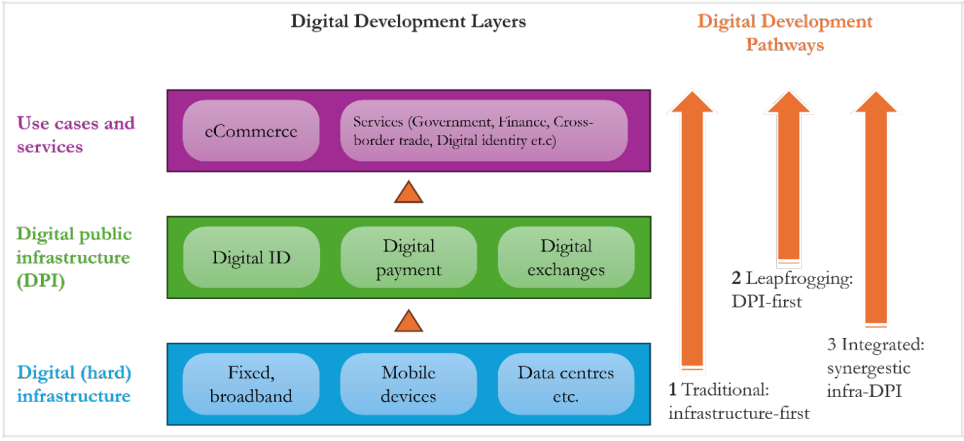
1. Traditional infrastructure-first path: Economies build hard infrastructure foundations (broadband, mobile networks, data centres) before implementing DPI systems, following conventional development sequences.

2. Leapfrogging DPI-first path: Economies strategically deploy DPI systems (digital identity, payments, data exchange) to overcome infrastructure constraints and enable rapid digital economic participation.

3. Integrated synergistic path: Economies pursue simultaneous infrastructure and DPI development, creating amplification effects through coordinated deployment strategies.

The framework suggests different development pathways may be optimal under different starting conditions. Infrastructure-abundant economies may follow traditional connectivity-first approaches, while infrastructure-constrained economies might achieve success through strategic DPI deployment. Mixed contexts may require balanced approaches combining infrastructure development with targeted DPI investments. This theoretical foundation informs our empirical analysis of how infrastructure and DPI factors interact to determine economic outcomes across country contexts.

Figure 1. Digital development pathway framework: Traditional, leapfrogging, and integrated approaches



Source: Author's adaptation based on Mazzucato et al. (2024).

IV. DATA AND METHODOLOGY

This study employed cross-sectional comparative analysis across 149 economies to examine digital development patterns through three complementary methodological approaches. First, to examine independent and joint effects of infrastructure and DPI, we

used stepwise regression analysis to identify key predictors, followed by instrumental variables estimation to mitigate potential reverse causality and omitted variable bias. Second, to investigate alternative development pathways, we employed threshold analysis comparing complete versus incomplete DPI systems and examined whether economies can achieve e-commerce success despite infrastructure constraints. Third, to identify optimal investment combinations, we conducted incremental analysis measuring the additional explanatory power from different digital foundation configurations.

Data and Sources. Our analysis integrated data from multiple sources ensuring coverage across the digital development spectrum. The varying sample sizes across dimensions reflected data availability constraints, with the DPI dataset representing the most coverage due to systematic data collection efforts across all global economies.

Table 1. Data sources and coverage

Data Domain	Source/s	No. of economies included	Variables	Period
Infrastructure	International Telecommunications Union	194	16 indicators on fixed and mobile infrastructures, access, and affordability	2023–2024
DPI Systems	DPI Map University College London Institute for Innovation and Public Purpose	204	Digital ID, digital payments, digital exchange systems capabilities	June 2025
E-commerce	Statista	149	Revenue ($ billions), user penetration (per cent)	2023

Sources: International Telecommunications Union, University College London Institute for Innovation and Public Purpose, and Statista.

Variable Construction

Infrastructure. Infrastructure development employed systematic variable selection and standardization procedures. We first tested for multicollinearity using variance inflation factor (VIF) analysis, retaining only variables with VIF < 5 to ensure statistical independence and model stability. Selected infrastructure variables underwent min-max normalization to create comparable scales across different measurement units (broadband subscriptions, coverage percentages, bandwidth usage etc.).

This standardization enabled robustness to outliers while maintaining interpretability across connectivity, coverage, and adoption dimensions. Final variables included international bandwidth usage, mobile broadband subscriptions, fixed broadband subscriptions, mobile cellular subscriptions, household internet access, individual mobile ownership, mobile data costs, fixed broadband costs, mobile low-usage costs,

2G coverage, 3G coverage, 4G coverage, 5G coverage, mobile high-consumption costs, mobile low-consumption costs and fixed telephone subscriptions.

DPI Quality Index. We developed comprehensive quality indices for each DPI component following the UCL Institute framework dimensions. We constructed quality measures for each DPI system (digital identity, payment systems, and data exchange) across five key attributes following framework in Table 2.

We constructed both categorical classifications based on system combinations and continuous composite scores measuring implementation quality across six UCL framework dimensions: (1) foundational functions, (2) interoperability and extensibility, (3) transparency, accountability and oversight, (4) privacy, safety and security, (5) non-discrimination and inclusion, and (6) capacity and coordination. The composite DPI quality index averaged normalized scores across the three core systems (digital identity, payment systems, data exchange) with equal weighting.

Table 2. DPI Quality Index Framework

UCL dimension	Digital identity (23 indicators)	Payment systems (22 indicators)	Data exchange (11 indicators)
Foundational functions	DPI status, authentication capability, know-your customer functions, legal proof	DPI status, real-time capabilities, transaction types, system name	DPI status, implementation status
Interoperability and extensibility	Portal authentication, sectoral use, technical standards, biometrics, URL, status	Interoperability policy, cross-border capability, bank/non-bank participation, QR codes, URL, standards	Semantic interoperability, real-time sharing, scalability, cross-sectoral scope
Transparency and accountability	Legal frameworks, governance structures, redress mechanisms, data terms, oversight, reporting	Operator governance, participation rules, data handling rules, reporting, participant metrics	Governance entity, participation conditions, multi-stakeholder involvement
Privacy, safety and security	Data protection laws, breach notification, security standards, procedural rules, data handling	Data handling, fraud prevention, security compliance, settlement systems	-
Capacity and coordination	Implementation status, funding arrangements, technical support	Implementation status, national/regional scale, performance metrics	National/regional scale, multi-entity usage

Source: University College London Institute for Innovation and Public Purpose.

Individual indicators employed standardized coding schemes to ensure cross-country comparability:

1. Binary indicators coded presence/absence of institutional features as 1 for “yes” and 0 for “no/NA”

2. Implementation status used ordinal scaling reflecting development stages: 1 for "implemented", 0.5 for "planned/piloted", and 0 for non-existent systems

3. Redress mechanisms employed comprehensiveness scaling: 0 for no mechanisms, 1 for single-channel availability, 2 for multi-channel frameworks, normalized to 0–1 scale

4. Ownership structures utilized dummy variables (public=1, joint=1) with private as the omitted reference category to avoid arbitrary numerical assignments

5. Other multi-category variables employed binary classification distinguishing public-sector operators from private operators

Dimension scores aggregated individual indicators using equal weighting within each dimension. Component-level quality indices (digital identity, payment systems, data exchange) averaged dimension scores, and the overall DPI quality index averaged component indices. This consistent equal weighting approach maintained 0–1 scaling throughout while avoiding arbitrary weight assignments that lack empirical justification

E-commerce Outcome Variables. E-commerce revenue data underwent natural logarithm transformation to address skewness and enable percentage interpretation of regression coefficients. User penetration rates were used in their original percentage form.

Regression model specifications. To test our digital development pathway framework, we employed four complementary regression specifications designed to address our core research questions about infrastructure-first versus DPI-first development strategies. Statistical analysis employed stepwise regression to identify key predictors, particularly among infrastructure variables, followed by interaction modelling to test pathway theories.

Model 1: Infrastructure-First Theory (Traditional Development). This baseline model tests infrastructure determinism by examining whether traditional connectivity measures alone can explain e-commerce development outcomes. The model includes high-quality connectivity indicators (international bandwidth, broadband subscriptions) and coverage measures (2G, 3G, 4G networks) to capture the full spectrum of digital infrastructure capabilities.

$$ln(Revenue) = \beta_0 + \beta_1 Infrastructure\ Effects \quad (1)$$

Model 2: DPI-First Theory (Leapfrogging Development). This specification tests whether DPI systems alone can drive digital economic outcomes, representing the strongest form of the leapfrogging hypothesis. A significant positive coefficient would suggest that strategic DPI deployment can enable digital commerce development independent of traditional infrastructure foundations.

$$ln(Revenue) = \beta_0 + \beta_1 DPI\ Overall\ Quality \quad (2)$$

Model 3: Combined Effects Model (Complementarity). This model examines whether infrastructure and DPI systems provide complementary rather than competing contributions to digital development. Significant coefficients for both infrastructure and DPI variables would support the complementarity hypothesis, while dominance of one set would indicate substitution effects.

$$ln(Revenue) = \beta_0 + \beta_1 Infrastructure\ Effects + \beta_2 DPI\ Overall\ Quality \quad (3)$$

Model 4: Interaction Effects Model (Synergistic Development). This specification tests for synergistic effects where DPI effectiveness varies by infrastructure context. Positive interaction terms would indicate that DPI and infrastructure create amplification effects when deployed together, while negative interactions might suggest diminishing returns or substitution relationships.

$$ln(Revenue) = \beta_0 + \beta_1 Infrastructure\ Effects + \beta_2 DPI\ Overall\ Quality + \beta_2 DPI\ Overall\ Quality\ x\ Infrastructure\ Effects \quad (4)$$

Each model used robust standard errors to address heteroskedasticity and uses log-transformed e-commerce revenue as the primary dependent variable to enable percentage interpretation of coefficients.

Endogeneity Testing and Instrument Variables We conducted endogeneity testing due to concerns about reverse causality between e-commerce development and digital infrastructure investments. Economies may expand infrastructure and DPI systems in response to growing digital economic activity, potentially biasing ordinary least squares (OLS) estimates upward and conflating causal effects with responsive investment patterns.

We assessed endogeneity severity by regressing each explanatory variable on e-commerce revenue while controlling for other model variables (equation 5). Variables with $R^2 > 0.30$ in reverse regressions were considered potentially endogenous, requiring instrumental variables estimation.

$$Variables\ Tested\ for\ Endogeneity = \beta_0 + \beta_1 ln(Revenue) + \beta_2 Other\ Variables \quad (5)$$

We constructed income-group-based instruments using World Bank income classifications (low income, lower-middle income, upper-middle income, high income). For each potentially endogenous variable, the instrument equals the average value of that variable across all other economies in the same income group, excluding the country being analysed.

This creates exogenous variation based on income group averages while excluding own-country influence. The instruments satisfy relevance conditions (strong

correlation with endogenous variables through shared development characteristics) and exogeneity conditions (income group averages unlikely influenced by individual country e-commerce performance, particularly for smaller economies within groups).

We employed instrumental variables estimation through two sequential stages to isolate causal effects from endogeneity bias. We designed the first-stage regression to examine whether income group patterns can predict individual country investments in digital infrastructure and DPI systems. We recognise that economies within the same income classification typically face similar resource constraints, institutional capacities, and development priorities, creating systematic variation in their digital development approaches that remains external to any individual country's e-commerce performance.

$$\textit{Variables Tested} = \delta_0 + \delta_1 \textit{Income Group Average} + \delta_2 \textit{Other Controls} \quad (6)$$

We assessed first-stage relationships through F-statistics, with $F > 10.00$ indicating strong instruments that avoid weak instrument bias. We interpret the coefficient δ_1 as measuring how closely individual country digital investments align with patterns observed across similar economies.

We then employed these predicted values to estimate causal effects on digital commerce outcomes (equation 7). The predicted values represent the component of digital development driven by income group characteristics rather than responsive to e-commerce success.

$$\textit{ln(Revenue)} = \beta_0 + \beta_1 \widehat{\textit{Predicted Variables}} + \beta_2 \textit{Other Variables} \quad (7)$$

We designed this approach to ensure that the estimated coefficient β_1 captures only the exogenous variation in digital development capabilities, eliminating bias from reverse causality where economies might expand digital infrastructure in response to growing e-commerce activity rather than as a driver of such growth.

Given sample size constraints (149 observations) and multiple potentially endogenous variables (up to 6), we employed individual instrumental variables estimation to avoid over-instrumentation problems that arise in joint estimation. We recognized that attempting to instrument all variables simultaneously would create weak identification problems and reduce statistical power.

We therefore instrumented each potentially endogenous variable separately to isolate its estimated effect while acknowledging limitations in testing interaction effects. We applied this individual estimation approach to ensure sufficient statistical power for each test while avoiding the weak identification bias that emerged when jointly instrumenting correlated endogenous variables.

Digital Development Pathways Classification. Using an expanded sample of 204 economies, we classified each into digital development pathways based on their relative positions on the infrastructure and DPI dimensions. We split the composite infrastructure score and composite DPI quality score independently into terciles. This classification resulted to five distinct pathways:

1. Digital Leaders: Top tercile infrastructure paired with top tercile DPI systems. These economies have both digital foundations largely complete.

2. Infrastructure Advantage: Top-tercile infrastructure paired with lower-two tercile DPI. These economies have advanced connectivity with DPI systems still in progress.

3. DPI Innovators: Lower-two tercile infrastructure paired with top tercile DPI systems. These leapfrogging economies completed their DPI systems despite limited infrastructure.

4. Emerging Digital: Lower-two tercile positioned on either infrastructure or DPI systems. These economies exhibited partial progress on both dimensions.

5. Foundational Development: Lowest tercile on both infrastructure and DPI systems. These economies have limited progress on both dimensions.

V. RESULTS AND DISCUSSION

Our analysis tested four fundamental questions about digital development pathways across 149 economies with complete data: how infrastructure and DPI systems independently and jointly influence e-commerce outcomes, whether alternative development pathways exist for infrastructure-constrained economies, which investment combinations optimize digital trade readiness, and what strategic approaches should guide different country contexts. The following sections present our empirical findings on these core questions, revealing insights that challenge conventional development assumptions and identify distinct pathways to digital economic success.

Descriptive statistics and clustering. Table 3 presents summary statistics for key variables in our analysis, focusing on core measures due to the extensive nature of the dataset. E-commerce revenue showed substantial variation, ranging from $0.05 million to over $1.00 billion annually, while user penetration varied from 3.7 per cent to 81.3 per cent across economies.

DPI quality indices averaged around 0.5 on our 0–1 scale, indicating moderate global implementation levels. Data exchange systems showed the highest average quality (0.55) but also the greatest variation ($\sigma = 0.39$). Digital identity and payment systems demonstrated more consistent implementation patterns with similar means (0.46 and 0.49, respectively).

Infrastructure indicators revealed significant global disparities. Mobile broadband penetration averaged 84.9 per cent but ranged from zero to over 400 per cent, indicating over-subscription in some markets. Fixed broadband remained more limited globally (mean = 16.9 per cent). Household internet access averaged 68.9 per cent with substantial variation, and 4G coverage reached 83.1 per cent on average but varied from complete absence to full coverage across economies.

Table 3. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	N
E-commerce outcomes					
Revenue ($ million, 2023)	21.68	115.91	0.05	1,027.42	149
User penetration (per cent, 2023)	28.57	19.81	3.70	81.30	149
DPI Quality Indices					
DPI overall simple	0.51	0.29	0.00	0.96	203
Digital ID quality	0.46	0.28	0.00	1.00	203
Payment quality	0.49	0.34	0.00	1.00	203
Data exchange quality	0.55	0.39	0.00	1.00	203
Selected infrastructure indicators					
Mobile broadband subscribers (per cent)	84.92	51.67	0.00	421.39	204
Fixed broadband subscribers (per cent)	16.90	15.80	0.00	56.00	204
Household internet (per cent)	68.89	27.27	0.00	100.00	204
4G coverage (per cent)	83.11	26.30	0.00	100.00	204

Source: Author's calculations.

Infrastructure Foundations and Digital Capabilities. Our stepwise regression analysis across 149 economies revealed that digital infrastructure capabilities explain substantial variance in e-commerce outcomes. Table 4 presents our core empirical findings testing infrastructure-first versus DPI amplification theories across four model specifications.

Table 4. E-commerce revenue models: Infrastructure vs DPI pathways

	Model 1 ln (Revenue)	Model 2 ln (Revenue)	Model 3 ln (Revenue)	Model 4 ln (Revenue)
International bandwidth usage (Mb/s)	12.948***		13.079***	36.968***
	(2.512)		(2.855)	(10.219)
Active mobile broadband subscriptions	5.235*		3.352	3.779
	(2.139)		(1.868)	(4.379)
Mobile cellular subscriptions	-3.148			
	(1.790)			
Fixed broadband subscriptions per 100 people	3.370***		2.720***	1.938
	(0.696)		(0.754)	(2.632)
DPI overall (Simple index)		4.072***	1.746**	16.483*
		(0.468)	(0.622)	(8.316)
2G coverage (per cent)			-5.332*	-1.246
			(2.114)	(3.392)
3G coverage (per cent)	-2.381*		-2.456*	
	(1.083)		(0.977)	
4G coverage (per cent)	2.548**		2.200*	
	(0.800)		(0.843)	
DPI overall (Simple index) X active mobile broadband subscriptions				0.619
				(6.376)
DPI overall (Simple index) X fixed broadband subscriptions per 100 people				1.258
				(3.394)
DPI overall (Simple index) X 2G Coverage (per cent)				-15.039
				(9.003)
DPI overall (Simple index) X International bandwidth usage (Mb/s)				-32.127*
				(14.030)
N	149	149	149	149
R-squared	0.546	0.271	0.563	0.572

*Standard errors in parentheses. ***p ≤ 0.001, **p ≤ 0.01, *p ≤ 0.05*

Source: Author's calculations.

The results reveal key findings about digital development pathways. Model 1 demonstrates that infrastructure-first approaches achieve strong explanatory power ($R^2 = 0.546$), with international bandwidth emerging as the dominant predictor ($\beta = 12.948$, $p < 0.001$), followed by mobile broadband subscriptions ($\beta = 5.235$, $p < 0.05$). Coverage networks show mixed effects, with 4G coverage positively associated with outcomes while 3G coverage shows negative coefficients, suggesting economies benefit from advancing beyond basic connectivity toward higher-quality infrastructure.

Model 2 tests DPI-first theory, showing that DPI quality alone achieves significant but more limited explanatory power ($R^2 = 0.271$, $\beta = 4.072$, $p < 0.001$). While DPI demonstrates clear positive effects, the lower R-squared indicates DPI-only approaches explain less variance than infrastructure-first strategies.

Model 3 combines both approaches, achieving modestly higher explanatory power ($R^2 = 0.563$) compared to the infrastructure-only model ($R^2 = 0.546$). DPI quality remains significant ($\beta = 1.746$, $p < 0.01$) when controlling for infrastructure, indicating additional effects beyond basic connectivity. The minimal R-squared improvement of only 1.7 percentage points suggests infrastructure remains the dominant driver, with DPI providing supplementary rather than substitute effects.

Model 4 examines interaction effects between DPI and infrastructure variables ($R^2 = 0.572$). The results reveal limited evidence of synergistic relationships. Most interaction terms are not statistically significant: the DPI × mobile broadband interaction ($\beta = 0.619$, $p = 0.923$) and DPI × fixed broadband interaction ($\beta=1.258$, $p=0.711$) show no meaningful effects. The only significant interaction is negative: DPI × international bandwidth ($\beta = -32.127$, $p = 0.024$) suggests that DPI benefits diminish at higher bandwidth levels, possibly indicating substitution effects where advanced infrastructure reduces the marginal value of DPI systems. The DPI × 2G coverage interaction shows marginal significance ($\beta = -15.039$, $p = 0.097$), also in the negative direction.

These findings contrast with simple synergy hypotheses and suggest more complex relationships between digital infrastructure and DPI systems. The predominance of null and negative interactions indicates that DPI and infrastructure may function more as alternative or complementary pathways rather than purely synergistic ones. These OLS estimates may be subject to endogeneity concerns due to potential reverse causality. Additionally, omitted variables such as institutional quality or entrepreneurial culture could correlate with both digital investments and e-commerce outcomes. To address these potential biases, we employ instrumental variables estimation for main effects in succeeding section.

Endogeneity assessment and causal identification. Applying the endogeneity assessment described in the previous section, coverage variables demonstrated severe endogeneity, with 4G coverage ($R^2 = 0.724$) and 3G coverage ($R^2 = 0.709$) showing strong reverse relationships indicating economies expand these services

in response to e-commerce growth. Mobile broadband subscriptions exhibited moderate-high endogeneity ($R^2 = 0.514$), while fixed broadband subscriptions also demonstrated concerning reverse causality ($R^2 = 0.566$).

Reverse regression of model 2 revealed moderate endogeneity (reverse $R^2 = 0.271$) for DPI simple index, motivating instrumental variables estimation. While DPI showed lower reverse causality than infrastructure variables, economies do incrementally improve DPI systems in response to e-commerce success, necessitating causal identification through income group instruments. International bandwidth also showed low endogeneity ($R^2 = 0.272$), likely reflecting its dependence on long-term international infrastructure agreements, submarine cable investments, and geographic constraints rather than responsive domestic policy decisions. Given its borderline endogeneity level and strong theoretical justification for exogeneity, we treated international bandwidth as exogenous in our instrumental variables specifications.

Table 5. Infrastructure vs DPI pathways: OLS and IV coefficients

Variable	OLS	IV	
International bandwidth		12.948***	12.896***
		(2.512)	(2.263)
Active mobile broadband subscriptions		5.235*	14.644***
		(2.139)	(1.968)
Fixed broadband subscriptions per 100 people		3.370***	5.355***
		(0.696)	(0.637)
4G Coverage		2.548**	7.697***
		(0.800)	(1.351)
3G Coverage		-2.381*	17.137***
		(1.083)	(4.078)
DPI Overall Quality		4.072***	7.150***
		(0.522)	(1.093)

*Standard errors in parentheses. ***p ≤ 0.001, **p ≤ 0.01, *p ≤ 0.05*
OLS coefficients are from Models 1 and 2 from Table 4. IV Coefficients are from individual IV estimation (one endogenous variable per model, income-group instruments, international bandwidth as control).

Source: Author's calculations.

Instrumental variables estimation using income-group averages as instruments produced different estimates than ordinary least squares. Assuming that income-group averages affect e-commerce outcomes only through digital infrastructure and DPI variables, these results offer possible causal evidence. All endogenous variables show statistically significant effects under this specification, with magnitudes that help explain apparent paradoxes in correlational analysis.

The IV estimates suggest that coverage variables showing mixed or negative effects in OLS may in fact generate positive economic returns. Most notably, 3G coverage

shows the largest estimated impact (β = 17.137, $p < 0.001$), while 4G coverage shows a substantial estimated effect (β = 7.697, $p < 0.001$). This pattern helps resolve the apparent paradox in which 3G coverage appeared negatively associated with e-commerce outcomes in the correlational analysis.

Mobile broadband subscriptions showed an upward revision from modest correlational effects (β = 5.235, $p < 0.05$) to larger IV estimates (β = 14.644, $p < 0.001$), while fixed broadband subscriptions showed moderate increases from OLS (β = 3.370) to IV estimates (β = 5.355, $p < 0.001$). These patterns are consistent with downward bias in infrastructure effects when endogeneity concerns are not addressed.

DPI effects appear even more underestimated in the correlational analysis. The IV estimate of overall DPI quality (β = 7.150, $p < 0.001$) is 76% larger than the OLS estimate (β = 4.072, $p < 0.001$), consistent with downward bias from reverse causality. Economies with successful e-commerce outcomes do invest incrementally in DPI improvements, but this responsive investment could mask the underlying relationship between strategic DPI deployment and e-commerce outcomes.

First-stage regressions indicate strong instruments across all endogenous variables, with F-statistics substantially exceeding conventional thresholds (all $F > 19.98$) indicate strong instruments. Income group instruments capture shared development characteristics and institutional capacities that influence digital investment patterns. This follows the assumption that these characteristics operate on e-commerce performance only through the digital infrastructure and DPI channels, particularly for smaller economies within groups.

Income-group instruments carry important limitations. Within-group heterogeneity may be substantial, particularly for resource-rich economies or high-inequality economies that deviate from typical group patterns. We explored alternative instruments based on geographic regional groupings as a robustness check, but these performed poorly (weak first-stage F-statistics and failed overidentification tests), likely because regional proximity introduces additional endogeneity through technology diffusion and policy spillovers between neighbouring economies.

The income-group approach, despite its limitations, provides the most viable identification strategy given data constraints. Future research with panel data could employ country fixed effects or exploit policy discontinuities (e.g., regulatory reforms, infrastructure investment shocks) to test these relationships through alternative identification strategies.

Digital development pathway performance analysis. Our pathway-based analysis provides evidence for distinct digital development routes and their effectiveness. Analysis of variance (ANOVA) results across 149 economies with complete data demonstrate differences between pathway types for both e-commerce outcomes.

Pathway classification alone explains variance in digital economic performance: 35.1 per cent of revenue variance ($F = 19.45$, $p < 0.001$) and 58.0 per cent of user penetration variance ($F = 49.80$, $p < 0.001$).

Regression analysis with pathway dummy variables reveals performance hierarchies, with DPI Innovators serving as the reference category representing successful leapfrogging strategies. For e-commerce revenue, Digital Leaders demonstrate the highest performance with a coefficient of 0.736 ($p = 0.075$), indicating marginally significant revenue advantages over DPI Innovators. Infrastructure Advantage economies achieve comparable revenue outcomes to DPI Innovators ($\beta = -0.023$, $p > 0.1$), suggesting no meaningful difference between the two pathways. However, emerging digital economies underperform ($\beta = -1.631$, $p < 0.001$), while pre-digital foundations show the largest negative coefficient ($\beta = -2.446$, $p < 0.001$).

User penetration results reveal pathway effects with differences across all categories. Digital leaders achieve the highest user penetration rates, with a 25.786 percentage-point advantage over DPI innovators ($p<0.001$). Infrastructure advantage economies demonstrate user engagement with a 13.850 percentage point premium ($p < 0.05$), indicating these economies leverage advanced connectivity for digital commerce adoption despite incomplete DPI systems. Emerging digital economies show lower penetration (-6.901 percentage points, $p<0.05$), while pre-digital foundations exhibit the largest deficit (-15.359 percentage points, $p < 0.001$).

These findings confirm the validity of our pathway classification while revealing strategic insights. The similar revenue performance between infrastructure advantage and DPI innovator economies demonstrates that different combinations of infrastructure and DPI capabilities can achieve comparable economic outcomes. However, infrastructure advantage economies show superior user penetration rates, suggesting these economies achieve broader digital commerce adoption through connectivity even without complete DPI systems. This pattern indicates infrastructure advantage economies possess untapped potential that could be unlocked through strategic DPI completion initiatives.

Digital development pathways and policy recommendations. Our integrated infrastructure × DPI analysis expanded to include 204 economies and identified five distinct digital development pathways, each requiring targeted strategies for optimal digital economic development . These empirically grounded typologies move beyond income-based classifications to recognize diverse routes to digital readiness based on infrastructure capabilities and DPI system maturity.

Digital leaders achieve the highest performance across both revenue and user penetration measures, with a 25.786 percentage point advantage in user penetration over the baseline DPI innovators ($p < 0.001$). This pathway demonstrated that digital foundations with complete system implementation generate superior digital commerce

outcomes. These economies can focus on cross-border interoperability and regional digital corridor development to leverage their complete systems for international trade facilitation, while serving as anchor points for regional digital integration initiatives.

Table 6. Digital development pathway performance analysis

	ln (revenue)	User penetration (per cent)
Digital leaders	0.736	25.786***
	(0.426)	(3.687)
Infrastructure advantage	-0.023	13.850*
	(0.837)	(5.866)
Emerging digital	-1.631***	-6.901*
	(0.372)	(3.115)
Pre-digital foundations	-2.446***	-15.359***
	(0.380)	(2.816)
N	149	149
R-squared	0.351	0.580
F-statistic	27.046***	75.636***

****p ≤ 0.001, **p ≤ 0.01, *p ≤ 0.05. DPI innovators serve as the reference category (omitted). Revenue coefficients represent log differences relative to DPI innovators. User penetration coefficients represent percentage point differences relative to DPI innovators.*

Source: Author's calculations.

Infrastructure advantage demonstrate strong user engagement capabilities, achieving 13.850 percentage point higher penetration than DPI innovators ($p < 0.05$) while maintaining similar revenue performance. This category have advanced technical foundations but lacking complete DPI system integration. The strong user penetration performance indicates these economies leverage connectivity for digital commerce adoption, revealing untapped potential that could be unlocked through strategic DPI completion. These economies represent high-return investment opportunities, as they possess technical foundations requiring only DPI completion to achieve digital leader status. They should fast-track DPI deployment through accelerated implementation programs, given their demonstrated ability to achieve strong user penetration rates through existing connectivity capabilities.

DPI innovators serve as the empirical baseline, demonstrating successful leapfrogging through strategic implementation despite infrastructure constraints. This pathway proves that complete DPI systems can enable digital commerce development even without advanced infrastructure. These economies demonstrate patterns consistent with leapfrogging strategies, proving that strategic public digital systems can enable economic outcomes despite infrastructure constraints. They should prioritize scaling domestic innovations regionally while sharing leapfrogging strategies through South-

South cooperation, as their success demonstrates replicable models for infrastructure-constrained contexts. Development assistance should prioritize knowledge transfer mechanisms enabling these economies to serve as regional centres of excellence.

Emerging digital show lower performance than DPI innovators, with 6.901 percentage point lower user penetration ($p = 0.028$) and revenue deficits. This largest category represents economies with developing infrastructure and partial DPI implementations. The performance gap indicates these economies require strategic intervention to avoid being trapped in intermediate development status. This suggests current development approaches may be insufficient for economies in intermediate development stages, requiring more strategic intervention to prevent developmental stagnation. Priority actions include balanced infrastructure-DPI development approaches with clear implementation sequencing, regional cooperation frameworks for system interoperability, and targeted technical assistance to accelerate pathway progression.

Foundational Development exhibit the lowest performance across both measures, with 15.359 percentage point lower user penetration ($p < 0.001$) and the largest revenue deficits. These economies require foundational development combining mobile-first infrastructure with targeted DPI capabilities. However, the analysis suggests this should emphasize mobile-first approaches combined with targeted DPI capabilities rather than attempting infrastructure development before digital system implementation. The success of DPI innovators provides evidence that strategic digital investments can generate returns even in constrained infrastructure contexts. Strategic approaches include partnerships with DPI innovators for knowledge transfer, phased development plans aligning infrastructure investments with foundational DPI capabilities, and international support for basic digital capacity building.

These digital development pathways manifest differently across Asia-Pacific subregions, suggesting differentiated strategic priorities. Caucasus and Central Asia economies should leverage existing DPI innovation for regional integration initiatives. East Asia should prioritize DPI system completion for infrastructure advantage economies to unlock their technical foundations. South Asia should scale successful leapfrogging models from India and Bangladesh through regional knowledge-sharing mechanisms. Southeast Asia should promote South-South cooperation among DPI innovators to strengthen their pathway diversity advantages. Pacific economies require foundational support through regional system access arrangements before pursuing domestic capability development, given their concentrated pre-digital foundation status.

The pathway distribution enables strategic regional integration approaches where different pathway types contribute complementary capabilities. Digital leaders and infrastructure advantage economies could provide regional connectivity backbones, while DPI Innovators could contribute system design expertise and implementation experience. This differentiated regional cooperation could accelerate development

for emerging digital and pre-digital foundation economies through access to regional systems before achieving domestic capability maturity. The pathway distribution suggests opportunities for regional digital integration initiatives where digital leaders and DPI innovators could anchor regional networks, infrastructure advantage economies could provide connectivity backbones, emerging digital economies could serve as regional integration pilots, and pre-digital foundation economies could access regional systems before developing domestic capabilities.

The empirical evidence challenges traditional development sequencing assumptions by demonstrating that infrastructure advantage and DPI innovator pathways achieve similar revenue outcomes through different **a**pproaches. This suggests development strategies should be optimized based on economies' existing capabilities rather than following universal sequences. Economies with strong connectivity should prioritize DPI completion, while those with limited infrastructure should consider strategic DPI investments as foundations for subsequent infrastructure development. This approach could accelerate global digital trade participation by enabling economies to contribute to regional digital ecosystems before achieving complete domestic system maturity.

Development implications: Availability, accessibility, and affordability

The pathway findings also addressed development questions that extend beyond aggregate e-commerce performance. Do digital commercial systems reach economies at different development stages (availability)? Is participation within those systems broad or concentrated (accessibility)? And are the costs of engagement within reach of lower-income populations and firms (affordability)?

Availability. The distribution of 204 economies across the five pathways reveals the scale of the availability challenge. The pre-digital foundation economies and emerging digital economies together represent more than half of the economies in the analysis. For these economies, the basic preconditions for e-commerce participation remain incomplete. The revenue deficits observed for these groups (–2.446 log points for pre-digital foundations and –1.631 for emerging digital relative to DPI innovators, both $p < 0.001$) represent foregone economic activity and constrained market access for households and firms.

The DPI innovator pathway demonstrates that availability need not require prior completion of expensive physical infrastructure. The DPI innovator economies achieve revenue outcomes statistically equivalent to the infrastructure advantage economies ($\beta = -0.023$, $p = 0.978$), despite fundamentally different development profiles. For the lower-pathway economies mentioned in the previous paragraph, this finding carries a practical implication that extending the availability of digital commercial systems does not necessarily require completing the infrastructure first. Targeted and working DPI investment, whether digital identity, payment platforms, and data exchange frameworks, represents a potentially faster and more financially accessible

route to establish basic conditions for e-commerce participation.

Accessibility. While revenue equivalence between infrastructure advantage and DPI innovator pathways is the paper's headline finding, the user penetration results reveal an important nuance with direct bearing on accessibility. Infrastructure advantage economies achieve 13.850 percentage points higher user penetration than DPI innovators ($p<0.05$), despite generating similar aggregate revenues. This gap suggests that pathways producing equivalent commercial value do not necessarily produce equivalent participation breadth. Infrastructure-rich pathways appear to distribute digital commerce participation more widely across populations. DPI-enabled pathways, albeit commercially effective, may concentrate activity among a narrower set of users or firms.

This accessibility gap matters for development outcomes. Sustainable Development Goal (SDG) 9 (inclusive and sustainable industrialization) and SDG 10 (reduced inequalities) requires that economies achieve digital commercial activity in aggregate and that the benefits reach across income groups and population segments. The difference in user penetration suggests that DPI-enabled leapfrogging risks producing commercially successful but inclusively limited outcomes, if pursued without complementary investments in connectivity and digital skills. For development institutions supporting DPI innovator and pre-digital foundation economies, this finding points toward the importance of pairing DPI investment with demand-side interventions to convert system availability into genuine population-level participation. This includes digital literacy programmes, device affordability support, and last-mile connectivity

Affordability. With affordability metrics excluded during variable selection due to multicollinearity concerns, the affordability dimension is addressed indirectly through the cost structure implications of the DPI versus infrastructure comparison. DPI quality generates an IV-estimated effect of $\beta = 7.150$ on e-commerce outcomes, comparable to 4G coverage at $\beta = 7.697$. These effects are of similar magnitude, but the cost structures are substantially different. Physical network deployment requires capital-intensive investment in towers, cables and devices, typically passed through to users. DPI, by contrast, is primarily an institutional investment through legal frameworks, interoperability standards, and system design. Once deployed, well-designed DPI reduces per-transaction costs structurally by enabling competitive service provision across any qualified provider accessing the open architecture.

The Kenya M-Pesa case illustrates this mechanism of a DPI-enabled payment layer reduced the effective cost of financial transactions for millions of users who remained excluded from formal banking infrastructure (Ndung'u, 2019). The comparable causal magnitudes in our cross-country analysis suggest this affordability dynamic may generalize beyond single-country cases. For the emerging digital economies facing

both infrastructure cost barriers and incomplete DPI systems, this points toward DPI investment as an affordability intervention. It can lower the structural costs of digital commercial participation even before full infrastructure deployment is achieved.

Implications of the study for the SDGs. Together, the three dimensions suggest that digital development pathway choice has consequences for the SDGs. The availability evidence supports SDG 17 (partnerships for the goals) by demonstrating that DPI-enabled pathways offer developing country partners a viable alternative to infrastructure-first sequencing, broadening the menu of development cooperation instruments available to international institutions. The accessibility gap between infrastructure and DPI pathways points to the additional policy effort needed to translate aggregate digital economic gains into broadly shared welfare improvements consistent with SDG 10. The affordability argument for DPI investment supports SDG 9 by providing evidence-based justification for integrated digital infrastructure financing that addresses both physical and institutional dimensions of digital development.

The pathway framework developed in this study offers development planners a practical tool for locating any economy within the global distribution of digital capabilities and identifying the investment combination most likely to advance e-commerce outcomes while attending to who participates and at what cost. Closing the gap between aggregate digital economic performance and equitable digital inclusion remains a challenge for all pathway types. Evidence suggests that the challenge looks different and it demands different responses, depending on where a country sits in the distribution.

VI. CONCLUSIONS

This study provides empirical analysis of digital development pathways and their effectiveness for enabling e-commerce growth across 149 economies. Using an integrated dataset combining infrastructure metrics, DPI quality indices, and e-commerce outcomes, we tested competing theories about optimal approaches to building digital economic capabilities in developing economies.

Our primary contribution demonstrates that infrastructure capabilities and DPI systems operate as complementary rather than competing development strategies. High-quality connectivity infrastructure remains foundational, explaining substantial variance in digital economic outcomes. International bandwidth emerges as the dominant infrastructure predictor, followed by fixed broadband subscriptions and 4G coverage. However, strategic DPI deployment provides significant amplification effects beyond infrastructure alone. When controlling for infrastructure investments, DPI quality remains highly significant, indicating that economies implementing complete digital identity, payment, and data exchange systems achieve additional e-commerce benefits beyond connectivity improvements.

Our instrumental variables analysis addresses endogeneity concerns inherent in cross-sectional development research. Using income-group averages as instruments for endogenous digital investments, we find that causal estimates strengthen the positive association between DPI quality and e-commerce outcomes. This suggests that reverse causality or omitted variable bias does not drive observed relationships, but rather strategic digital investments causally influence economic outcomes.

The pathway analysis provides evidence for conditional leapfrogging under specific circumstances. DPI innovator economies, including Bangladesh, India, Indonesia, and Cambodia, demonstrate that strategic digital system implementation can achieve comparable revenue outcomes to infrastructure advantage economies despite infrastructure constraints. This finding challenges traditional development sequences requiring infrastructure completion before digital system deployment. Digital leaders, however, combine both advanced infrastructure and complete DPI systems to achieve superior outcomes across all measures. This indicates that integrated approaches remain optimal when resources permit.

Our pathway-based framework enables differentiated development strategies based on country capabilities rather than universal prescriptions. Economies should align digital investments with existing foundations: those with infrastructure advantages should prioritize DPI completion, while those with DPI capabilities can pursue alternative pathways despite infrastructure constraints. This differentiated approach has implications for development finance allocation, suggesting that effective assistance requires diagnostic assessment of country starting conditions rather than standardized intervention packages.

Several limitations warrant acknowledgment. Our instrumental variables approach using income-group averages addresses endogeneity but may mask within-group heterogeneity, particularly for resource-rich or high-inequality economies. The substantial coefficient changes between OLS and IV specifications warrant cautious interpretation. Our cross-sectional design precludes analysis of dynamic trajectories and country fixed effects; future longitudinal research should examine pathway transitions as multi-year DPI data becomes available. Infrastructure indicators exclude affordability measures, and country-level aggregation masks within-country heterogeneity across provinces and urban-rural divides.

Sample size constraints (149 economies) limited statistical power for detailed sub-regional analysis. Sub-regional analysis within Asia-Pacific developing member economies yielded weaker results than global analysis, suggesting pathway effects may operate primarily at broader development levels or that regional samples were insufficient for reliable inference. Potential omitted variables including human capital quality, institutional effectiveness, and regulatory environments may introduce bias despite our instrumental approach. These limitations suggest findings should

be interpreted as suggestive evidence warranting further investigation rather than definitive causal relationships.

As digital transformation continues reshaping global economic activity, this analysis provides evidence for understanding effective approaches to building digital economic capabilities. The pathway-based framework enables more precise targeting of development assistance based on country capabilities and contexts rather than uniform approaches, contributing to more effective and efficient digital development strategies. Our findings suggest that while infrastructure remains foundational, strategic DPI investments create viable alternative pathways for economies facing resource constraints, with implications for development finance allocation and national digital transformation planning.

Note on Author

Homer Pagkalinawan is a senior data and geospatial analytics professional with over 15 years of experience in business intelligence, spatial analysis, and international development. Based at the Asian Development Bank, he leads analytics work spanning sovereign operations, data engineering, and decision-support tools across Asia-Pacific. He holds advanced degrees in geomatics and geodetic engineering and has published research in collaboration with leading policy and technical institutions globally.

REFERENCES

Atasoy, H. (2013). The effects of broadband internet expansion on labor market outcomes. https://doi.org/10.1177/0019793913066002O2

DPI Map (2025). Institute for Innovation and Public Purpose, UCL. https://dpimap.org/data

Eaves, D., and K. Rao (2025). Digital public infrastructure: A framework for conceptualisation and measurement. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2025-01). https://www.ucl.ac.uk/bartlett/public-purpose/wp2025-01

Gates Foundation (2024). Digital public infrastructure. https://www.gatesfoundation.org/our-work/programs/global-growth-and-opportunity/digital-public-infrastructure

GSMA (2024a). The mobile economy 2024. https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/wp-content/uploads/2024/02/260224-The-Mobile-Economy-2024.pdf

GSMA (2024b). The state of mobile internet connectivity report 2024. https://www.gsma.com/r/wp-content/uploads/2024/10/The-State-of-Mobile-Internet-Connectivity-Report-Key-Findings-2024.pdf

GSMA (2025). The state of the industry report on mobile money 2025. https://www.gsma.com/sotir/wp-content/uploads/2025/04/The-State-of-the-Industry-Report-2025_English.pdf

Hjort, J., and J. Poulsen (2019). The arrival of fast internet and employment in Africa. American Economic Review, Vol. 109, No. 3. https://doi.org/10.1257/aer.20161385

International Telecommunication Union (2024). ITU DataHub: Economy profiles for digital development indicators. Geneva: ITU Publications. https://datahub.itu.int/

Jack, W., and T. Suri (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. American Economic Review, Vol. 104, No. 1. https://doi.org/10.1257/aer.104.1.183

Lee, K. (2019). Economics of technological leapfrogging. Inclusive and Sustainable Industrial Development Working Paper Series WP 17/2019. https://downloads.unido.org/ot/16/41/16414872/WP_17_FINAL.pdf

Mazzucato, M., D. Eaves, and B. Vasconcellos (2024). Digital public infrastructure and public value: What makes DPI "public"? UCL Institute for Innovation and Public Purpose Policy Brief (IIPP PB 2024-03). https://www.ucl.ac.uk/bartlett/public-purpose/publications/2024/mar/digital-public-infrastructure-and-public-value-what-public-about-dpi

Ndung'u, N. (2019). Digital technology and state capacity in Kenya. Center for Global Development. https://www.cgdev.org/publication/digital-technology-and-state-capacity-kenya

Organisation for Economic Co-operation and Development. (2024). OECD digital economy outlook 2024: Embracing the Technology Frontier. Paris: OECD Publishing. https://doi.org/10.1787/a1689dc5-en

Suri, T., and W. Jack (2016). The long-run poverty and gender impacts of mobile money. Science, Vol. 354, No. 6317. https://doi.org/10.1126/science.aah5309

UCL Institute for Innovation and Public Purpose. (2025). DPI map: Global state of DPI. London: UCL Press. https://dpimap.org/global-state-of-dpi/

UK Government (2023). Connectivity - building world-class digital infrastructure for the UK. https://www.gov.uk/government/publications/uk-digital-strategy/1-connectivity-building-world-

class-digital-infrastructure-for-the-uk

United Nations (UN) (2021). Digital connectivity essential for least developed countries to reap benefits of fourth industrial revolution. https://press.un.org/en/2021/dev3439.doc.htm

UN (2023). Widening digital gap between developed, developing states threatening to exclude world's poorest from next industrial revolution. https://press.un.org/en/2023/gaef3587.doc.htm

United Nations Conference on Trade and Development (2021). Digital economy report 2021: Cross-border data flows and development. Geneva: UNCTAD Publications. https://digitallibrary.un.org/record/4053820?v=pdf

United Nations Development Programme (2024a). Digital Public Infrastructure. https://www.undp.org/digital/digital-public-infrastructure

United Nations Development Programme (UNDP) (2024b). Digital Transformation Framework. https://www.undp.org/digital/transformations

Wong, A. (2025). Digital infrastructure investment: Where will the billions come from? International Telecommunication Union. https://www.itu.int/hub/2025/01/digital-infrastructure-investment-where-will-the-billions-come-from/

World Bank (2023). Digital progress and trends report 2023. Washington, DC: World Bank Publications. https://www.worldbank.org/en/publication/digital-progress-and-trends-report

World Bank (2024a). Digital. https://www.worldbank.org/en/topic/digital/overview

World Bank. (2024b). Putting people at the center of digital public infrastructure: ID4D and G2Px annual report 2023. http://documents.worldbank.org/curated/en/099647503042425828

World Bank and World Trade Organization (2023). Digital trade for development (Joint report with IMF, OECD, and UNCTAD). https://www.wto.org/english/res_e/booksp_e/dtd2023_e.pdf

World Economic Forum (2024a). What to expect for digital public infrastructure in 2024. https://www.weforum.org/stories/2024/02/dpi-digital-public-infrastructure/

World Economic Forum (2024b). What is digital public infrastructure and why does it matter? https://www.weforum.org/stories/2024/12/can-digital-public-infrastructure-help-guide-the-transformation/

World Trade Organization (2023). World trade report 2023: Re-globalization for a secure, inclusive and sustainable future. Geneva: WTO Publications. https://www.wto.org/english/res_e/publications_e/wtr23_e.htm

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

DIGITAL TRADE FOR MACROECONOMIC DEVELOPMENT: EVIDENCE FROM ASEAN'S E-COMMERCE INTEGRATION

John Paolo R. Rivera[1]

Email: jrivera@pids.gov.ph

The Association of Southeast Asian Nations (ASEAN) is undergoing rapid digital transformation as cross-border e-commerce increasingly drives trade and inclusive growth. Using panel data and selected pillars of the ASEAN Digital Integration Index, this study finds that digital skills and talent are the strongest drivers of digitally delivered services exports, while digitally enabled trade and logistics primarily shape imports. Cross-border e-commerce, proxied by digitally delivered services exports and imports, supports GDP growth, though the impact on the current account is uneven. Policy implications emphasize skills upgrading, logistics interoperability and stronger digital ecosystem governance.

Keywords: ASEAN, digital trade, digitally delivered services, cross-border e-commerce, macroeconomic development

JEL classification: F13, F14, O19, O33, L86

[1] The author gratefully acknowledges the valuable guidance and mentorship of Dr. Cassey Lee throughout the development of this study. The author also thanks the delegates and discussants of the Asian Think Tank Network (ATTN) Forum 2025 for their insightful comments and constructive feedback, which helped sharpen the conceptual framing and empirical analysis. This study was presented at the forum on 28–30 October 2025 at the Asian Development Bank Institute in Tokyo. The author extends appreciation to the ATTN Secretariat for facilitating a rigorous and collegial platform for scholarly exchange that meaningfully grounded and strengthened this research.

I. INTRODUCTION

Dynamic digital economic growth in the Association of Southeast Asian Nations (ASEAN) is driven by its young population, internet penetration, and expanding digital infrastructure (Sefrina, 2024; Sonobe et al., 2024; Ing et al., 2023). ASEAN's digital economy exceeded US$200 billion in 2023 and was projected to reach more than US$330 billion by 2025, reflecting a growth rate that has outpaced earlier forecasts (Sefrina, 2024; Google et al., 2023). The ASEAN digital economy is projected to grow 6% annually to reach $1 trillion by 2030 (Yang, 2023), as digital economic growth creates unprecedented opportunities (WEF, 2025; Liu and Sengstschmid, 2024; Google et al., 2023). Cross-border e-commerce can facilitate this growth[2] (Chen et al., 2025) and has enabled micro, small, and medium enterprises (MSMEs) to access regional and global markets (Wijaya et al., 2025; Chen et al., 2024; Carlos et al., 2022). Platforms (e.g., Lazada, Shopee) are facilitating regional digital trade, especially during COVID-19, which disrupted traditional trade channels (Salisu et al., 2025; Hijanto, 2020).

Despite these opportunities, the regional digital trade landscape remains uneven (Sempena and Sitorus, 2025; Zhang et al., 2025). Regulatory fragmentation, infrastructure gaps, inconsistent digital payment systems and limited digital literacy hinder inclusive cross-border e-commerce (Hariyani et al., 2025). Moreover, the macroeconomic implications of digital trade, such as its role in driving growth and improving current account balances, have yet to be examined in-depth in the regional context (Beirne and Fernandez, 2020).

This study investigates how cross-border e-commerce participation is driving macroeconomic development in the context of ASEAN member states[3] moving toward the comprehensive Digital Economy Framework Agreement (DEFA). The ASEAN Digital Integration Index (ADII) is a composite measure to assess member states progress on creating a regionally integrated digital economy. As states integrate digital trade into national and regional strategies, understanding structural enablers and policy levers becomes vital for driving equitable and stable growth (Smeets, 2021). While digital trade is often discussed in terms of trade facilitation and access, our analysis is situated within the broader macroeconomic discourse in the regional context. Thus, we inquire into (1) *which digital trade enablers drive macroeconomic development*, and (2) *how regional digital trade policies can be recalibrated toward macroeconomic*

[2] Trade of goods and services conducted through digital platforms across international borders (Wang and Zhou, 2025; Ding et al., 2017). We use digital trade as the broader umbrella concept, while cross-border e-commerce refers to the transactional, platform-enabled subset of digital trade that involves cross-border exchange of goods and services ordered digitally.

[3] Timor-Leste is not included in this study as it officially became ASEAN's 11th member state only on 26 October 2025.

development? In addressing these, we set the following objectives:

1. Analyse the link between cross-border e-commerce performance and selected macroeconomic indicators.

2. Identify enablers for macroeconomic development across ASEAN member states.

3. Craft policy recommendations to harmonize digital trade frameworks and support macroeconomic development.

Our regional empirical perspective linking digital transformation with macroeconomic development provides evidence-based insights on recalibrating digital trade strategies to enhance macroeconomic growth and development and improve current account balances. For development institutions and policy think tanks, we augment regional dialogues on macroeconomic growth and development in the digital age.

We examine cross-border e-commerce through digitally delivered services,4 which capture the services-intensive backbone of digital trade, including platform intermediation, professional services, information and communication technology-enabled services, and digital logistics, rather than focusing solely on goods-based online retail transactions. Likewise, digitally delivered services are treated not as a substitute for goods-based cross-border e-commerce, but as the macroeconomically relevant layer of digital trade through which digital integration affects growth and external performance in ASEAN.

Beyond its trade and macroeconomic relevance, we align with the Sustainable Development Goals (SDGs), particularly SDG 8 (decent work and economic growth), SDG 9 (industry, innovation, and infrastructure), and SDG 10 (reduced inequalities). By examining how digitally delivered services are shaped by digital skills, institutional readiness, and trade facilitation, we touch on the mechanisms through which digitalization can translate into productivity gains, employment creation, and more resilient growth pathways. Results are relevant for ASEAN and other emerging economies, where digitally delivered services offer a pathway for MSMEs and workers to integrate into regional and global markets without the scale requirements of traditional goods trade. Hence, cross-border e-commerce participation via digital services is not only a trade outcome but also a development instrument that can support inclusive growth by lowering entry barriers, expanding market access, and strengthening economic resilience, all of which are core objectives of the SDG agenda.

II. LITERATURE REVIEW

Cross-border e-commerce and ASEAN's digital transformation. With more than 460 million internet users, ASEAN has become a fertile environment for the growth of cross-border e-commerce, which has reshaped trade patterns, expanded market access for MSMEs, and supported broader digitalization (Carlos et al., 2022; Isono and

Prilliadi, 2023). However, despite strong headline growth, cross-border e-commerce participation across ASEAN remains uneven, reflecting persistent infrastructural, regulatory, and institutional constraints (Salisu et al., 2025; Sefrina, 2024; Chen and Kimura, 2020).

ASEAN's digital landscape: Growth, opportunities and asymmetries. Projections suggest that ASEAN's digital economy could reach $1 trillion by 2030, with cross-border e-commerce playing a central role in this expansion (Yang, 2023). Yet, the region's digital transformation is characterised by significant asymmetries. While economies such as Singapore, Malaysia, Vietnam, Indonesia, Thailand, and the Philippines lead in digital adoption (Rotberg, 2025; Fuentes, 2024; Chadha, 2023), many MSMEs and rural communities continue to face barriers related to digital access, affordability, skills, and logistics (Sefrina, 2024; Ing et al., 2023). These contributed to uneven distribution of ASEAN's digital integration, with digital opportunities concentrated in more advanced segments of the region (Yang, 2023).

Cross-border e-commerce and regional integration. ASEAN has positioned e-commerce as a strategic instrument for advancing its regional integration. The 2019 ASEAN Agreement on Electronic Commerce marked an important step toward harmonizing rules on e-commerce, trust, and cybersecurity, while ongoing negotiations on the DEFA aim to deepen cooperation in areas such as digital payments, data governance, logistics interoperability, and digital skills (Ing et al., 2023; Singh and Masaya, 2021). Nevertheless, regulatory fragmentation remains a major impediment to cross-border e-commerce. Divergent data localization requirements, inconsistent consumer protection regimes, and heterogeneous customs procedures raise transaction costs and discourage smaller firms from engaging in cross-border digital trade (Xiao and Sihuay, 2023; Smeets, 2021; Serzo, 2020). Thus, ASEAN's digital governance landscape remains decentralized, reflecting differing national priorities and capacities across its member states (Yang, 2023).

Governance, digital public infrastructure, and regional cooperation. Scholarly literature highlights the importance of digital public infrastructure, including interoperable payment systems, digital identification, and data exchange frameworks, as foundational to cross-border e-commerce (OECD, 2024; UNDP, 2023). For ASEAN, investments in digital public infrastructure are critical given the region's diversity in development levels and institutional capacity (Markus and Nazara, 2023). As per Hariyani et al. (2025), such infrastructure helps achieve the SDGs by lowering transaction costs and broadening financial inclusion (UNDP, 2023). While post-pandemic recovery strategies increasingly incorporate digital cooperation initiatives, gaps persist in areas such as taxation of digital services, intellectual property rights protection, and cross-border dispute resolution (Salisu et al., 2025; Markus and Nazara, 2023; Kang et al., 2022; Cuenca, 2021). Rather than full regulatory harmonization, interoperability and mutual recognition are underscored as pragmatic pathways to support cross-border

e-commerce, while preserving national regulatory autonomy (Digital Cooperation Organization, 2023; Smeets, 2021).

Digital trade outcomes and macroeconomic transmission channels. Studies increasingly treat digital trade, particularly digitally delivered services exports and imports, as a structural channel through which broader economic outcomes materialise (Sonobe et al., 2024; Beirne and Fernandez, 2020). Hence, macroeconomic indicators such as real gross domestic product (GDP) growth and current account performance are downstream outcomes that reflect the scale, composition, and resilience of digital trade participation.

Digital trade and economic development. Empirical studies also show that digital trade can support economic growth and development by lowering transaction costs, enabling market diversification, and sustaining economic activity during disruptions (Feng et al., 2022; Beirne and Fernandez, 2020). During COVID-19, digitally delivered services (e.g., online retail, digital finance, logistics, remote professional services) helped cushion output contractions by allowing firms and households to maintain cross-border economic engagement despite mobility restrictions (Sefrina, 2024; Google et al., 2023). AMS with more developed cross-border e-commerce ecosystems and digital infrastructure recovered more quickly than peers with weaker digital readiness, underscoring the role of digital trade as a stabilizing mechanism.

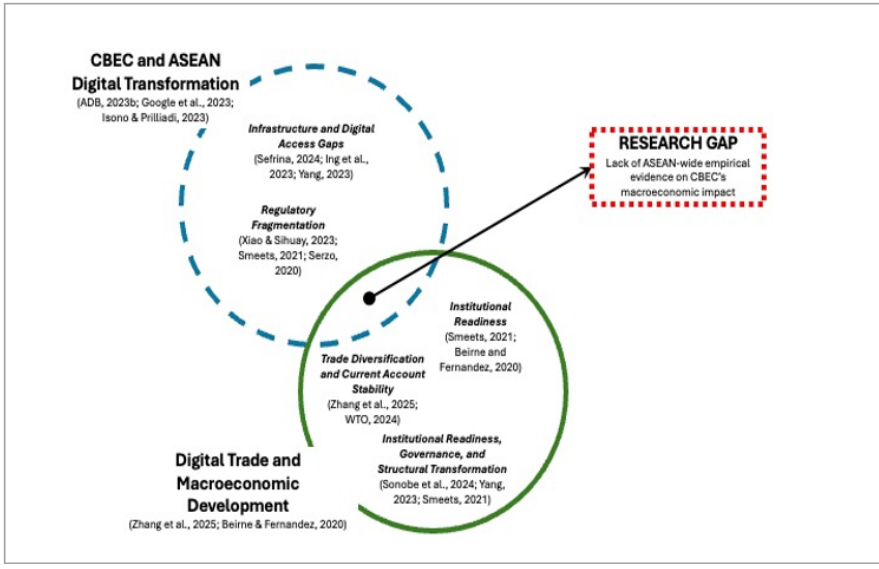
Trade diversification and current account stability. Digital trade contributes to trade diversification, widely considered a buffer against external shocks. By expanding the role of services less dependent on physical transport and global logistics chains, digitally delivered services exports can mitigate exposure to commodity price volatility and supply-chain disruptions (World Bank and WTO, 2024; UNCTAD, 2019). Evidence from ASEAN suggests economies with higher cross-border e-commerce penetration experience relatively more stable external balances during crisis periods, as growth in digital services partially offsets declines in traditional goods exports (Zhang et al., 2025; Shirakawa, 2024). However, the magnitude of these effects varies across economies, reflecting differences in skills, institutional readiness, and digital ecosystem maturity.

Institutional and regulatory coherence. The literature further emphasizes that the macroeconomic relevance of digital trade depends on institutional and regulatory coherence. Effective data governance, secure cross-border payment systems, digital taxation frameworks and cybersecurity regimes are essential for scaling cross-border e-commerce and sustaining trust in digital transactions (Smeets, 2021). Regional initiatives such as the ASEAN Single Window and DEFA represent important steps toward addressing these challenges, but uneven implementation and policy fragmentation continue to limit the region's ability to fully leverage cross-border e-commerce for macroeconomic development (Yang, 2023).

Likewise, digital trade is linked to longer-term structural transformation. By facilitating the expansion of knowledge-intensive and technology-enabled services, cross-border e-commerce can reduce reliance on volatile commodity exports and support more sustainable growth trajectories (Sonobe et al., 2024). Economies with stronger digital innovation capacity, measured through investments in skills, infrastructure, and research and development (R&D), are better positioned to capture these structural gains (Zhang et al., 2025).

Research gap. Figure 1 shows that while ASEAN's cross-border e-commerce landscape is vibrant, it remains uneven. Accelerating integration and development requires investment in foundational digital infrastructure, alignment of regulatory frameworks, and support for MSMEs to upgrade their digital capabilities.

Figure 1. Literature map



Source: Author's illustration.

We do not seek to contribute directly to structural growth theory or current account modelling. Instead, GDP growth and the current account balance are used as reduced-form macroeconomic indicators to assess the broader economic relevance of cross-border e-commerce participation. While literature on growth accounting and external balance dynamics is well developed, the empirical link between digital trade participation and these headline outcomes remains underexplored in the ASEAN and regional context. By focusing on these indicators, we provide an initial macroeconomic mapping that motivates deeper investigation into structural channels such as human capital accumulation, productivity, and investment-savings behaviour.

While discourse recognizing the link between digital trade and macroeconomic development is growing, several knowledge gaps remain. While the ADII offers a useful composite snapshot of regional digital readiness, it is limited as a standalone explanatory variable. The ADII masks heterogeneity across its pillars and is published for only a limited number of years and economies (ASEAN Secretariat, 2021).

Smeets (2021) and Ing et al. (2023) have emphasized the importance of disaggregating digital enablers to understand their distinct impacts. Thus, it is imperative to depart from existing approaches by analysing the individual indicators used to construct ADII, such as digital logistics, broadband penetration, and digital skills, rather than relying solely on the aggregate index. This allows more granular and empirically robust analysis of how specific enablers shape cross-border e-commerce participation and macroeconomic development outcomes.

III. FRAMEWORK AND METHODOLOGY

Conceptual framework. Our conceptual framework is anchored on the determinants of digital trade participation, with macroeconomic indicators introduced as outcome variables to evaluate the broader economic relevance of cross-border e-commerce than as primary objects of theoretical inquiry. As gleaned from literature, our framework links (1) digital trade enablers, (2) cross-border e-commerce participation, and (3) macroeconomic development. Figure 2 illustrates the causal flow from digital trade enablers to cross-border e-commerce participation to macroeconomic development. Table 1 spells out the constructs and possible corresponding representation. Thus, we treat digitally delivered services, as noted earlier, as the macroeconomically relevant layer of digital trade through which digital integration affects growth and external performance in ASEAN.

Figure 2. Conceptual framework



Note. Solid arrows represent primary causal relationships.
Source: Author's conceptualization.

Table 1. Core components

Construct	Possible representation	Reference
Digital trade enablers	Public infrastructure (broadband penetration, digital ID, mobile payments)	Hariyani et al. (2025)
	Regulatory frameworks (cross-border data rules, cybersecurity, tax harmonization)	Yang (2023); Smeets (2021)
	Institutional mechanisms (regional agreements and support programs)	Sefrina (2024); Ing et al. (2023)
Cross-border e-commerce participation	Volume of digital exports/imports; platform-based small and medium-sized enterprise integration; inclusion metrics (participation by women, rural enterprises, and low-income groups)	Carlos et al. (2022)
Macroeconomic development	GDP growth stability	Beirne and Fernandez (2020);
	Current account balance performance	Zhang et al. (2025); Shirakawa (2024)
	employment elasticity in digital trade sectors	Chen and Xu (2024); Serafica and Albert (2018)
	Reduction in inequality proxies (e.g., Gini coefficient, rural-urban income gaps)	Hariyani (2025); Smeets (2021)

Source: Author's conceptualization.

From figures 1 and 2, and table 1, we pose two hypotheses:

1. Digital trade enablers lead to increased cross-border e-commerce participation.

2. Increased cross-border e-commerce participation contributes positively to macroeconomic development.

Operational framework. Table 2 maps a construct-variable matching as the basis for our model. A key limitation of our study is the use of digitally delivered services as a proxy for cross-border e-commerce-related activity. Digitally delivered services exports and imports proxy the services dimension of digitally enabled cross-border commercial activity, capturing the services backbone that enables and scales cross-border e-commerce ecosystems. That is, while digitally delivered services capture the services infrastructure underpinning digital trade, they do not directly measure goods-based cross-border e-commerce, which remains concentrated in a few global players (e.g., The People's Republic of China (PRC). Consequently, our findings reflect the macroeconomic relevance of digitally enabled services trade instead of the scale of goods-based cross-border e-commerce participation.

Table 2. Construct-variable matching and description

Construct	Variable/Code	Variable Description	Variable Justification
Digital trade enablers ($ADIIPX_{it}$)	ASEAN Digital Integration Index (ADII) **$ADIIPX_{it}$**	Composite scores across digital readiness pillars, produced by a measurement tool developed to assess and track the progress of digital integration across ASEAN, and its trading partners (ASEAN Secretariat, 2021).	Each ADII pillar captures a critical enabler of ASEAN's digital economy. Collectively, they give a holistic picture of how ready each AMS is to integrate into a unified regional digital economy (ASEAN Secretariat, 2021).
	ADII Pillar 1: Digital Trade and Logistics **$ADIIP1_{it}$**	Measures how well AMS enable cross-border digital trade through logistics efficiency, trade facilitation, customs digitalization, and cross-border interoperability; focuses on reducing barriers to cross-border e-commerce and digital supply chains (ASEAN Secretariat, 2021).	
	ADII Pillar 2: Data Protection and Cybersecurity **$ADIIP2_{it}$**	Tracks the development of data governance frameworks, privacy protection laws, and cybersecurity readiness; ensures trust in digital transactions and safeguards personal and business data (ASEAN Secretariat, 2021).	
	ADII Pillar 3: Digital Payments and Identities **$ADIIP3_{it}$**	Looks at adoption and interoperability of digital payment systems, e-money, and fintech solutions; considers the existence of digital identity systems that allow seamless authentication for services and trade (ASEAN Secretariat, 2021).	
	ADII Pillar 4: Digital Skills and Talent **$ADIIP4_{it}$**	Measures the availability and quality of digital literacy, ICT skills, and workforce readiness for a digital economy; reflects investments in education, training, and human capital development (ASEAN Secretariat, 2021).	

Construct	Variable/Code	Variable Description	Variable Justification
	ADII Pillar 5: Innovation and Entrepreneurship **ADIIP5$_{it}$**	Evaluates support for start-ups, innovation ecosystems, and R&D capacity; focuses on how conducive the environment is for digital entrepreneurship, creative industries, and new technologies (ASEAN Secretariat, 2021).	
	ADII Pillar 6: Institutional and Infrastructural Readiness **ADIIP6$_{it}$**	Covers broadband access, connectivity infrastructure, and policy and regulatory frameworks that enable digital integration; reflects government coordination, regulatory efficiency, and investment in foundational digital public infrastructure (ASEAN Secretariat, 2021).	
Macroeconomic development	Real GDP Annual Growth **RGDPAG$_{it}$**	Measures the annual percentage change in an AMS' GDP, adjusted for inflation.	Reflects AMS ability to absorb shocks, sustain activity, and recover quickly (Ndou, 2025; Hallegate, 2014).
	Current Account Balance (as % of GDP) **CABGDP$_{it}$**	Difference between what an AMS earns from abroad (i.e., exports, primary income, and transfers) and what it spends (i.e., imports, income owed, and transfers), expressed as a percentage of GDP.	Reveals whether an AMS is a net exporter or a net borrower of capital offering a snapshot of external economic health; an indicator whether an AMS can stabilize itself during shocks by buffering demand and financing needs (UNDP, 2015); imbalances can signal structural fragilities or distorted economic fundamentals (Camarero et al., 2025).
cross-border e-commerce participation (DDSTRD$_{it}$)	Digitally Delivered Services Exports (digitally delivered services) (as % of total trade in services) **DDSEXP$_{it}$**	Service transactions that are delivered remotely via digital networks (e.g., software downloads, cloud-based services, telecommunications, financial services, professional consulting, streaming media). Expressed as a percentage of total services trade, it quantifies how much of an AMS' international services activity is conducted digitally.	Provides insight on the digitalization level of service exports and imports, beyond non-digitized forms of trade; a direct proxy for cross-border digital engagement signalling AMS' deeper digital integration and cross-border e-commerce usage. (Houngbonon and Mothobi, 2025; Liberatore et al., 2022; OECD, n.d.)
	Digitally delivered services Imports (as % of total trade in services) **DDSIMP$_{it}$**		

Source: Author's tabulations.

Equation 1 specifies our empirical model, which shows the direct effect of digital trade enablers (ADIIPXit) on cross-border e-commerce participation (DDSTRDit) (Hypothesis 1). Likewise, because we have variables to represent ADII pillars, we use them as predictors of cross-border e-commerce participation to show the extent to which digital trade enabling pillar drives digitally delivered services trade.

$$DDSTRD_{it} = \alpha_0 + \alpha_i \sum_{i=1}^{j} ADIIPX_{it} + \varepsilon_{it} \quad (1)$$

Predicted values of DDSTRDit (DDSEXPit and DDSIMPit) were determined to explain macroeconomic development, measured by economic growth (RGDPAGit) and current account balance share to GDP (CABGDPit) (Hypothesis 2). This allows the identification of the extent to which a particular digital trade enabler drives macroeconomic development through cross-border e-commerce participation. Thus, we have equations 2 and 3.

$$RGDPAG_{it} = \beta_0 + \beta_1 \widehat{DDSTRD}_{it} + \varepsilon_i \quad (2)$$

$$CABGDP_{it} = \beta_0 + \beta_1 \widehat{DDSTRD}_{it} + \varepsilon_i \quad (3)$$

Note: Independent variables in Equations 2 and 3 represents predicted values of such from Equation 1.

Our empirical strategy follows a two-stage logic. First, we examine how digital trade enablers, proxied by selected ADII pillars, shape participation in digitally delivered services, which represent the services-intensive backbone of digitally enabled cross-border commercial activity. This stage does not estimate the determinants of goods-based cross-border e-commerce transactions per se. Second, predicted digitally delivered services participation is linked to macroeconomic outcomes to assess how services-led digital trade contributes to growth and external performance.

Methodology

Data requirements and number of observations. Digital trade enablers are captured by the six pillars of the ADII (ASEAN Secretariat, 2021). However, as of writing, ADII data is available only for 2021, which initially restricts the analysis to a cross-sectional design with ASEAN members as observations. This limitation poses challenges due to the small number of observations.

To address this, we extend the analysis by moving toward a panel data framework. Rather than being constrained solely by the aggregate ADII scores for ASEAN members, we draw upon the underlying indicators and datasets used to construct the ADII pillars. These component indicators are available for a larger set of economies and across multiple years, thus expanding both the coverage and temporal scope of our analysis. This enables us to undertake panel estimations, increase the robustness of the results, and better capture the dynamic relationships among digital trade

enablers, cross-border e-commerce participation, and macroeconomic outcomes.

A key limitation emerges from the uneven availability of consistent data across economies and years, particularly for digital trade enablers. While most indicators are available for 2021 and 2023, some series are available only for 2020 and/or 2024, and not all economies report complete coverage even for common years. Thus, the panel was constructed by selecting only those economies with consistently available data for aligned years, preserving comparability across variables. This inevitably reduces the overall sample size and narrows the set of variables that can be included, but it strengthens internal validity by ensuring that the estimated cross-economy relationships are not biased by temporal mismatches or reporting gaps.

The following arise from our data and methodological limitations. First, we employ a panel data analysis encompassing 2021 and 2023, the only years with sufficiently consistent coverage across key indicators. These years are analytically meaningful as they capture the early phase of post-pandemic recovery when digital trade and cross-border e-commerce were rapidly accelerating, offering valuable insights into how digital integration relates to macroeconomic development. By consistently using 2021 and 2023 data, we enhance statistical power relative to a cross-sectional analysis and maintain coherence across the dataset, even if it means foregoing more recent figures. Also, because only two time periods are available, the fixed-effects (FE) estimator primarily controls for time-invariant country characteristics rather than for dynamic adjustment processes.

Second, not all six ADII pillars are represented in our empirical model. Only pillars 1 (digital trade and logistics), 4 (digital skills and talent), and 6 (institutional and infrastructural readiness) were included, as they have viable datasets that remain consistent with the other variables under consideration. Nonetheless, given the broad and interlinked nature of ADII measures, the selected indicators may also indirectly capture dimensions of the other pillars. This overlap, while imperfect, enhances the robustness of the analysis by reflecting complementarities across ADII dimensions and ensuring that the estimates retain relevance to ASEAN's broader digital integration agenda. We plot in table 3 a construct-variable matching for our selected ADII pillars serving as the basis for our empirical model.

Third, although the central focus remains on ASEAN, we expand the scope to a broader set of regional and global economic blocs, namely member economies of the Regional Comprehensive Economic Partnership (RCEP), BRICS, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and the Group of 20 (G20). This is justified on two grounds. They represent the wider economic ecosystem in which ASEAN's digital trade and cross-border e-commerce participation are embedded (ASEAN Secretariat, 2021). Since they also constitute major trading partners of AMS their inclusion strengthens the analysis of regional interdependencies.

And expanding the sample size improves the robustness of the econometric estimates, enhancing both external validity and cross-case comparability (Smeets, 2021; Sonobe, et al., 2024).

Table 3. Construct-variable matching and description for selected ADII pillars

Construct	Variable / Code	Variable Description	Variable Justification
ADII Pillar 1 (Digital Trade and Logistics)	Digital Development Score $ADIIP1_DDS_{it}$	Composite score based on 70 qualitative indicators grouped into four clusters namely national collaborative governance; policy design principles; digital development toolbox; and digital economic policy agenda.	Emphasizes digital trade, logistics readiness, regulatory and infrastructural foundations that enable efficient cross-border e-commerce trade facilitation (ASEAN Secretariat, 2021); captures quality of collaborative governance, regulatory frameworks, and infrastructure policies that underpin digital trade systems.
ADII Pillar 4 (Digital Skills and Talent)	Digital Innovation Capacity (Global Innovation Index [GII] Score) $ADIIP4_DIC_{it}$	Annual composite score assessing ASEAN member states' innovation performance; summarizes how well member fosters innovation in both inputs (i.e., infrastructure, institutions, human capital, market and business sophistication) and outputs (i.e., technology, knowledge, creative goods); provides a multi-dimensional view of innovation ecosystems.	Assesses digital innovation as it captures technology-related enablers (e.g., ICT infrastructure, R&D intensity, high-tech outputs); proxy for national innovation capacity, reinforcing its robustness and reliability in innovation research (Duarte and de Oliveira Carvalho, 2025; Nasir and Zhang, 2024).
ADII Pillar 6 (Institutional and Infrastructural Readiness)	Fixed Broadband Subscription (per 100 people) $ADIIP6_FBS_{it}$	Measures the extent of household and business access to stable, high-speed Internet.	Indicates how widely populations can access reliable Internet, which enables their participation in education, work, commerce, and public life in the digital age (Wert, 2025; International Telecommunications Union [ITU], 2023; UNCTAD, 2015).

Source: Author's tabulations.

To mitigate the small-sample risk of overfitting, we adhere to the principle of parsimony by running separate regressions with only a limited set of carefully specified exogenous variables (Rivera, 2023). This ensures that results remain statistically meaningful while balancing analytical depth with constraints on degrees of freedom. A related limitation concerns the treatment of regional and global economic blocs. While we leverage them to enhance comparability, richer datasets using component-level digital

indicators across broader groupings would introduce greater variation and may yield stronger statistical significance. However, such an extension would require a more granular classification of agreements based on the depth, timing, and enforceability of digital trade provisions, which is beyond our current scope. Table 4 recaps a detailed description of the actual data used.

Table 4. Data description

Variable		Description	Unit of analysis	Coverage	Source
$ADIIP1_DDS_{it}$		Digital Development Score	index	2021, 2023	World Bank's World Development Indicators [1]
$ADIIP4_DIC_{it}$		Digital Innovation Capacity	score	2011-2024	World Intellectual Property Organization (WIPO) Global Innovation Index (GII) Report[2]
$ADIIP6_FBS_{it}$		Fixed Broadband Subscription	per 100 population	1998-2024	World Bank's World Development Indicators[3]
$RGDPAG_i$		Real GDP Annual Growth	%	1960-2024	World Bank's World Development Indicators[4]
$CABGDP_i$		Current Account Balance	% of GDP	1960-2024	World Bank's World Development Indicators[5]
$DDSTRD_{it}$	$DDSEXP_{it}$	Exports of Digitally Delivered Services	% of total trade in services	2010-2023	UNCTAD Data Hub[6]
	$DDSIMP_{it}$	Imports of Digitally Delivered Services	% of total trade in services	2010-2023	

[1] *https://data360.worldbank.org/en/indicator/ITU_ICT_G5_DIG_DEV*
[2] *https://www.wipo.int/publications/en/series/index.jsp?id=129*
[3] *https://data.worldbank.org/indicator/IT.NET.BBND.P2*
[4] *https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG*
[5] *https://data.worldbank.org/indicator/BN.CAB.XOKA.GD.ZS*
[6] *https://unctadstat.unctad.org/datacentre/dataviewer/US.DigitallyDeliverableServices*

Source: Author's tabulations.

We note that the choice of real GDP growth and current account balance as outcome variables reflects their role as widely used macroeconomic summary indicators in policy analysis. Given our data constraints and focus on cross-economy comparability, we adopt a reduced-form approach that captures the aggregate macroeconomic associations of digital trade participation. Structural growth-accounting variables, such as capital accumulation, augmented human capital, or total factor productivity, are not modelled explicitly but are recognized as important transmission channels through which digital trade may affect long-run growth.

While we recognize that policy discussions increasingly emphasize inclusion, sustainability, and sectoral transformation as outcomes of digital trade, we do not attempt to model these dimensions directly. Doing so requires a distinct theoretical framework and an empirical design that link cross-border e-commerce to poverty reduction, equity, and

sector-specific dynamics in agriculture, manufacturing, and services. Instead, our analysis focuses on how trade in digitally delivered services relates to headline macroeconomic outcomes across economies at different stages of development. These results are intended to motivate, rather than substitute for, deeper structural and distributional analyses.

Empirical analysis. Using a panel-data approach, we rewrite Equation 1 into Equation 4. We estimate an economy-level panel comprising 35 economies observed over two years (2021 and 2023), yielding 70 observations. The unit of observation is the economy-year. Estimation is undertaken using the least-squares dummy variable (LSDV) estimator, which incorporates economy FE to control for unobserved time-invariant heterogeneity across economies and a 2023-time dummy to capture common post-pandemic effects. Thus, the FE specification exploits within-economy variation over time while controlling for persistent cross-country differences.

The regional and global economic blocs (ASEAN, RCEP, BRICS, CPTPP, and G20) are estimated separately rather than jointly. Because several economies belong to more than one regional grouping (e.g., ASEAN and RCEP, or CPTPP and G20), the bloc dummies should be interpreted as descriptive controls representing broad institutional environments rather than mutually exclusive treatment effects. Consequently, differences across blocs may also reflect differences in income levels, market sizes, digital maturity, and country composition, rather than bloc policies.

$$DDSTRD_i = \alpha_0 + \alpha_i \sum_{i=1}^{j} ADIIPX_{it} + \beta_i \sum_{i=1}^{i=kl} DVRGEB_{it} + \gamma_i \sum_{t=2}^{T} DVYEAR_{it} + \varepsilon_{it} \quad (4)$$

Because we have only three variables to capture digital trade enablers and variables for both digitally delivered services exports (DDSEXPit) and digitally delivered services imports (DDSIMPit), we use them both in separate regressions, as shown in Equations 5 and 6.

$$DDSEXP_{it} = \alpha_0 + \alpha_1 ADIIP1_DDS_{it} + \alpha_2 ADIIP4_DIC_{it} + \alpha_3 ADIIP6_FBS_i + \beta_1 ASEAN_{it} + \beta_2 RCEP_{it} + \beta_3 BRICS_{it} + \beta_4 CPTPP_{it} + \beta_5 G20_{it} + \gamma_2 DVYEAR_{i2023} + \varepsilon_{it} \quad (5)$$

$$DDSIMP_{it} = \alpha_0 + \alpha_1 ADIIP1_DDS_i + \alpha_2 ADIIP4_DIC_{it} + \alpha_3 ADIIP6_FBS_i + \beta_1 ASEAN_{it} + \beta_2 RCEP_{it} + \beta_3 BRICS_{it} + \beta_4 CPTPP_{it} + \beta_5 G20_{it} + \gamma_2 DVYEAR_{i2023} + \varepsilon_{it} \quad (6)$$

Likewise, Equation 2 can be rewritten as Equations 7 and 8, while Equation 3 can be rewritten as Equations 9 and 10.

$$RGDPAG_{it} = \beta_0 + \beta_1 \widehat{DDSEXP}_{it} + \varepsilon_i \quad (7)$$

$$RGDPAG_{it} = \beta_0 + \beta_1 \widehat{DDSIMP}_{it} + \varepsilon_i \quad (8)$$

$$CABGDP_{it} = \beta_0 + \beta_1 \widehat{DDSEXP}_{it} + \varepsilon_i \quad (9)$$

$$CABGDP_{it} = \beta_0 + \beta_1 \widehat{DDSIMP}_{it} + \varepsilon_i \quad (10)$$

Note: Independent variables in Equations 7 to 10 represents predicted values of such from Equations 5 and 6.

Preliminary and diagnostic runs guided our empirical specifications. First, the ADII pillars were retained together in the regression. Diagnostic tests confirmed that these variables are not severely multicollinear, with variance inflation factors (VIFs) well below the conventional threshold of 10 (Wooldridge, 2025). Although the pillars are conceptually related, each represents a distinct structural aspect of digital readiness, reducing the risk of overlap while supporting their joint inclusion. Estimating them together is consistent with the ADII's design as complementary and mutually reinforcing dimensions of ASEAN's digital integration strategy (ASEAN Secretariat, 2021). This approach allows the analysis to isolate the marginal contribution of each pillar, controlling for the others, thereby improving policy relevance by identifying specific dimensions of digital integration that strongly influence cross-border e-commerce participation and macroeconomic outcomes.

Second, digitally delivered services exports and imports were not estimated jointly because diagnostic tests indicated severe multicollinearity. This is unsurprising as economies with greater digital trade capacity typically engage actively in both exports and imports (OECD, 2024; World Bank and WTO, 2024). Together, they inflated standard errors, produced unstable coefficient signs, and undermined the reliability of parameter estimates (Wooldridge, 2025; Greene, 2018). To address this, we estimated separate auxiliary regressions, one with exports and another with imports, thus preserving model parsimony and reducing estimation bias. While this entailed some efficiency loss, it avoided misleading inferences arising from multicollinearity and enabled clearer interpretation of the distinct roles of digitally delivered service exports versus imports in shaping macroeconomic development (Hallegatte, 2014; Ndou, 2025). By using a simple and transparent framework, we maximize analytical clarity, robustness, and policy relevance.

Third, regarding potential endogeneity between cross-border e-commerce participation and macroeconomic outcomes, although FE estimation controls for time-invariant heterogeneity, time-varying feedback effects, such as faster-growing economies attracting more digital trade, cannot be fully ruled out. Our short panel structure and limited availability of suitable instruments preclude the use of instrumental variables or dynamic panel methods. Thus, our findings are best viewed as policy-relevant correlations that highlight structural linkages rather than definitive causal estimates.

Standard errors are reported using the conventional variance estimator and are not clustered or bootstrapped. Also, because the second-stage regressions employ predicted values of digitally delivered services, the estimated standard errors should be interpreted conservatively. Given the short panel and limited sample size, bootstrapped standard errors were not feasible. Accordingly, the second-stage estimates are interpreted as policy-relevant associations rather than precise causal estimates.

While our current analysis estimates digital trade enablers to assess their relative marginal effects, it does not impose a formal sequencing structure across constraints. Conceptually, our framework aligns with a diagnostic approach in which different digital enablers may bind at different stages of digital trade development. Thus, estimated coefficients can be interpreted as reduced-form indicators of constraint severity, motivating more explicit hierarchical or diagnostic extensions in future work.

Interpretation of sub-sample regressions and institutional context. Our sub-sample regressions are intended to provide comparative insights across regional and global economic blocs that share partial institutional or policy orientations toward digital trade, rather than to attribute causal effects solely to formal membership. Note that ASEAN, RCEP, CPTPP, BRICS, and G20 differ markedly in terms of the timing, scope, and enforceability of their digital trade-related initiatives.

For instance, ASEAN's digital integration efforts, through the 2019 ASEAN Agreement on Electronic Commerce and DEFA, remain largely cooperation- and capacity-building-oriented, whereas CPTPP incorporates binding digital trade provisions, and RCEP emphasizes trade facilitation and supply-chain integration with more limited digital rule depth. These differences imply that estimated coefficients may reflect varying stages of digital trade policy maturity, implementation capacity, and economic structure rather than uniform group effects. Accordingly, sub-sample results are interpreted cautiously, with attention to within-group heterogeneity and institutional context.

It is also critical to underscore that the sub-sample regressions are interpreted with explicit recognition that each regional and global economic bloc is not a neutral statistical cluster but rather reflects distinct institutional entry conditions, policy depth, and the timing of digital trade commitments. CPTPP membership requires compliance with high-standard provisions on digital trade, data flows, and regulatory coherence, implying a selection effect whereby member economies have already achieved a minimum level of digital readiness prior to accession. Hence, estimated coefficients for CPTPP are expected to exhibit weaker marginal effects and lower statistical variation, not because digital trade is unimportant, but because foundational enablers are largely internalized. Thus, our analysis treats sub-sample estimates as indicative of differential policy transmission channels rather than uniform treatment effects across blocs.

IV. RESULTS AND DISCUSSION

Descriptives. Several patterns stand out in the dataset[4] used. Within ASEAN, digital trade enablers, proxied by ADII pillars, displayed wide variation. Singapore, Malaysia, and Thailand consistently score at the upper end of Pillar 1 (Digital Trade and

[4] Dataset can be requested from the author.

Logistics) and Pillar 6 (Institutional and Infrastructural Readiness), while Cambodia, Lao People's Democratic Republic (PDR), and Myanmar lag significantly, reflecting persistent structural gaps. For Pillar 4 (Digital Skills and Talent), Singapore and the Philippines lead the region, whereas Myanmar and Lao PDR remain in the lower tier.

ASEAN's real GDP growth rates were generally higher than those of advanced economies, with Vietnam and the Philippines registering robust expansion in both 2021 and 2023, while Myanmar experienced contractions reflecting political and structural instability. The share of current account balances in GDP showed a mixed picture. Brunei Darussalam and Singapore recorded persistent surpluses, while Cambodia and the Philippines posted deficits.

Regarding digitally delivered services, ASEAN member states exhibited diverse integration patterns. Thailand, Vietnam, and the Philippines displayed high shares of digitally delivered services exports, consistent with their expanding ICT-enabled services sectors, while Cambodia and Myanmar remained low. Imports of digitally delivered services were similarly heterogeneous, with Singapore and Thailand as regional leaders.

Non-ASEAN RCEP economies showed higher average infrastructure and skills scores, aligning with their more mature digital economies. Among BRICS, India stood out for strong digitally delivered services exports relative to GDP size, while South Africa and Brazil registered moderate integration. Within the CPTPP and G20, advanced economies such as the United States of America, Germany, and the United Kingdom dominated in Pillar 4 (Digital Skills and Talent) and Pillar 6 (Institutional and Infrastructural Readiness), underscoring the digital divide that ASEAN economies continue to face.

To contextualize each regional and global economic bloc, note that ASEAN's digital trade agenda is largely oriented toward narrowing internal development gaps, strengthening digital skills, and building institutional readiness, consistent with its emphasis on inclusivity and capacity-building among heterogeneous member states. In contrast, the RCEP's stronger logistics-related effects reflect its function as a supply-chain-integrating bloc, where digital trade complements manufacturing depth, trade facilitation, and regional production networks. The CPTPP economies, many of which are already digitally advanced, exhibit patterns consistent with innovation- and skills-driven digital trade, reflecting commitments to high-standard digital trade rules and regulatory coherence.

Meanwhile, BRICS outcomes are shaped primarily by domestic market scale and nationally driven digital strategies rather than coordinated regional digital governance, leading to more heterogeneous effects across members. The G20 differs from all other groupings in that its digital trade effects are dominated by scale, institutional maturity, and ecosystem governance rather than marginal gains from liberalization

or connectivity. For these economies, digital trade performance hinges on innovation capacity, regulatory sophistication, and global market reach. Taken together, these differences underscore that bloc membership signals distinct economic functions and policy priorities, rather than a common digital trade template.

We can infer from our descriptives that ASEAN's dual reality is characterized by relatively dynamic GDP growth and rising participation in digitally delivered services trade, but by persistent disparities in skills, infrastructure, and institutional readiness compared to advanced economies. Unlike PRC, most ASEAN members are not yet dominant players in goods-based cross-border e-commerce. Thus, the succeeding discussion on the estimated effects primarily reflects the role of digital services (e.g., platform intermediation, outsourcing, digital business services) in supporting cross-border commercial integration. These gaps frame the central challenge of leveraging digital trade to boost macroeconomic development.

For the interpretation of the empirical estimates, note that because the LSDV estimator absorbs economy-specific intercepts, the coefficients for individual economy dummy variables are not reported in the succeeding regression tables. Accordingly, the reported coefficients represent within-economy estimates after controlling for unobserved time-invariant heterogeneity.

Hypothesis 1. As a precaution, all empirical results should be interpreted as reflecting the macroeconomic relevance of digitally delivered, services-based cross-border e-commerce rather than goods-based online retail.

We begin by examining the determinants of cross-border e-commerce participation, which constitute the core explanatory mechanism of our study. In supporting our first hypothesis that digital trade enablers lead to increased cross-border e-commerce participation, represented by digitally delivered services exports, we refer to our estimates of Equation 5 (table 5).

Full sample. Digital Skills and Talent (ADIIP4) emerged as the strongest positive predictor of digitally delivered services exports. This underscored the role of human capital in enabling economies to scale these services trade, echoing findings in WTO (2024) and UNCTAD (2019) that skills are the critical bottleneck in cross-border e-commerce participation. Moreover, Digital Trade and Logistics (ADIIP1) has a positive and significant effect, suggesting that efficient trade facilitation and logistics ecosystems matter, though the effect is smaller than skills. This is consistent with Smeets (2021) and Sonobe et al. (2024) that efficient logistics and trade facilitation are prerequisites for scaling e-commerce. In contrast, Institutional and Infrastructural Readiness (ADIIP6) showed a significant negative association, which likely reflects a saturation or substitution effect. Economies with very high broadband penetration may already be advanced digitally, and their digitally delivered services export expansion depends more on innovation or global demand than on access infrastructure, per se. This counterintuitive result is consistent with

Beirne and Fernandez (2020), who noted that infrastructure alone is insufficient unless matched with institutional readiness and complementary innovation policies. The 2023 dummy was strongly negative, suggesting a contraction in digitally delivered services exports across most economies, possibly reflecting global headwinds to post-pandemic digital trade growth. This echoed Sefrina (2024), who identified uneven digital recovery trajectories across ASEAN and its partners.

Table 5. Analysis of the impact of digital trade enablers on Cross-border e-commerce participation (digitally delivered services exports)

$DDSEXP_{it}$	All countries		ASEAN	RCEP	BRICS	CPTPP	G20
$ADIIP1_DDS_{it}$	0.9904** (0.4771)	0.8706 (0.5361)	2.2506** (0.8347)	1.2452* (0.6785)	1.7653 (1.6771)	0.5636 (0.7826)	-0.1756 (1.0637)
$ADIIP4_DIC_{it}$	1.6050*** (0.2731)	1.4620*** (0.2852)	0.6819 (0.5821)	1.2074** (0.4696)	2.2330* (1.0535)	1.4571*** (0.3619)	1.6093*** (0.3518)
$ADIIP6_FBS_{it}$	-0.8985*** (0.2313)	-0.8707*** (0.2599)	-0.6644 (0.6331)	-0.8352** (0.3715)	-1.4776** (0.5249)	-0.3239 (0.4050)	-1.0640*** (0.2859)
D_2023_{it}	-11.3726*** (3.9137)	-11.2073*** (3.8189)	-28.2408*** (7.9854)	-17.2790*** (5.8217)	-7.7392 (8.6741)	-14.1549** (5.4572)	-6.6434 (5.3153)
D_ASEAN_{it}		12.7589 (7.9762)					
D_RCEP_{it}		-5.1776 (5.9345)					
D_BRICS_{it}		-0.4679 (5.0666)					
D_CPTPP_{it}		1.8788 (4.2874)					
D_G20_{it}		15.3798*** (4.8679)					
nT	70	70	20	30	20	24	38
Prob > F	0.0000	0.0000	0.0007	0.0001	0.0087	0.0001	0.0008
R^2	0.5476	0.6197	0.7017	0.6085	0.5751	0.6949	0.4268

** Significant at the 10%; ** Significant at the 5%' *** Significant at the 1%; ( ) standard error.*
Source: Author's calculations.

ASEAN subsample. In ASEAN, where digital trade cooperation is still evolving, results mirrored global trends but with sharper contrasts. Digital Skills and Talent (ADIIP4) again dominated, reinforcing the importance of workforce upskilling in the region's export competitiveness (ASEAN Secretariat, 2021). While Digital Trade and Logistics has the expected positive sign, it is not statistically significant, suggesting that ASEAN still struggles with uneven trade facilitation and logistics capabilities relative to advanced economies (ADB, 2023). Institutional and Infrastructural Readiness again showed a negative and significant effect, consistent with UNESCAP (2022), which noted that in ASEAN, access is no longer the main barrier but rather, affordability, quality, and digital literacy. This also reinforced the notion that in ASEAN, inclusion through connectivity must be complemented by institutional and innovation capacity to translate into trade competitiveness

(Zhang et al., 2025). The 2023 dummy was again strongly negative, pointing to regional vulnerabilities in sustaining digital service exports during the global digital slowdown. The ASEAN dummy itself was positive but insignificant, suggesting that while ASEAN economies may have latent advantages (e.g., young workforce, services outsourcing niches), these are not yet robustly capitalized upon. It is also possible that ASEAN's vulnerability to global shocks stems from weaker innovation ecosystems, leaving the region more exposed (Sempena and Sitorus, 2025).

Cross-regional and global economic blocs subsample comparisons. The RCEP economies, where supply-chain integration predates digital rulemaking, showed the strongest Digital Trade and Logistics effect, reflecting their superior trade facilitation systems (e.g., Japan, Republic of Korea, PRC) where logistics efficiency amplifies digitally delivered services exports (Sonobe et al., 2024; OECD, 2024; ADB, 2023). BRICS, where digital trade outcomes are shaped more by domestic market scale and national digital strategies than by shared regional rules, reflected a balanced pattern, where both logistics and skills matter significantly, supporting Chen et al. (2024) that digital exports in emerging economies require parallel advances in physical trade systems and human capital. Among the CPTPP members, where binding digital trade provisions were adopted earlier, results highlighted the primacy of skills, consistent with the bloc's digital trade provisions that stress innovation and workforce readiness (Smeets, 2021).

Finally, in the G20, where binding digital trade provisions were also adopted earlier, results resembled the global baseline, in which skills are highly significant, broadband remains negative, and the G20 dummy is strongly positive, reflecting structural scale advantages and policy coherence among the world's largest economies (Beirne and Fernandez, 2020). Note that the weak or negative coefficient on broadband infrastructure should not be interpreted as evidence that infrastructure is unimportant for cross-border e-commerce. Instead, it reflects a threshold effect. Once basic connectivity is achieved, additional gains in participation in digitally delivered services depend less on access and more on complementary factors such as digital skills, institutional quality, and regulatory coherence. This is consistent with the services-oriented nature of digitally delivered services, where human capital and organizational capability are the binding constraints rather than physical connectivity alone.

Overall, results suggested that skills upgrading is the most binding constraint for ASEAN, logistics efficiency is critical for the RCEP economies, and scale effects dominate in G20 members. Broadband penetration by itself does not guarantee stronger digital exports. Its effect is conditional on the presence of innovation capacity and institutional readiness (ASEAN Secretariat, 2021; Zhang et al., 2025).

In supporting our first hypothesis that digital trade enablers lead to increased cross-border e-commerce participation, represented by digitally delivered services imports, we estimated Equation 6 (table 6).

Table 6. Analysis of the impact of digital trade enablers on cross-border e-commerce participation (digitally delivered services imports)

$DDSIMP_{it}$	All countries		ASEAN	RCEP	BRICS	CPTPP	G20
$ADIIP1_DDS_{it}$	1.2843*** (0.3831)	1.4363*** (0.4207)	2.5553*** (0.7913)	2.2140*** (0.6627)	1.0513 (1.6697)	1.2801* (0.7013)	-1.0893 (0.7466)
$ADIIP4_DIC_{it}$	0.5766** (0.2193)	0.3193 (0.2238)	0.1477 (0.5519)	0.3135 (0.4587)	1.0374 (1.0489)	0.4176 (0.3243)	0.5535** (0.2469)
$ADIIP6_FBS_{it}$	-0.2542 (0.1857)	-.2255864 (.2039433)	-0.5477 (0.6002)	-0.4919 (0.3629)	-0.4189 (0.5226)	0.0412 (0.3630)	-0.2750 (0.2006)
D_2023_{it}	-10.5206*** (3.1426)	-11.0719*** (2.9964)	-18.3243** (7.5705)	-14.7991** (5.6864)	-11.0685 (8.6361)	-11.8217** (4.8907)	-8.4516** (3.7309)
D_ASEAN_{it}		9.7918 (6.2583)					
D_RCEP_{it}		-1.1792 (4.6563)					
D_BRICS_{it}		-1.4885 (3.9754)					
D_CPTPP_{it}		7.5914** (3.3640)					
D_G20_{it}		12.4158*** (3.8195)					
nT	70	70	20	30	20	24	38
Prob > F	0.0000	0.0000	0.0051	0.0006	0.1785	0.0077	0.0115
R^2	0.4601	0.5667	0.6066	0.5294	0.3261	0.5021	0.3173

** Significant at the 10%; ** Significant at the 5%' *** Significant at the 1%; ( ) standard error.*
Source: Author's calculations.

Full sample. Digital Trade and Logistics (ADIIP1) was the strongest and most consistent determinant of imports of digitally delivered services. This suggested that the ease of cross-border flows and efficient logistics infrastructure directly shape import demand for digitally delivered services; this is also consistent with Smeets (2021) and Sonobe et al. (2024), who emphasized trade facilitation as central to digital integration. Digital Skills and Talent (ADIIP4) was positive and significant, highlighting that absorptive capacity matters. That is, economies with stronger human capital can better utilize imported digital services (Ing et al., 2023; ASEAN Secretariat, 2021). By contrast, Institutional and Infrastructural Readiness (ADIIP6) was negative but insignificant, echoing Beirne and Fernandez (2020), who stressed that connectivity alone does not translate into effective digital trade unless coupled with institutional and innovation capacity. Finally, the 2023 dummy was negative and significant, pointing to a contraction in digitally delivered services imports across the sample, consistent with Sefrina (2024), as noted on uneven post-pandemic adjustments.

ASEAN subsample. Digital Trade and Logistics (ADIIP1) emerged as the most important driver of digitally delivered services imports, while Digital Skills and Talent (ADIIP4) were positive but insignificant. Thus, for ASEAN, the biggest constraint is not in human capital

but in the efficiency of trade and logistics networks, consistent with ASEAN Secretariat (2021) and Ing et al. (2023). Institutional and Infrastructural Readiness (ADIIP6) again showed a negative, insignificant effect, indicating that infrastructure expansion alone does not ensure greater digital trade utilization (Zhang et al., 2025). The 2023 dummy was strongly negative, underscoring ASEAN's heightened vulnerability to shocks in the global digital economy relative to advanced economies.

Cross-regional and global economic blocs subsample comparisons. Clear differences emerged in what drives imports of digitally delivered services. In ASEAN, the strongest determinant is Digital Trade and Logistics (ADIIP1), reflecting the region's reliance on efficient cross-border flows and trade facilitation to support e-commerce (ASEAN Secretariat, 2021; Ing et al., 2023). In the RCEP, the coefficient on logistics was also significant, underscoring how the bloc's deeper supply-chain integration and digital trade commitments amplify the role of logistics in shaping digitally delivered services imports (Sonobe et al., 2024). Among BRICS, both Digital Trade and Logistics (ADIIP1) and Digital Skills and Talent (ADIIP4) mattered, consistent with Chen et al. (2024), who noted that emerging economies require improvements in both infrastructure and absorptive capacity to fully leverage digital trade.

For the CPTPP, the effects were weaker and less consistent, likely reflecting heterogeneity among members with advanced and developing economies, though the positive sign on Digital Skills and Talent (ADIIP4) aligned with Smeets (2021) on the bloc's innovation focus. Finally, in the G20, Digital Skills and Talent (ADIIP4) were the significant driver rather than Digital Trade and Logistics (ADIIP1), highlighting that for advanced economies, human capital and innovation capacity were the binding constraints (Beirne and Fernandez, 2020). These patterns suggested that while ASEAN and RCEP must prioritize strengthening logistics and connectivity, G20 economies demonstrated that long-term sustainability of digital trade rests on building skills and talent to absorb and scale digital services.

Across all samples, Digital Trade and Logistics (ADIIP1) dominated in ASEAN and RCEP, while Digital Skills and Talent (ADIIP4) mattered more in G20 and the global sample. The negative but insignificant effect of Institutional and Infrastructural Readiness (ADIIP6) indicated that digital inclusion policies must go beyond access toward ecosystem strengthening (ASEAN Secretariat, 2021; Zhang et al., 2025). The consistent 2023 contraction effect highlighted systemic vulnerabilities in global trade in digitally delivered services post-COVID recovery (Sefrina, 2024).

Key implication. Hypothesis 1 was supported by our regression results. Stronger digital trade enablers are linked to greater cross-border e-commerce participation. For digitally delivered services exports, Digital Skills and Talent (ADIIP4) are the binding constraint, while for digitally delivered services imports, Digital Trade and Logistics (ADIIP1) dominate. Institutional and Infrastructural Readiness (ADIIP6) alone does not guarantee trade

gains, underscoring the need for complementary institutional and innovation capacity. ASEAN's gaps in logistics and institutional readiness contrast with G20 economies, where skills and absorptive capacity matter most, highlighting differentiated policy priorities.

Hypothesis 2. We then assess whether cross-border e-commerce participation translates into measurable macroeconomic outcomes, thereby supporting the economic relevance of digital trade integration. In providing evidence for our second hypothesis that increased cross-border e-commerce participation contributes positively to macroeconomic development, we estimated Equations 7 and 8 (tables 7 and 8, respectively). Importantly, our second-stage estimates capture the macroeconomic relevance of digitally delivered services rather than goods-based cross-border e-commerce, explaining why the results are economically meaningful for ASEAN economies despite their limited participation in large-scale cross-border e-commerce in goods.

Table 7. Analysis of the impact of cross-border e-commerce participation (exports) on macroeconomic development (real GDP growth)

$RGDPAG_{it}$	All countries		ASEAN	RCEP	BRICS	CPTPP	G20
$\widehat{DDSEXP}_{it}$	0.0590** (0.0264)	0.0774** (0.0337)	0.1397*** (0.0453)	0.1311*** (0.0408)	0.0409 (0.0261)	0.0226 (0.0437)	0.0271 (0.0364)
D_2023_{it}	-1.8046 (0.8703)	-1.5974* (0.8952)	4.0855** (1.7580)	2.3605* (1.3149)	-0.0977 (0.9445)	-3.4568** (1.4962)	-3.6457*** (0.9014)
D_ASEAN_{it}		-1.4015 (1.5700)					
D_RCEP_{it}		-1.2326 (1.2522)					
D_BRICS_{it}		0.5404 (0.9946)					
D_CPTPP_{it}		-0.4166 (0.9938)					
D_G20_{it}		-1.8949 (1.3489)					
nT	70	70	20	30	20	24	38
Prob > F	0.0017	0.0102	0.0170	0.0121	0.2876	0.0332	0.0002
R^2	0.1740	0.2488	0.3810	0.2789	0.1364	0.2770	0.3814

** Significant at the 10%; ** Significant at the 5%' *** Significant at the 1%; ( ) standard error.*
Source: Author's calculations

Full sample. Digitally delivered services exports exerted a positive, statistically significant effect on real GDP growth, suggesting that greater engagement in cross-border e-commerce via these exports supported macroeconomic expansion. This is consistent with Ing et al. (2023) and WTO (2023), which highlighted services trade as an engine of productivity and innovation-led growth.

ASEAN subsample. The effect of digitally delivered services exports was stronger, underscoring the region's reliance on digitally intensive trade to drive output. This aligns with ASEAN Secretariat (2021), which deemed cross-border e-commerce as a growth

catalyst for emerging AMS markets. However, the 2023 dummy was significantly negative, indicating that post-pandemic global shocks reduced the momentum of growth in digitally delivered services, one again in keeping Sefrina (2024) on ASEAN's uneven recovery.

Cross-regional and global economic blocs comparisons. The RCEP displayed even stronger effects reflecting how integration into regional and global value chains amplifies digital trade's growth impact (Sonobe et al., 2024; Chen et al., 2024). By contrast, BRICS, CPTPP, and G20 results were weaker and insignificant, suggesting that in advanced economies the marginal growth effect of digital exports was lower, possibly due to already high digital trade penetration and diminishing returns (Beirne and Fernandez, 2020). The 2023 dummy was positive for RCEP and BRICS, implying resilience in emerging economies, while strongly negative for G20, consistent with OECD (2024) findings that advanced economies experienced sharper slowdowns in global digital trade demand.

Table 8. Analysis of the impact of cross-border e-commerce participation (exports) on macroeconomic development (current account balance performance)

$CABGDP_{it}$	All countries		ASEAN	RCEP	BRICS	CPTPP	G20
$\widehat{DDSEXP}_{it}$	0.0818*	0.0923	0.1779	0.1791	0.0176	0.0476	-0.0470
	(0.0484)	(0.0629)	(0.1305)	(0.1060)	(0.0598)	(0.0962)	(0.0380)
D_2023_{it}	1.1409	1.2591	6.5361	4.3693	-1.0028	0.9926	-2.0728**
	(1.5936)	(1.6718)	(5.0593)	(3.4162)	(2.1621)	(3.2904)	(0.9417)
D_ASEAN_{it}		2.2947					
		(2.9320)					
D_RCEP_{it}		-0.2363					
		(2.3384)					
D_BRICS_{it}		2.1844					
		(1.8575)					
D_CPTPP_{it}		2.1254					
		(1.8559)					
D_G20_{it}		-0.6196					
		(2.5192)					
nT	70	70	20	30	20	24	38
Prob > F	0.2440	0.5060	0.3254	0.2234	0.8268	0.8809	0.0925
R^2	0.0412	0.0930	0.1237	0.1051	0.0221	0.0120	0.1272

** Significant at the 10%; ** Significant at the 5%' *** Significant at the 1%; ( ) standard error.*
Source: Author's calculations.

Full sample. Results were more muted. While digitally delivered services exports were weakly positive, the effect was not as robust as with real GDP growth. This indicated that while digitally delivered services exports supported growth, their impact on external balances was less systematic, echoing Beirne and Fernandez (2020) who argued that digital trade's contribution to current account depends heavily on structural competitiveness and sectoral composition.

ASEAN subsample. The effect was positive but insignificant, suggesting limited short-

run effects on current account sustainability. This is consistent with UNESCAP (2022), which noted that ASEAN's digital exports are still concentrated in low-value segments, limiting their contribution to external surplus.

Cross-regional and global economic blocs comparisons. Among the RCEP, BRICS, and CPTPP, coefficients were positive but insignificant, indicating potential benefits for external stability that have not yet materialized. In contrast, the G20 showed a negative coefficient, though insignificant, implying that in advanced economies, digital trade integration may be offset by high import demand for digital services (OECD, 2024). The 2023 dummy was negative and significant for G20, suggesting that external positions of advanced economies deteriorated further during the global digital demand slowdown.

Furthermore, in providing empirical support to our second hypothesis that increased cross-border e-commerce participation contributes positively to macroeconomic development, we estimated Equations 9 and 10 (tables 9 and 10, respectively).

Table 9. Analysis of the impact of cross-border e-commerce participation (imports) on macroeconomic development (real GDP growth)

$RGDPAG_{it}$	All countries		ASEAN	RCEP	BRICS	CPTPP	G20
$\widehat{DDSIMP}_{it}$	0.1055*** (0.0390)	0.1636*** (0.0575)	0.1684*** (0.0525)	0.1582*** (0.0441)	0.0371 (0.0519)	0.0694 (0.0738)	0.0296 (0.0987)
D_2023_{it}	-1.6098* (0.8654)	-1.1358 (0.9221)	2.5943 (1.5626)	1.6658 (1.1820)	-0.0381 (1.1190)	-3.1330 (1.5055)	-3.5619** (1.3560)
D_ASEAN_{it}		-1.3039 (1.5240)					
D_RCEP_{it}		-1.1893 (1.2269)					
D_BRICS_{it}		0.7351 (0.9789)					
D_CPTPP_{it}		-1.6273 (1.1412)					
D_G20_{it}		-2.8946* (1.4592)					
nT	70	70	20	30	20	24	38
Prob > F	0.0006	0.0037	0.0132	0.0050	0.7046	0.0246	0.0003
R^2	0.1998	0.2791	0.3991	0.3245	0.0404	0.2974	0.3732

** Significant at the 10%; ** Significant at the 5%' *** Significant at the 1%; ( ) standard error.*
Source: Author's calculations.

Full sample. Digitally delivered services imports were a strong and positive determinant of real GDP growth, suggesting that greater reliance on foreign digitally delivered services supports productivity and innovation spillovers that translate into macroeconomic expansion. This is consistent with Ing et al. (2023) and WTO (2023), which stressed the role of digital imports in upgrading capabilities and accelerating growth through technology transfer.

ASEAN subsample. The effect was even larger, reinforcing the region's dependence

on imported digital services (e.g., cloud computing, financial technology, and business process platforms) to sustain growth. This echoed ASEAN Secretariat (2021), which emphasized that imports of digital solutions help bridge domestic gaps in skills and infrastructure. The 2023 dummy was negative but insignificant, indicating that while ASEAN experienced some slowdown, its growth, linked to digitally delivered services imports, remained resilient compared to that of advanced economies.

Cross-regional and global economic blocs comparisons. The RCEP displayed similar strong effects, showing that in emerging and regionally integrated economies, digital imports were a critical growth channel. By contrast, BRICS, CPTPP, and G20 effects were insignificant and of lower magnitude, suggesting that for advanced economies, digitally delivered services imports may already be saturated or offset by strong domestic digital industries. Notably, the 2023 dummy was mostly insignificant, highlighting how global demand shocks disproportionately hurt advanced economies (OECD, 2024; Sefrina, 2024).

Table 10. Analysis of the impact of cross-border e-commerce participation (imports) on macroeconomic development (current account balance performance)

$CABGDP_{it}$	All countries		ASEAN	RCEP	BRICS	CPTPP	G20
$\widehat{DDSIMP}_{it}$	0.1288* (0.0724)	0.2003* (0.1085)	0.1479 (0.1575)	0.1366 (0.1218)	0.1530 (0.1068)	-0.1009 (0.1641)	-0.1237 (0.1026)
D_2023_{it}	1.2700 (1.6065)	1.8520 (1.7408)	4.2147 (4.6874)	2.7896 (3.2612)	0.4993 (2.3014)	-0.6398 (3.3479)	-2.9929** (1.4087)
D_ASEAN_{it}		2.3921 (2.8772)					
D_RCEP_{it}		-0.1814 (2.3163)					
D_BRICS_{it}		2.4258 (1.8482)					
D_CPTPP_{it}		0.6224 (2.1544)					
D_G20_{it}		-1.9082 (2.7549)					
nT	70	70	20	30	20	24	38
Prob > F	0.2103	0.3746	0.5116	0.4688	0.3279	0.8248	0.0957
R^2	0.0455	0.1105	0.0758	0.0546	0.1229	0.0182	0.1255

* Significant at the 10%; ** Significant at the 5%' *** Significant at the 1%; ( ) standard error.
Source: Author's calculations.

Full sample. The effect of digitally delivered services imports on current account balance performance was weaker and only marginally significant, suggesting some positive association but less robust than with economic growth. As Beirne and Fernandez (2020) noted, imports can initially widen external imbalances unless complemented by export capacity, and benefits may accrue more through productivity channels than external stability.

ASEAN subsample. For ASEAN, the coefficient was stronger, indicating that imports of digital services can likely improve external positions by enhancing export competitiveness of goods and services through better digital inputs (ASEAN Secretariat, 2021). However, significance remained marginal, reflecting structural asymmetries in ASEAN's trade balance.

Cross-regional and global economic blocs comparisons. RCEP and BRICS both showed positive but insignificant coefficients, again implying potential but not robust effects. CPTPP and G20 also show negative but insignificant results, which may reflect heterogeneity among members. It may also suggest that, in advanced economies, a high reliance on imported digitally delivered services could weigh on current accounts. The 2023 dummy was negative and insignificant, showing resilience of external balances.

Key implication. Hypothesis 2, that cross-border e-commerce participation through digitally delivered services exports supports macroeconomic development, was more strongly supported by GDP growth than by current account balance performance. For ASEAN and other emerging blocs, digitally delivered services exports significantly accelerated economic growth, though external balance effects remained modest. By contrast, advanced economies showed weaker growth dividends and, in some cases, external vulnerabilities, reflecting diminishing returns to digital trade in already saturated markets.

Hypothesis 2, that cross-border e-commerce participation via digitally delivered services imports contributes to macroeconomic development, was supported robustly for GDP growth but only weakly for current account balance performance. For ASEAN and other emerging blocs, digitally delivered services imports were a key driver of growth, supporting catch-up dynamics and technology transfer, while effects on external stability remained tentative. In contrast, advanced economies gained less from digital imports in terms of growth, and in some cases face external vulnerabilities.

We can construe from our results that digital exports drive outward competitiveness, while digital imports sustain absorptive capacity. Both are especially critical for economies still consolidating their digital transformations, whereas advanced economies face different challenges, such as optimizing efficiency, ensuring inclusivity, and managing structural vulnerabilities.

Differences across sub-sample estimates are consistent with the timing, depth, and policy orientation of collective digital trade initiatives across regional and global economic blocs. Advanced regional and global economic blocs, such as the CPTPP and the G20, which adopted comprehensive digital trade and digital economy provisions earlier, tend to exhibit stronger associations between digital skills and cross-border e-commerce outcomes, reflecting more mature and institutionalized digital ecosystems. Coefficient estimates for these groups are weaker and less stable overall, which likely reflects limited cross-economy variation after foundational stages of digital infrastructure deployment, regulatory harmonization, and skills development have largely been completed. As such, marginal changes in trade in digitally delivered services are less likely to generate size-

able macroeconomic effects.

By contrast, ASEAN, RCEP, and BRICS economies display stronger and more consistent relationships between cross-border e-commerce participation and trade facilitation or logistics-related enablers, aligning with their current policy emphasis on interoperability, supply-chain efficiency, and institutional upgrading rather than binding digital rules. These suggest that digital trade enablers operate through different transmission channels depending on policy maturity and institutional readiness, underscoring the need to interpret sub-sample results as reflecting differences in policy function and development stage rather than policy effectiveness or failure across blocs.

The comparatively weaker and less stable estimates for the CPTPP should be interpreted considering the agreement's high-standard design. The CPTPP economies are characterized by advanced regulatory frameworks, mature digital infrastructure, and deep market integration, which compress cross-country variation in key digital trade enablers. Consequently, regressions using aggregate cross-border e-commerce indicators are less likely to capture sizeable marginal effects. This contrasts with ASEAN and RCEP economies, where heterogeneity in institutional readiness and logistics performance remains substantial, allowing digital trade participation to play a more pronounced developmental role. Thus, the findings reflect differences in policy maturity and sequencing rather than differences in policy effectiveness.

A salient finding from our sub-sample analysis is that regional and global economic groupings should not be treated as pursuing a uniform digital trade agenda. While regional and global economic blocs are often collectively described as facilitating and liberalizing digital trade, our empirical results suggest functional differentiation across them. Each regional and global economic bloc appears to address distinct economic constraints and structural priorities, shaped by differences in membership composition, institutional design, and development stage. Hence, the estimated effects of digital trade enablers reflect not a single liberalization model, but multiple pathways through which digital trade supports economic objectives.

IV. CONCLUSIONS AND RECOMMENDATIONS

We examined whether digital trade enablers strengthen ASEAN's cross-border e-commerce participation and whether such participation contributes to macroeconomic development. Using FE panel regression analysis of the components of the ADII rather than the aggregate index, we provided empirical evidence in support of our two hypotheses. First, cross-border e-commerce participation, through digitally delivered services exports and imports, is positively shaped by distinct digital enablers, with Digital Skills and Talent (ADIIP4) emerging as the most critical driver for exports and Digital Trade and Logistics (ADIIP1) as the strongest determinant for imports. Second, cross-border e-commerce participation contributes significantly to macroeconomic development, particularly in real GDP growth, though its impact on current account balances is more modest and uneven across regional and global economic blocs. Thus, our objectives

have been addressed. Cross-border e-commerce enablers indeed support participation, and participation in turn enhances macroeconomic development. Effects vary between advanced and emerging economies.

Results underscored three broad insights. For ASEAN, the RCEP, and BRICS, digitally delivered services exports and imports are clear growth drivers, highlighting the importance of catching up in skills and trade facilitation. For advanced blocs such as the CPTPP and the G20, effects are weaker or mixed, suggesting diminishing returns to digital trade in already saturated markets. The negative or insignificant role of Institutional and Infrastructural Readiness (ADIIP6) further suggested that access alone does not translate into trade gains unless complemented by institutional readiness, ecosystem trust, and innovation capacity. These findings highlight the need for disaggregating the ADII into its underlying components, as the aggregate index may mask the differentiated and sometimes contradictory effects of skills, logistics, and infrastructure on cross-border e-commerce participation.

From a policy standpoint, our results suggested three specific policy recommendations for ASEAN:

1. **Prioritize regional digital skills development,** as human capital has proven to be the strongest driver of cross-border e-commerce participation and macroeconomic growth. This requires harmonizing digital competency standards across AMS, scaling up training partnerships with universities and private technology firms, and setting measurable targets, such as certifying millions of digitally skilled workers. Lessons from the CPTPP show that innovation-driven workforce development translates directly into competitiveness, and ASEAN may follow suit.

2. **Accelerate logistics integration and digital trade facilitation, since trade and logistics efficiency emerged as a critical determinant of both exports and imports of digitally delivered services.** This entails deepening the ASEAN Single Window, implementing fully interoperable e-customs and cross-border payment systems, and creating a regional digital trade facilitation scorecard to benchmark progress and enforce accountability, like RCEP's successful supply-chain integration mechanisms.

3. **Move beyond simply expanding broadband coverage toward ecosystem strengthening, as infrastructure alone did not guarantee positive outcomes in the analysis.** Instead, investments should focus on digital public infrastructure (e.g., interoperable e-identification systems, secure data exchange frameworks, and robust consumer protection regimes) that build affordability, trust, and cross-border e-commerce inclusion. Drawing from G20 economies, where ecosystem governance rather than mere connectivity drives sustainable digital trade, ASEAN could also establish a regional digital inclusion fund to reduce rural-urban digital divides. Together, these actions provide a concrete pathway for ASEAN to turn cross-border e-commerce into both a growth engine and a development strategy while addressing the structural asymmetries highlighted in this study.

We caution against across-the-board prescriptions that treat digital trade liberalization as a homogeneous policy objective across regional and global economic blocs. Instead, effective digital trade strategies must be aligned with each regional and global economic bloc's functional role and binding constraints. For ASEAN, this implies prioritizing digital skills upgrading and ecosystem governance; for the RCEP, logistics interoperability and trade facilitation; and for the CPTPP, BRICS, and G20, sustaining innovation capacity rather than expanding basic connectivity. Thus, policy learning across regional and global economic blocs is most productive when it is selective and function-specific rather than based on wholesale emulation.

For future research, it is necessary to incorporate socioeconomic and inclusivity variables, such as poverty, inequality, gender, rural participation, and MSME penetration, to assess whether cross-border e-commerce-driven growth is broad-based. Also, our analysis can be extended in several critical ways:

1. Continuously exploit the underlying component indicators used to construct the ADII and its six pillars.

2. Incorporate industry-level data on digitally delivered services and link these to sectoral GDP performance in agriculture, manufacturing, and services, thereby testing how digital trade operates as a transmission channel within global value chains.

3. Utilize improved and more granular data, particularly firm-level, transaction-level, or sector-specific datasets, to refine understanding of how cross-border e-commerce participation interacts with macroeconomic development in heterogeneous contexts.

4. Extend our analysis beyond aggregate macroeconomic indicators to incorporate outcomes related to inclusion, sustainability, and structural transformation, as emphasized in recent development policy literature.

5. Extend our analysis by embedding digital trade more explicitly within a growth-accounting framework.

6. Explore the application of hierarchical regression techniques (Rodrik, 2010) to identify binding constraints in digital trade development.

With respect to SDGs 8, 9, and 10, we position digital trade in services as a mechanism for inclusive growth and economic resilience. By identifying which digital enablers matter most for cross-border e-commerce participation and macroeconomic outcomes, we contributed evidence on how digitalization can support productivity growth while widening access to cross-border economic opportunities.

We confirm that cross-border e-commerce participation, supported by targeted digital enablers, can be a transformative lever for ASEAN's growth and resilience. Yet, the pathway is not automatic as it requires deliberate policies that build human capital, strength-

en trade logistics, and ensure conducive digital ecosystems. By learning from the differentiated experiences of RCEP, BRICS, CPTPP, and G20, ASEAN can accelerate its transition toward a digitally integrated, resilient, and inclusive economic future.

Note on Author

John Paolo R. Rivera is a Senior Research Fellow at the Philippine Institute for Development Studies and a Visiting Research Fellow at Ritsumeikan Asia Pacific University in Japan. His research interests include macroeconomics, tourism development, trade, and industrial development. He has extensive teaching experience across undergraduate, graduate, and executive education programs. In 2024, he was recognized by the National Academy of Science and Technology, Philippines, as the Outstanding Young Scientist in Economics.

REFERENCES

ASEAN Secretariat (2021). ASEAN Digital Integration Index Report 2021. Jakarta: ASEAN Secretariat. Available at https://asean.org/wp-content/uploads/2021/09/ADII-Report-2021.pdf.

Asian Development Bank (2023). E-commerce Evolution in Asia and the Pacific: Opportunities and Challenges. Manila: Asian Development Bank.

Beirne, John, and D.G. Fernandez, eds. (2020). Macroeconomic Stabilization in the Digital Age. Tokyo: Asian Development Bank Institute.

Camarero, Mariam, J. Carrion-i-Silvestre, and C. Tamarit (2025). Current account determinants in a globalized world. Empirical Economics, vol. 68, pp. 1497–1527.

Carlos, Jose Carlo T., J.J.P. Katigbak, and J.A.V. Bacasmas (2022). Analysis of the cross-border e-commerce environment for Philippine women-led MSMEs: challenges and opportunities. PIDS Discussion Paper Series No. 2022-40. Quezon City: Philippine Institute for Development Studies.

Chadha, Sandhya (2023). How Southeast Asia can become a $1 trillion digital economy. World Economic Forum, 12 December. Available at https://www.weforum.org/stories/2023/12/how-southeast-asia-can-become-trillion-digital-economy/.

Chen, Jiaming, and Z. Xu (2024). The impact of the digital divide on labor mobility and sustainable development in the digital economy. Sustainability, vol. 16, No. 22, p. 9944.

Chen, Kun, S. Luo, and D.Y. Kin tong (2024). Cross-border e-commerce development and enterprise digital technology innovation: empirical evidence from listed companies in China. Heliyon, vol. 10, No. 15, e34744.

Chen, Lurong, and F. Kimura, eds. (2020). E-commerce Connectivity in ASEAN. Jakarta: Economic Research Institute for ASEAN and East Asia.

Chen, Yujie, Q. Wang, and J. Zhang (2025). The role of cross-border e-commerce platforms in the digital economy: empowering firms to gain global market insights to increase global competitiveness. Journal of Digital Management, vol. 1, No. 4.

Cuenca, Janet S. (2021). Emerging tax issues in the digital economy. Discussion Paper Series No. 2021-08. Quezon City: Philippine Institute for Development Studies.

Digital Cooperation Organization (2023). Developing interoperability mechanisms to enable cross-border data flows. Policy Brief. Riyadh: Digital Cooperation Organization.

Ding, Fei, J. Huo, and J.K. Campos (2017). The development of cross-border e-commerce. Advances in Economics, Business and Management Research, vol. 37, pp. 370–383.

Duarte, Margarida P., and F.M. de Oliveira Carvalho (2025). The measurement of innovation: a systematic review and bibliometric analysis of Global Innovation Index research. Publications, vol. 13, No. 3, p. 31.

Feng, Pu, X. Zhou, D. Zhang, Z. Chen, and S. Wang (2022). The impact of trade policy on global supply chain network equilibrium: a new perspective of product-market chain competition. Omega, vol. 109, p. 102612.

Fuentes, Angelica (2024). Philippine digital economy posts fastest growth in SE Asia: study. ABS-CBN News, 27 November. Available at https://www.abs-cbn.com/news/business/2024/11/27/philippine-digital-economy-posts-fastest-growth-in-se-asia-study-1807.

Google, Temasek, and Bain and Company (2023). e-Conomy SEA 2023: Southeast Asia's Digital Economy Research Programme. Available at https://www.temasek.com.sg/content/

dam/temasek-corporate/news-and-views/resources/reports/google-temasek-bain-economy-sea-2023-report.pdf.

Greene, William H. (2018). Econometric Analysis, 8th ed. New York: Pearson.

Hallegatte, Stéphane (2014). Economic resilience: definition and measurement. Policy Research Working Paper No. 6852. Washington, D.C.: The World Bank.

Hariyani, Deepak, P. Hariyani, and S. Mishra (2025). Digital technologies for the Sustainable Development Goals. Green Technologies and Sustainability, vol. 3, No. 3, p. 100202.

Herman, Peter R., and S. Oliver (2023). Trade, policy, and economic development in the digital economy. Journal of Development Economics, vol. 164, p. 103135.

Hijanto, Michael (2020). Assessing the impact of COVID-19 on Lazada, Shopee, and Tokopedia in 2020. Medium, 7 May. Available at https://medium.com/m2-insights/assessing-the-impact-of-covid-19-on-lazada-shopee-and-tokopedia-in-2020-m2-insights-ddc5c69f1e11.

Houngbonon, Georges V., and O. Mothobi (2025). Digital trade and development. GW Competition and Innovation Lab Working Paper Series No. 2025/06. Washington, D.C.: George Washington University.

Ing, Lili Yan, Y. Vadila, I. Markus, and L. Nazara (2023). ASEAN digital community 2045. ERIA Discussion Paper Series No. 487. Jakarta: Economic Research Institute for ASEAN and East Asia.

International Telecommunications Union (2023). Digital Inclusion for All. Geneva: International Telecommunications Union. Available at https://www.itu.int/en/mediacentre/backgrounders/Pages/digital-inclusion-of-all.aspx.

Isono, Ikumo, and H. Prilliadi (2023). ASEAN's Digital Integration: Evolution of Framework Documents. Jakarta: Economic Research Institute for ASEAN and East Asia.

Kang, Jong Woo, M. Helble, R. Avendano, P. Crivelli, and M.C. Tayag, eds. (2022). Unlocking the Potential of Digital Services Trade in Asia and the Pacific. Manila: Asian Development Bank.

Lee, Jong-Ook (2024). How ASEAN is building trust in its digital economy. World Economic Forum, 12 January. https://www.weforum.org/stories/2024/01/asean-building-trust-digital-economy/.

Liberatore, Annalisa, R. Avendano, and W.H. Cho (2022). Trends in digital services trade in Asia and the Pacific. In Kang, J.W., M. Helble, R. Avendano, P. Crivelli, and M.C. Tayag, eds., Unlocking the Potential of Digital Services Trade in Asia and the Pacific (pp. 10–35). Manila: Asian Development Bank.

Liu, Jia, and U. Sengstschmid (2024). Investing in ASEAN's digital economy: risks and opportunities. ACI Research Paper No. 11-2024. Singapore: Asia Competitiveness Institute.

Markus, Iman, and L.F. Nazara (2023). Unlocking ASEAN's digital economy entails embracing trustworthy and inclusive payments systems. Southeast Asia Development Solutions, 5 October. Available at https://seads.adb.org/articles/unlocking-aseans-digital-economy-entails-embracing-trustworthy-and-inclusive-payments.

Nasir, Muhammad Husnain, and S. Zhang (2024). Evaluating innovative factors of the global innovation index: a panel data approach. Innovation and Green Development, vol. 3, No. 1, p. 100096.

Ndou, Ellis (2025). Macroeconomic resilience and GDP growth nexus: evidence from GDP growth dynamics in South Africa. SN Business and Economics, vol. 5, p. 92.

Organisation for Economic Co-operation and Development (OECD) (n.d.). Digitally-deliverable

services as a share of commercial services trade. Available at https://goingdigital.oecd.org/en/indicator/71.

OECD (2024). Digital Public Infrastructure for Digital Governments. OECD Public Governance Policy Papers. Paris: OECD Publishing.

Rivera, John Paolo R. (2023). Statistical Analysis with Software Applications. Manila: Rex Publishing.

Rodrik, Dani (2010). Diagnostics before prescription. Journal of Economic Perspectives, vol. 24, No. 3, pp. 33–44.

Rotberg, Frida (2025). Unlocking Southeast Asia's economic potential. Infocomm Asia 2025, 10 July. Available at https://invidis.com/news/2025/07/infocomm-asia-2025-unlocking-southeast-aseas-economic-potential/.

Salisu, Mojeed A., L. Marafa, N.B. Bamiro, M.O. Shokunbi, and B.O. Raimi (2025). Systematic review of post-COVID policies and strategies for strengthening e-commerce cooperation among ASEAN countries. Journal of Economic and Administrative Sciences. Available at https://doi.org/10.1108/JEAS-04-2024-0102.

Sefrina, Mia (2024). An Inclusive Digital Economy in the ASEAN Region. ERIA Discussion Paper Series No. 505. Jakarta: Economic Research Institute for ASEAN and East Asia.

Sempena, Sovia, and R.E. Sitorus (2025). Harnessing digital platforms for Southeast Asia's inclusive prosperity. Southeast Asia Development Solutions, 5 February. Available at https://seads.adb.org/articles/harnessing-digital-platforms-southeast-asias-inclusive-prosperity.

Serafica, Ramonette B., and J.R.G. Albert (2018). Issues on digital trade. Discussion Paper Series No. 2018-30. Quezon City: Philippine Institute for Development Studies.

Serzo, Ana Liza O. (2020). Cross-border issues for digital platforms: a review of regulations applicable to Philippine digital platforms. Discussion Paper Series No. 2020-45. Quezon City: Philippine Institute for Development Studies.

Shirakawa, Noboru, ed. (2024). Digital Transformation in Asian Economies: Enhancing Productivity, Socioeconomic Impacts, and Policy Insights. Tokyo: Asian Productivity Organization.

Singh, Surendar, and M. Masaya (2021). Accelerating e-commerce in ASEAN. Policy Brief. Manila: Asian Development Bank.

Smeets, Maarten, ed. (2021). Adapting to the Digital Trade Era: Challenges and Opportunities. Geneva: World Trade Organization.

Sonobe, Tetsushi, N.J.A. Buchoud, R. Akbar, and B. Altansukh, eds. (2024). Transforming ASEAN: Strategies for Achieving Inclusive and Sustainable Growth. Tokyo: Asian Development Bank Institute.

United Nations Conference on Trade and Development (UNCTAD) (2015). Internet Broadband for an Inclusive Digital Society. UNCTAD Current Studies on Science, Technology and Innovation No. 11. Geneva: United Nations.

UNCTAD (2019). Digital economy report 2019. Geneva: United Nations.

United Nations Development Programme (UNDP) (2015). Economic resilience and fiscal capacity. In Towards human resilience: Sustaining MDG progress in an age of economic uncertainty (pp. 224–267). New York: United Nations Development Programme.

UNDP (2023). Accelerating the SDGs through digital public infrastructure. New York: United Nations Development Programme.

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). Shaping

our digital future: Asia-Pacific Digital Transformation Report 2022. Bangkok: United Nations. Available at https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP-2022-Flagship-Asia-Pacific-Digital-Transformation-Report.pdf

Wang, Fei, and Y. Zhou (2025). Cross-border e-commerce, platform economy, and export product quality. International Business Review. Available at https://doi.org/10.1016/j.ibusrev.2025.102466.

Wert, Katelyn (2025). Together, broadband deployment and digital inclusion programs support increased internet adoption. Pew, 28 January. Available at https://www.pew.org/en/research-and-analysis/articles/2025/01/28/together-broadband-deployment-and-digital-inclusion-programs-support-increased-internet-adoption.

Wijaya, Lina Izzatul, Z. Zunairoh, M. Isharuddin, and A. Rianawati (2025). Scope of e-commerce use, innovation capability, and performance: food sector MSMEs in Indonesia. Journal of Open Innovation: Technology, Market, and Complexity, vol. 11, No. 1, p. 100459.

World Bank and World Trade Organization (WTO) (2024). Trade in services for development. Washington, D.C. and Geneva: World Bank and WTO.

World Economic Forum (2025). Why ASEAN's new digital economy framework agreement is a game-changer. World Economic Forum, 26 May. https://www.weforum.org/stories/2025/05/asean-digital-economy-framework-agreement-a-gamechanger/.

Wooldridge, Jeffrey M. (2025). Introductory Econometrics: A Modern Approach, 8th ed. Mason, Ohio: Cengage Learning.

WTO (2024). World Trade Report 2024. Geneva: World Trade Organization.

Xiao, Yuhan, and L. Sihuay (2023). Cross-border payments can't rely on tech alone: four ways to make them work. World Economic Forum, 24 October. Available at https://www.weforum.org/stories/2023/10/cross-border-payments/.

Yang, Alan T.H. (2023). ASEAN's splintering digital economy governance. East Asia Forum, 20 April. Available at https://eastasiaforum.org/2023/04/20/aseans-splintering-digital-economy-governance/.

Zhang, Liang, T.D. Pham, R. Li, and T.T. Do (2025). Enhancing the sustainable development of ASEAN's digital trade: the impact mechanism of innovation capability. Sustainability, vol. 17, No. 4, p. 1766.

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

THE ROLE OF DIGITAL PLATFORMS AND CROSS-BORDER TRADE IN CAMBODIAN FIRM PERFORMANCE

Dina Chhorn, Sivly Houy, and Kean Muny Nhim

Corresponding Author: Dina Chhorn
Email: dina.chhorn@cdri.org.kh

Digital platforms are reshaping how firms access markets, manage transactions and participate in international trade. In Cambodia, where micro and small enterprises dominate, digital platforms offer opportunities to improve productivity, expand market reach and enable cross-border trade. Using firm-level data, this study examines the relationship between digital platform adoption, trade participation and firm performance. Results show that adopting firms achieve higher revenue, stronger formalization and greater productivity. However, urban firms outperform those in provincial and border areas, while female-owned enterprises face persistent barriers. Strengthening digital infrastructure, skills and access to finance is essential to maximize the benefits of digital transformation.

Keywords: firm performance, digital platforms, digital trade, cross-border trade

JEL classification: L86, O33, L25, F15

I. INTRODUCTION

Digital platforms are reducing trade barriers, enhancing market access and improving digital literacy by facilitating internet-enabled commerce, thereby generating socioeconomic and trade development (IMF, et al., 2023). They are also transforming how firms conduct business, allowing them to adopt hybrid (online/offline) models that lower transaction costs and stimulate the uptake of digital technologies, innovation and productivity. Carballo, et al. (2022) find that platform participation increases firms' exports by reducing search costs for business partners.

For developing economies such as Cambodia, digital platforms offer firms opportunities to formalize, innovate, scale and promote cross-border trade, core components of long-term productivity and inclusive growth (e.g., IMF, et al., 2023; Carballo, et al., 2022). The platforms give firms access to online markets, financial services and supply chain networks. However, their benefits are unevenly distributed. Variations in firm size, ownership, digital readiness and regulatory capacity shape how effectively firms leverage such platforms.

Cambodia exemplifies both rapid digital diffusion and fragmented adoption. The country's National Institute of Statistics (NIS) 2022 Cambodia Economic Census reveals that only a minority of firms, primarily urban and formal, utilize digital tools for trade, and significant divides persist across geography, gender and enterprise size (NIS 2023). In this context, local and foreign digital platforms are reshaping firm performance by acting not just as marketplaces, but also as intermediaries of data, logistics, and payment systems while also bolstering trust, each influencing firms' capacity to scale and compete.

Local platforms are generally more embedded within Cambodia's domestic ecosystem, offering Khmer-language interfaces, localized payment systems (e.g., Wing, Association of Cambodian Local Economic Development Agencies or ACLEDA), and tailored logistics solutions. These features make the platforms accessible to micro and small enterprises with limited digital capacity. By contrast, foreign platforms, such as Facebook, Lazada, Alibaba and TikTok offer scalable infrastructure for cross-border e-commerce and online marketing, enabling Cambodian firms to reach broader Association of Southeast Asian Nations (ASEAN) and global markets. During COVID-19 these platforms vitally helped businesses sustain operations via livestream sales, messaging and integrated digital payments.

Despite these opportunities, firms, especially micro and small ones, face numerous barriers to digital adoption. Structural challenges such as limited digital literacy, high onboarding costs and financial constraints, especially among enterprises owned by women and rural enterprises, hinder widespread platform use (Omowole, et al., 2024; Tajuddin, 2025). Tajuddin (2025) also highlights external constraints, including weak digital infrastructure, regulatory inefficiencies and resistance to technological change.

Concerns over data security and privacy further inhibit adoption (Quach et al., 2022).

This study draws on evolving literature on digital trade and platform economics in Southeast Asia. According to Basu Das, et al. (2023), platform-driven trade is reshaping traditional trade facilitation by creating new forms of digital connectivity, data governance, and firm-to-firm coordination. Initiatives such as the ASEAN Single Window and the ASEAN Digital Economy Framework highlight the importance of interoperability, trust-based governance and enabling ecosystems. However, digital connectivity alone is insufficient; a coherent regulatory framework and strong public-private collaboration are essential to ensuring firms, especially in less-developed ASEAN economies, can benefit (Basu Das, et al., 2023).

Basu Das (2017a, 2017b, 2017c) further emphasises that regional digital integration and supply chain resilience must align. The analysis shows that multinational platforms often bypass local regulatory systems, limiting domestic firms' visibility, bargaining power and access to strategic data. These concerns are relevant to Cambodia, where unchecked foreign platform dominance could constrain local entrepreneurship in the absence of coherent digital industrial policies.

While existing studies highlight the broad benefits of digitalization (CDRI, 2023; Nucci, et al., 2023; Blut, et al., 2023), few examine the differentiated effects of platform origin on firm performance in Cambodia. This study, using the 2022 Economic Census, analyses how platform adoption influences firm outcomes, specifically revenue, formalization and productivity, and investigates structural and gender-based barriers to digital engagement.

Prior research has shown that firm-level factors such as information and communication technology (ICT) adoption, skilled management and digital registration systems significantly affect productivity and formalization (Medvedev and Oviedo, 2016; De Vries, 2010; Nucci, et al., 2023). Digital tools also enhance business processes across sales, administration, planning and payments, enabling innovation and cost reduction (CDRI, 2023). Sector-specific studies, particularly in tourism, confirm strong correlations between digital marketing/payment systems and firm revenue (CDRI, 2023).

Digital platforms also enhance firms and customer engagement, support innovation, and facilitate inclusive market participation regardless of firm size or customer location (Rahman, et al., 2024; Blut, et al., 2023; Ho, et al., 2020; Schreieck ,et al., 2024; Wang, et al., 2023; Triyana, et al., 2024). For Cambodian firms, this raises critical questions about inclusion and barriers.

This study examines the effect of digital platforms and cross-border trade on firm performance in Cambodia and explores structural and gender-specific barriers to digital technology adoption. It addresses the following research questions:

- How does the use of digital platforms affect firm performance in Cambodia?
- To what extent does digital platform adoption promote inclusive participation across gender, provinces, and firm sizes?
- Do cross-border trade and intellectual property–related trade activities contribute to improved firm performance?
- What structural and gender-specific barriers constrain firms' adoption of digital technologies?

This study distinguishes the effects of digital platforms on firm outcomes across gender, provinces, and firm sizes. Second, it provides empirical evidence of the relationship between digital platform use, trade participation and firm performance using nationally representative data. Third, it identifies structural inequalities in digital adoption by gender, aligning with regional frameworks on digital connectivity and trade facilitation.

This study is directly relevant to the Sustainable Development Goals (SDGs), particularly SDG 8 on decent work and economic growth, SDG 9 on industry, innovation and infrastructure, SDG 10 on reduced inequalities and SDG 5 on gender equality. Digital platforms can support productivity, market access, formalisation and cross-border trade, which are important channels for inclusive economic transformation in developing economies. At the same time, the SDG agenda emphasises that digital transformation must be inclusive and must not deepen existing inequalities.

The Sustainable Development Goals Report 2025 identifies digital transformation as one of the key transitions needed to accelerate SDG progress and stresses the importance of closing the digital divide and ensuring that technology is harnessed inclusively and responsibly (United Nations, 2025). This study therefore contributes empirical evidence from Cambodia on whether digital platforms are associated with improved firm performance, and whether these gains are shared across gender, geography and firm size. In doing so, it speaks to the broader SDG principle of "leaving no one behind", while avoiding the assumption that digital adoption alone is sufficient to generate inclusive development outcomes (UNDP, 2023; United Nations, 2025).

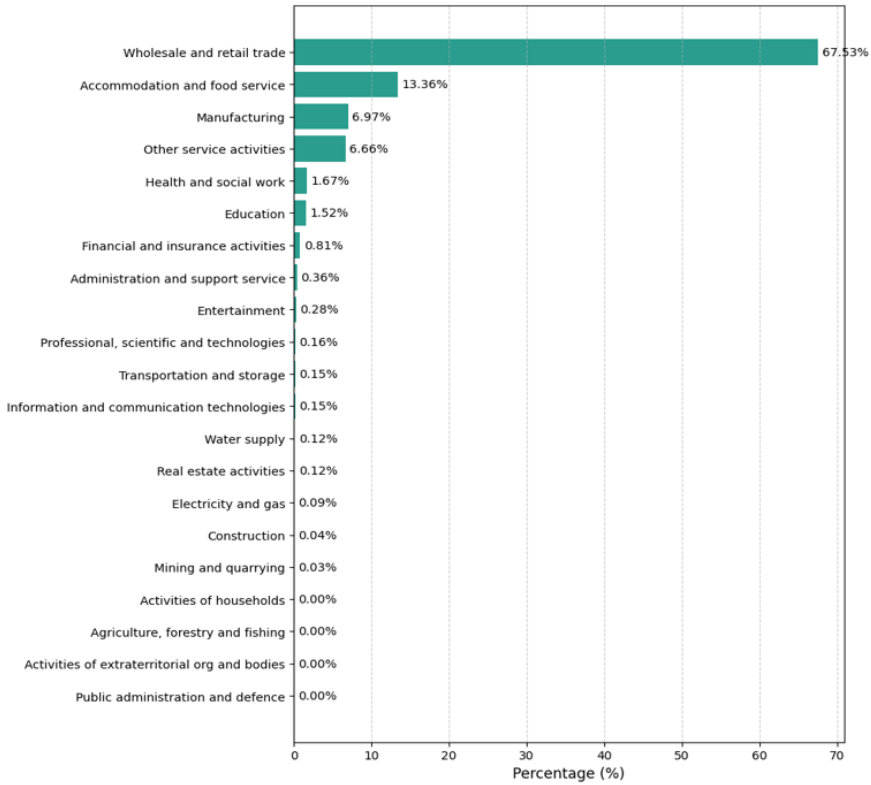
It finds that digital platform adoption significantly improves firm revenue, formalization and productivity, but these gains are not equally distributed. Phnom Penh firms benefit more than those outside the capital, likely due to greater platform density and infrastructure availability. While the adoption of digital platforms enables firms to strengthen cross-border trade, better manage trade-related activities—patents, industrial designs, trademarks—and improve overall business performance, impact in border provinces remains limited, likely because digital adoption there is still nascent. Also, female-owned firms benefit less than male-owned, and micro-enterprises gain more from digital adoption than larger ones, reflecting differences in digital readiness.

Key barriers include limited information, financial constraints and skill gaps.

II. STATE OF FIRMS, DIGITAL PLATFORMS AND TRADE IN CAMBODIA

Key characteristics of firms: Insight from the 2022 economic census. Cambodia's enterprise structure is predominantly service-oriented, led by wholesale and retail trade, at nearly two-thirds of establishments. Accommodation and food services and manufacturing follow. By employment, however, manufacturing now leads, absorbing over one-third of the workforce, largely in garment-related industries. Compared to 2011, the structure has shifted: Trade remains dominant in establishments, but manufacturing has strengthened its role as the primary employer (NIS 2012; NIS 2023).

Figure 1. Sectoral distributions of establishments in Cambodia in 2022



Note. The main results are taken from I Younan An and Chhorn Dina. 2025. Firm-Level Performance in Cambodia: An Economic Census-Based Diagnostics. CDRI Working Paper Series No. 152. Phnom Penh: CDRI.

Source: National Institute of Statistics. Cambodia Economic Census 2022.

Spatial concentration, enterprise structure, formality and ownership. Economic activity remains highly concentrated in urban areas, with Phnom Penh the clear economic core with around one-fifth of establishments and more than one-third of employment and dominating national sales. Industrial density is clustered in the city and surrounding provinces, while secondary urban centres such as Kandal, Siem Reap, Battambang and Takeo are important but significantly smaller. This spatial concentration reflects infrastructure advantages and agglomeration effects, reinforcing regional disparities in productivity and income generation.

Most Cambodian enterprises are also overwhelmingly tiny, employing only a handful of workers, and yet comprise the vast share of enterprises. Larger establishments have a disproportionate share of employment, especially in manufacturing such as garments, footwear and related export sectors. In the persistent "missing middle", small firms struggle to transition into medium-sized enterprises, suggesting structural barriers to scaling up.

Formality remains limited, constraining productivity, access to credit, participation in government programmes and integration into value chains. Most establishments are sole proprietorships, and registration rates remain low among micro and small firms—home or street based—and thus informal. Many enterprises own their business premises, but this may not translate into formal compliance or integration into formal financial and regulatory systems.

Further, even though most firms are domestically owned, foreign ownership among larger firms is high: small and micro businesses are domestic, while the export-oriented industrial segment is foreign led. This structure, largely unchanged since 2011, shapes growth, productivity and economic diversification.

Figure 2A. Business establishment map in 2022

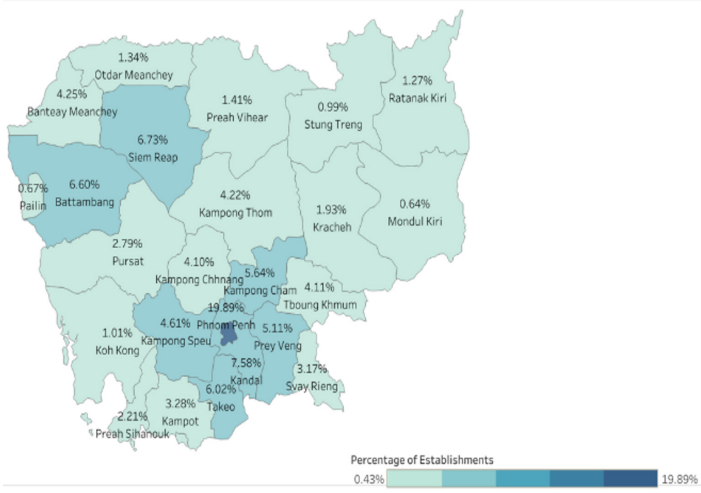


Figure 2B. Enterprise distribution in 2022

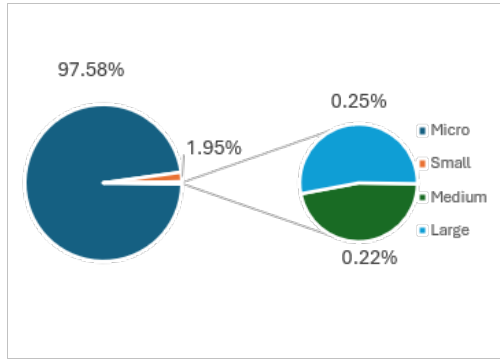


Figure 2C. Type of ownership across all size of establishments in 2011 and 2022

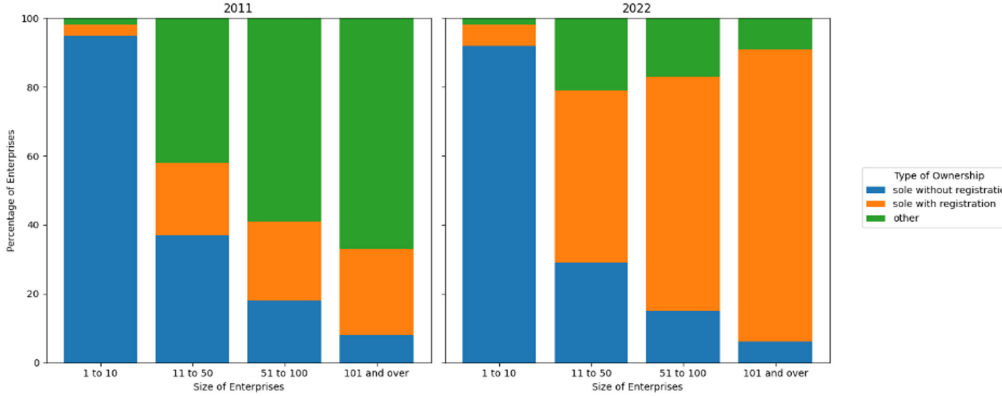
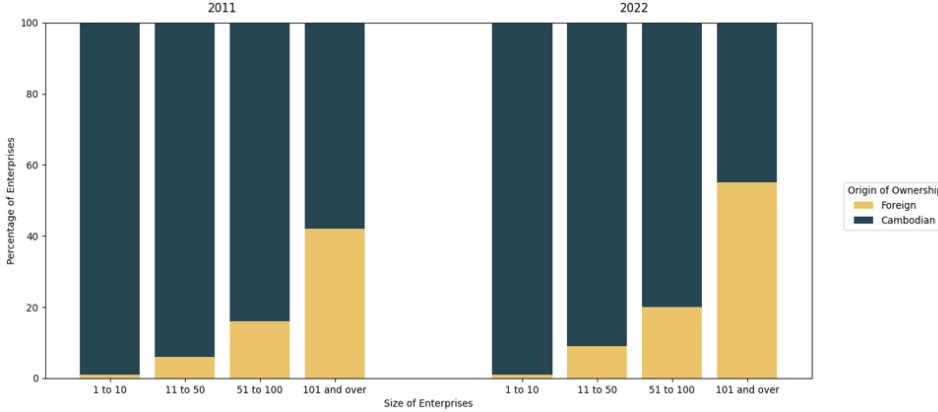


Figure 2D. Origins of ownership across all size of establishments in 2011 and 2022

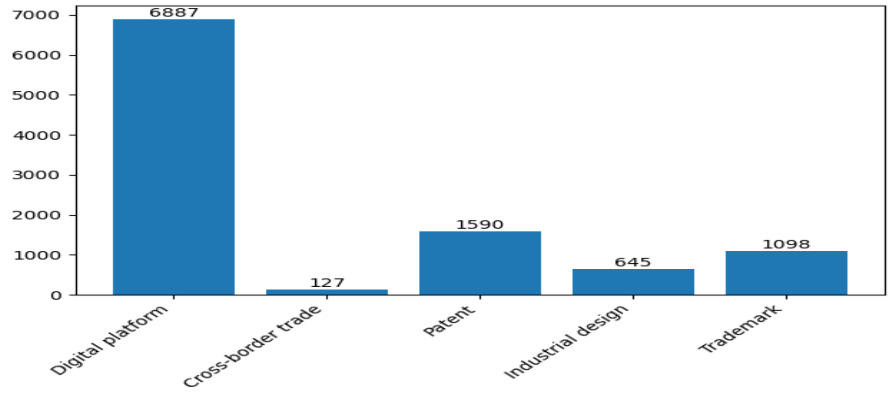


Note. The main results are taken from I Younan An and Chhorn Dina. 2025. Firm-Level Performance in Cambodia: An Economic Census-Based Diagnostics. CDRI Working Paper Series No. 152. Phnom Penh: CDRI.

Source: The 2011–2022 Cambodia Economic Census.

Digital platforms and intellectual property–trade activities. Figure 3 illustrates digital platform adoption, cross-border trade participation and ownership of intellectual property rights. Compared with the total firms recorded in the 2022 Cambodia Economic Census (753,670 establishments), the figure reveals several important structural patterns.

Figure 3. Digital platforms and intellectual property–trade activities



Note. Firms number 753,670. "Digital platform" refers to establishments that reported adopting or intensifying use of internet-based systems and services, such as websites, social media, mobile applications and email to support daily operations during the COVID-19 pandemic. Respondents answering "yes" were further asked to specify operational areas in which these tools were used; multiple responses were allowed, and cross-border trade constitutes one of these activities. The survey also collected information on whether establishments held registered intellectual property rights, including patents, industrial designs and trademarks.
Source. 2022 Cambodia Economic Census.

Digital platforms are the most widely used tool among firms: 6,887 establishments reported using digital platforms such as websites, social media, mobile applications or email to support business operations. Participation in cross-border trade is even more limited: only 127 establishments. Similarly low usage appears in ownership of intellectual property rights: 1,590 firms reported holding patents, 645 reported industrial designs, and 1,098 reported trademarks.

In other words, only a very small number of firms, out of the 750,000+ total, participates in higher-value digital activities. This likely reflects that small-scale and informal enterprises often lack the capacity, resources or incentives to adopt advanced digital tools, engage in export markets or formalise innovations through intellectual property systems.

Evolution of digital platform adoption in Cambodia. Digital platforms are understood as online infrastructure that facilitates interactions and transactions between groups of users, typically producers and consumers, through internet-based interfaces (e.g., Evans and Schmalensee, 2016; OECD, 2019; Tagaki, 2020; ADB, 2021).

This report uses "digital platforms" to refer to what OECD (2019) describes as "online platforms", a term the OECD uses to broadly encompass a wide range of internet-based services including online marketplaces, search engines, social media platforms, creative content outlets, application stores, communication services, payment systems and services in the collaborative or gig economy. Such digital infrastructure facilitates interactions, transactions and information exchange in the digital economy (OECD, 2019, p. 20).

Table 1. Local and foreign digital platforms in Cambodia

Types of digital platforms	Locally owned	Foreign owned
Ad-supported content		YouTube, Spotify
App stores		Apple App Store, Google Play
Ad-supported messaging platforms	CoolApp	Facebook Messenger, Telegram, WeChat, WhatsApp, Snapchat
C2C	Khmer24, L192	Facebook Marketplace
Third-party B2Cs	Tinh Tinh, Smile Shop, eMall Cambodia, Cambodia Trade, eCamShopping, Khmum eShop, Nironi Marketplace	Hungry ap, Amazon Marketplace, AliExpress, Lazada, MakroClick, AEON Online, Shopee
Fintech (mobile payment)	ACLEDA, Wing, KHQR, Bakong, Chip Mong, Vattanac, KB Prasac, Canadia	ABA, Woori, Sathapana, Pi Pay, TRUE Money
Social media	Beebush, Snapkyu	Facebook, WeChat, X (Twitter), LinkedIn, Instagram, TikTok, YouTube
Food delivery	Nham24 / Grab, Wingmall	Grab Food, Foodpanda
Transportation	Virak Buntham, Larryta, Passapp	Grab, TADA, DHL Express, J&T Express, ZTO Express, KWE Express
Travel booking	BookMeBus	Agoda, CamboTicket
Short-term accommodation		Airbnb

Note. Local and foreign platforms are classified according to the nationality of their founders at the time of establishment. This founder-nationality rule was chosen for consistency and data availability across platforms, but it does not necessarily reflect a platform's current legal incorporation, ownership structure or brand control, which may differ from founder nationality in some cases—for example, among financial institutions and other platforms listed here as foreign owned. See Appendix 2 for detailed information. In addition, while the OECD digital platform framework identifies 21 global platforms, this paper includes only 11, due to data availability and relevance to Cambodia's market context (see OECD, 2019, pp. 62–65).

Table 1 presents digital platforms in Cambodia, distinguishing between locally owned and foreign owned across several types of digital services. The table shows that foreign platforms dominate most segments, particularly in global-scale services such as ad-supported content, app stores, social media and short-term accommodation. Platforms such as YouTube, Spotify, Apple App Store, Google Play, Facebook, Instagram, LinkedIn and Airbnb illustrate the strong presence of international technology firms that provide widely used digital infrastructure in Cambodia. Foreign platforms are also strong in e-commerce, transportation, food delivery and logistics services, with companies such as Shopee, Lazada, or Grab hugely shaping digital market activities.

In contrast, locally owned platforms tend to be fewer and smaller. Local initiatives appear particularly in fintech and digital payment services, where Cambodian platforms such as ACLEDA, Wing, KHQR, Bakong and Chip Mong support domestic digital transactions and financial inclusion. Local platforms are also visible in online marketplaces, transportation services, and travel booking, including Khmer24, Smile Shop, eCamShopping, PassApp and BookMeBus. However, the table suggests that Cambodia's digital economy remains heavily integrated with foreign platform ecosystems, particularly in areas related to global digital services and cross-border e-commerce.

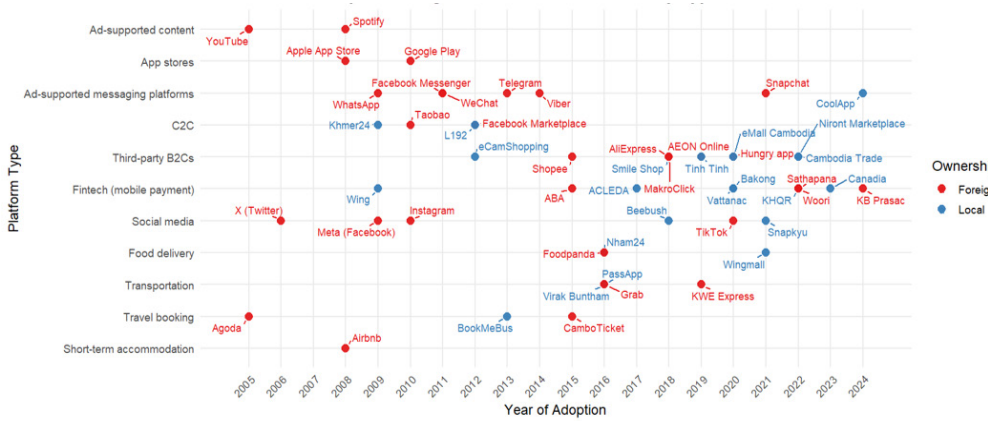
Figure 4 illustrates the evolution of digital platform adoption by type, and by foreign or local ownership. It shows that the earliest platforms were predominantly foreign, particularly in global digital services such as ad-supported content, app stores and social media. Platforms such as YouTube, Apple App Store, Google Play, Facebook and Instagram appeared between the mid-2000s and early 2010s, reflecting early penetration of global technology firms. Messaging platforms and cross-border marketplace platforms also expanded during the early 2010s, further integrating Cambodia into global digital networks.

From the mid-2010s, the digital platform landscape diversified, as platforms emerged across e-commerce, transportation, food delivery and fintech services. Foreign platforms such as Shopee, AliExpress, Grab, Foodpanda and AEON Online expanded rapidly, reinforcing the strong presence of international companies in Cambodia's digital market.

At the same time, locally developed platforms began to emerge more visibly, particularly in sectors such as fintech, transportation and digital marketplaces. Examples include Wing, ACLEDA, Bakong, PassApp, Khmer24, Smile Shop, and BookMeBus, many of which appeared after 2015.

The figure therefore reveals two key patterns: first, the early dominance of foreign platforms in establishing the country's digital infrastructure; and second, the gradual growth of locally owned platforms in more recent years, particularly in sectors linked to domestic services and digital payments.

Figure 4. Digital platform adoption in Cambodia by type and year



Note. Adoption year is restricted to 2005–2024, reflecting observed entry timeline of platforms operating in Cambodia within the study scope. For digital platforms globally without a distinct country launch, the reported year corresponds to initial public release, which proxies availability in Cambodia, since a specific Cambodia entry date is generally not formally recorded. Appendix 2 details this information.

Source: Authors' illustration.

Cambodian firms, digital platform and cross-border trade: review of border provinces[1], Cambodia's integration in the region is reflected in its strong cross-border trade, labour migration and tourism flows with Thailand. In 2024, bilateral trade reached around US$4 billion, largely driven by imports from Thailand. Yet, the impact on local productivity appears limited as many Cambodian workers migrate abroad rather than working in border provinces. Around 1.2 million Cambodian migrants are employed in Thailand, mainly in construction, agriculture, services and manufacturing. More than 70% originate from border provinces such as Banteay Meanchey, Battambang, Preah Vihear, Oddar Meanchey, and Pailin (CDRI and ERIA, 2025).

Although several northwestern and western provinces border Thailand, formal cross-border connectivity is concentrated in only six provinces: Banteay Meanchey, Battambang, Pailin, Oddar Meanchey, Preah Vihear and Koh Kong. Other provinces, such as Pursat, share a land boundary with Thailand but do not host international crossing points. This pattern shows that institutionalised cross-border trade and mobility are unevenly distributed, creating different levels of access to bilateral economic opportunities and regional trade dynamics.

Tourism further strengthens regional connectivity. International arrivals recovered

[1] See Appendices A3–A29 for detailed information and key statistics on Cambodian firms, digital platforms, and cross-border trade, with a focus on border provinces.

to about 6.7 million in 2024, with Thailand and Viet Nam becoming major sources of visitors. Cross-border tourism is also supported by the casino industry, with nearly two hundred licensed casinos located mainly in border and coastal provinces.

Economic activity in the six Thai-border provinces is largely driven by small and medium-sized enterprises (see Figure 5). Together, these provinces account for about 15% of Cambodia's firms, with Battambang and Banteay Meanchey holding the largest shares. Micro enterprises dominate, especially in wholesale and retail trade, followed by accommodation, services and manufacturing, reflecting Cambodia's persistent "missing middle".

Table 2: Cambodian provinces bordering Thailand border trade entry points

Cambodian province	Thailand boarder trade entry
Preah Vihear	An Ses
Oddar Meanchey	Chub Koki, O Smach, and Choam
Banteay Meanchey	Poi Pet, Steung Bot
Battambang	Daung, Phnom Dei
Pailin	Prum
Koh Kong	Cham Yeam

Digital platform adoption also differs across provinces. Banteay Meanchey records the highest adoption, reflecting economic activity around Poipet, a major checkpoint with logistics services, casinos and special economic zones. Yet direct firm participation in cross-border trade remains limited, suggesting that many activities operate through intermediaries or informal channels. Intellectual property registration and formalisation also vary, with Battambang leading in patents and registration, Banteay Meanchey in industrial design, and Koh Kong in trademarks. Overall, border provinces remain important but under-formalised and only weakly digitalised.

III. LITERATURE REVIEW

Digital platforms and firm performance. The transformative role of digital platforms in shaping firm development has gained increasing attention in the literature, particularly in developing economies. Digital platforms can reduce search and transaction costs, expand access to markets, improve payment efficiency and foster firm-level productivity and innovation (IMF, et al., 2023; Carballo, et al., 2022). Platforms ranging from e-commerce marketplaces and social commerce to digital financial services are critically enabling participation in trade, domestically and across borders. Similarly, Deng, et al. (2022) find that business-to-business digital platform adoption decreases firm exit from export markets. Having a strong digital platform and adoption capability is positively associated with boosting revenue, innovation and operation (Jiang, et al., 2023; Wang, et al., 2023; Li, et al., 2023; Han, et al., 2024).

Digital platforms have become crucial to firm development. Using a survey of 318 responses, Marzi, et al. (2023) find that firms adopt digital platforms for flexibility to reach wide networks of partners and to enhance relationships with suppliers. Several studies show positive relationships between digital platforms and firms' market access. For instance, Lee, et al. (2022) find that firms using digital platforms explore new market opportunities in foreign countries. In addition, e-commerce and communication platforms enhance relationships with customers (Rahman, et al., 2024; Faisal, et al., 2023; Sharabati, et al., 2024; Blut, et al., 2023; Ho, et al., 2020; Schreieck, et al., 2024).

Cao, et al. (2024) find that e-commerce platform adoption improved the survival rate of firms in the People's Republic of China during COVID-19. Firm survival increased by 3.0 to 3.4 percentage points by enlarging the market, limiting the decline of orders and increasing cash flow. Orman and Teker (2024), meanwhile, show the significant role of digital platforms like Amazon and Alibaba in shaping the trade landscape for firms in Türkiye. The platforms have been doing this by decreasing market-entry barriers and developing trust in digital payment systems. They have also encouraged the rise of small-package exports through innovation of logistics systems and allowing firms to overcome barriers in trade, market competitiveness and market access. Triyana, et al. (2024) also find that in Indonesia online platforms significantly enhance inclusive participation.

However, evidence from Southeast Asia suggests that digital adoption and platform use remain uneven, constrained by infrastructure, regulatory fragmentation and structural inequalities (Nucci et al., 2023; Blut et al., 2023). In Cambodia, the platform ecosystem is divided between foreign platforms, such as Facebook, Shopee, and Lazada, and local alternatives, such as SmileShop, Khmum eShop, and logistics-fintech hybrids like Wing and ABA. While foreign platforms dominate online commerce, their scale and cross-border operations may pose challenges for domestic regulatory oversight in areas such as taxation, data governance and competition. This can limit opportunities for local firms to integrate into the broader digital economy and constrain the ability of domestic platforms to compete on equal terms.

Digital trade infrastructure must be viewed as a form of "digital public good", requiring policy coherence, institutional trust and regulatory interoperability to be effective, especially for smaller and less digitally mature economies (Basu Das et al., 2023). In ASEAN, Basu Das highlights that regional frameworks such as the ASEAN Single Window and Digital Economy Framework Agreement aim to streamline cross-border trade, reduce non-tariff barriers and promote data governance standards. However, she also cautions that for member states like Cambodia, domestic capacity to implement and enforce such frameworks remains limited.

Basu Das, et al. (2023) underline the importance of "connectivity beyond infrastructure."

Digital transformation for firms requires not just broadband access or e-commerce tools, but also coordination mechanisms among customs, financial institutions and government agencies. Without strong institutional linkages and public-private partnerships, firms often remain excluded from the full benefits of digital trade. For Cambodia, this implies that enabling platform ecosystems must go beyond basic connectivity and address institutional bottlenecks in logistics, payment systems, and firm onboarding.

Basu Das, et al. (2023) also link digital trade to the structure of regional value chains and currency regimes. The continued dominance of the US dollar in trade invoicing within Asia, despite deepening intraregional trade, reflects a lack of regional financial integration and digital payment interoperability (Basu Das et al., 2023). This affects platform-mediated trade as well: firms dependent on platforms may face higher transaction costs and foreign exchange risks if settlements remain dollar-based or if regional platforms do not integrate local currency payments. The lack of scalable, interoperable digital payment systems can thus become a hidden barrier to firm participation in regional trade.

Although a growing body of empirical literature has explored the effects of digital adoption on firm performance (Huang, et al., 2025; Shah et al., 2024), few studies differentiate between platform types or consider how platform governance, ownership origin or data policies influence outcomes. Even fewer examine gendered and geographic barriers to digital platform participation. As a result, the heterogeneity in firm access and performance remains under-theorized and under-measured.

While digital platforms bring opportunities for firms to develop, key barriers hinder firms' technology adoption. Omowole, et al. (2024) say lack of digital skills, financial constraints and cyber security concerns prevent firm participation in digital technology adoption. Marzi, et al. (2023) say that firms' perception that there are many barriers to adoption is a hindrance. Nayak, et al. (2025) find that demographic moderators such as firm owners' ages, gender and level of education impact firms' adoption of technologies. Younger, male and more educated owners show stronger adoption responses.

For Cambodia, Chan (2022) finds that limited digital literacy and skills gaps in the underdeveloped workforce hamper use of digital tools. The paper highlights that low digital literacy leads to e-commerce distrust, limiting market participation. Regulatory and infrastructural challenges are also barriers. The same paper illustrates that inadequate regulations and policies that govern e-commerce create an ambiguous environment for firms. In addition, the lack of infrastructure coupled with bureaucratic inefficiencies in importation procedures stifles the ability of Cambodian firms to compete in the digital marketplace. According to Omowole, et al. (2024)., the innovation and rapid growth of digital infrastructure presents opportunities for firms. However,

many of these businesses lack resources, hindering investments in more advanced technologies and digital transformation. Likewise, women's firms and rural firms are more severely impacted amid limited access to digital tools and inability to leverage platforms and cyber protection.

Digital and cross-border trade, firm performance: Cambodia and ASEAN. Cambodia's digital trade integration has advanced through reforms such as as ASYCUDA World (Automated System for Customs Data), the National Single Window and ASEAN Single Window, enabling electronic customs clearance and paperless cross-border trade (OECD and WTO 2017). These reforms reduce transaction costs and delays and support cross-border e-commerce. However, high logistics costs, border inefficiencies and outdated trucking fleets remain constraints, weakening firm competitiveness and limiting productivity gains from digital platforms.

Firms engaged in international trade are generally more productive than domestic-only firms, reflecting scale effects, knowledge transfer and exposure to higher standards (World Bank, 2024). In Cambodia, this is evident in garment and footwear firms in special economic zones. Foreign platforms may extend similar gains by linking small producers to regional consumers, while local platforms need stronger integration with cross-border logistics. Digital trade facilitation, including Small Package E-Trade for SMEs for low-value items, can reduce compliance bottlenecks and support productivity (Ratana, 2020).

Cambodia's cross-border trade with ASEAN is closely linked to human mobility, especially with Thailand and Viet Nam. Border provinces such as Banteay Meanchey and Svay Rieng connect firms to regional production networks while also serving as migration corridors. ASEAN accession in 1999 and the ASEAN Economic Community in 2015 improved preferential market access, while tariff reductions supported regional integration. However, high transaction costs, migrant labour reliance and uneven trade facilitation continue to constrain gains (IOM 2021; Pitsuwan, et al., 2017).

Cambodia has significant trade links with Thailand, Myanmar, Lao People's Democratic Republic, and Malaysia. In 2022, border provinces in Thailand that share checkpoints with Cambodia were actively engaged in cross-border trade (Setthachotsombut, et al., 2022). Moreover, informal firms dominate border trade in sectors such as agriculture, food processing and consumer goods, particularly in export and import transportation. In 2005, many firms active at these borders were mostly informal and had limited access to financing and digital systems (Murshid and Tuot 2005). In these border areas, digital skills and high transport costs hamper performance.

In addition, demand for higher labour productivity in Thailand partly depends on migrating Cambodian workers (Pholphirul and Rukumnuaykit 2010). According to Hing, et al. (2011), the substantial portion of Cambodia's cross-border migrant workforce comes from provinces like Banteay Meanchey and Battambang and

around 180,000 Cambodians work unofficially in Thailand, with many originating from these border provinces. Moreover, migration corridors in districts such as Malai (Banteay Meanchey) and Kamrieng (Battambang) remained active even during the COVID-19 pandemic, underlining the resilience of these crossings as channels for human mobility (Oeur and Nil, 2023). The same research underscores the importance of human mobility in border corridors, which facilitate seasonal work migration and, increasingly, commerce-related crossing.

Following border-related disruptions between Cambodia and Thailand in 2025, an estimated 910,000 Cambodian migrant workers returned within a short period, equivalent to roughly 10% of the national workforce (CDRI and ERIA, 2026). Many of these returnees came from border provinces (Banteay Meanchey, Battambang, Oddar Meanchey), where labour migration has historically been an important source of household income. Return migration of this scale can influence local labour markets and may increase demand for digital platforms (digital ID systems, local digital payment services) and broader digital absorption. It may also support the growth of small enterprises and the adoption of technical and digital skills in border areas.

IV. METHODOLOGY AND DATA

Data. As noted, this study uses the NIS Cambodia Economic Census 2022, a nationwide survey covering business establishments across Phnom Penh and all provinces. Its dataset on 753,670 establishments details enterprise characteristics, registration status, business operations, employment and use of digital technologies (NIS, 2023). The census is the most comprehensive of its kind.

To improve the reliability of the analysis, extreme outliers are removed using the percentile range method. As the study focuses on financial performance, this filtering is applied specifically to revenue and profit-related variables. Observations falling below the 1st percentile and above the 99th are excluded to reduce the influence of extreme values and improve estimate robustness (Vinutha, et al., 2018).

Model specification. To examine the relationship between digital platform adoption, cross-border trade and firm performance, the study employs a linear probability model with robust standard errors. This approach enables analysis of use of digital platforms and cross-border trade relates to firm performance outcomes.

Firm performance is measured using three indicators (An and Chhorn, 2025). The first is revenue, reported by firms as daily and monthly income in the Economic Census. Given the skewed distribution of this variable, a natural logarithmic transformation is applied. The second indicator is firm registration status, a binary variable capturing whether the establishment is formally registered. The third measure is labour productivity, calculated as total revenue divided by the number of employees and expressed in logarithmic form.

The main explanatory variables are digital platform adoption and participation in cross-border trade. Firms were asked whether they adopted or increased the use of internet-based systems and services during COVID-19, with responses coded as a binary variable where one indicates adoption and zero otherwise. In this study, digital platforms refer to establishments that reported adopting or intensifying use of internet-based tools, such as websites, social media, mobile applications, and email, to support daily business operations during the pandemic. Firms that answered "yes" were asked to identify operational areas in which these tools were applied. Multiple responses were allowed and cross-border trade was identified as one activity conducted through these digital tools. Because this question was posed only to firms that reported digital platform adoption, cross-border trade findings in this study describe patters within this subsample of digital adopters and should not be generalized to the broader population of Cambodian firms engaged in cross-border trade.

Control variables include firm age, ownership structure, business location, type of premises, firm size measured by employment and the gender of the business owner. These factors help account for structural differences across enterprises that may influence performance outcomes.

Model 1: Association between digital platforms and firm performance. We estimate, using the linear probability model for binary, ordinary least squares for continuous outcomes with robust standard errors, a baseline model assessing the relationship between digital platform adoption and firm performance, measured by revenue, formal registration, and labour productivity:

$$Y_{isp} = \beta_0 + \beta_1 DigitalPlatform_{isp} + \beta_2 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \qquad (1)$$

where:

- Y_{isp}: Performance outcome: (log(revenue), registration status (binary: 1 if registered, 0 otherwise), or log(LaborProductivity)=log(Revenue/Employees))
- $DigitalPlatform_{isp}$: Binary variable (1 = adopted digital platform; 0 = not adopted)
- X_{isp}: Vector of firm-level controls (sex of owner, firm age, tenure, business place type, area of business)
- α_s, θ_p: Sector and province fixed effects
- ε_{isp}: Error term

Model 2: Association between digital platforms and firm performance: A comparative analysis of capital city and provinces. This model captures the differential association of digital platform adoption across regions:

$$Y_{isp} = \gamma_0 + \gamma_1 \text{DigitalPlatform}_{isp} + \gamma_2 \text{PhnomPenh}_{isp} + \gamma_3(\text{DigitalPlatform}_{isp} \times \text{PhnomPenh}_{isp}) + \gamma_4 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (2)$$

where:

- PhnomPenh_{isp}: Dummy variable for firms located in Phnom Penh
- $\text{DigitalPlatform}_{isp} \times \text{PhnomPenh}_{isp}$: Interaction term capturing the amplified association of digital adoption in Phnom Penh (proxy for foreign platform access)

We interpret that γ_1 captures local platform associations, and γ_3 captures additional association in Phnom Penh.

Model 3: Association between digital platforms and firm performance: a comparative analysis of women- and non-women-owned enterprises. This model explores differential associations between female- and male-owned firms:

$$Y_{isp} = \delta_0 + \delta_1 \text{DigitalPlatform}_{isp} + \delta_2 \text{FemaleOwner}_{isp} + \delta_3 (\text{DigitalPlatform}_{isp} \times \text{FemaleOwner}_{isp}) + \delta_4 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (3)$$

where:

- emaleOwner_{isp} : Dummy variable (1 if female-owned, 0 otherwise)
- $\text{DigitalPlatform}_{isp} \times \text{FemaleOwner}_{isp}$: Interaction capturing gender-differentiated returns to platform adoption

We interpret that δ_1 captures the association for male-owned firms, and δ_3 captures the marginal association for female-owned firms.

Model 4: Association between digital platforms and firm performance: Analysis of firm size. This model examines whether platform adoption associations vary by firm size:

$$Y_{isp} = \lambda^0 + \lambda^1 \text{DigitalPlatform}_{isp} + \lambda^2 \text{SmallFirm}_{isp} + \lambda_3 \text{MediumFirm}_{isp} + \lambda_4 (\text{DigitalPlatform}_{isp} \times \text{SmallFirm}_{isp}) + \lambda_5(\text{DigitalPlatform}_{isp} \times \text{MediumFirm}_{isp}) + \lambda_6 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (4)$$

where:

- SmallFirm_{isp}, MediumFirm_{isp}: Dummies for firm size category (reference group: micro)
- $\text{DigitalPlatform}_{isp} \times \text{SmallFirm}_{isp}$ and $\text{DigitalPlatform}_{isp} \times \text{MediumFirm}_{isp}$ Interaction terms capture the marginal association of digital adoption by firm size

We interpret that λ_1 represents the association for micro firms, and λ_4,λ_5 represent additional associations for small and medium firms.

Model 5: Association between digital platform and firm performance: an analysis of border provinces. This model investigates the differential association of digital platform adoption across regions:

$$Y_{isp} = \gamma_0 + \gamma_1 DigitalPlatform_{isp} + \gamma_2 BorderProvinces_{isp} + \gamma_3 (DigitalPlatform_{isp} \times BorderProvinces_{isp}) + \gamma_4 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (5)$$

- $BorderProvinces_{isp}$: Dummy variable for firms located in the border provinces
- $DigitalPlatform_{isp} \times BorderProvinces_{isp}$: Interaction term capturing the amplified association of digital adoption in the border province

We interpret that γ_1 captures the platform association and γ_3 captures the additional association in provinces next to the Thai border.

Model 6: Association between cross-border trade and firm performance

$$Y_{isp} = \beta_0 + \beta_1 \text{ Cross border trade}_{isp} + \beta_2 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (6)$$

where:

- $\text{Cross border trade}_{isp}$ 1 = Yes; 0 = No.

We interpret that γ_1 captures cross border associations on firm performance.

Model 7: **Association between intellectual property–trade activities and firm performance.** This model examines the differential association of firms with patent, industrial design and trademark ownership with firms' performance. It also explores the differential association of digital platform adoption across patent, industrial design and trademark:

$$Y_{isp} = \beta_0 + \beta_1 Patent_{isp} + \beta_2 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (7)$$

$$Y_{isp} = \beta_0 + \beta_1 Industrial\ design_{isp} + \beta_2 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp}$$

$$Y_{isp} = \beta_0 + \beta_1 Trademark_{isp} + \beta_2 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp}$$

$$Y_{isp} = \gamma_0 + \gamma_1 DigitalPlatform_{isp} + \gamma_2 Patent_{isp} + \gamma_3 (DigitalPlatform_{isp} \times Patent_{isp}) + \gamma_4 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp}$$

$$Y_{isp} = \gamma_0 + \gamma_1 DigitalPlatform_{isp} + \gamma_2 Industrial\ design_{isp} + \gamma_3 (DigitalPlatform_{isp} \times Industrial\ design_{isp}) + \gamma_4 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp}$$

$$Y_{isp} = \gamma_0 + \gamma_1 DigitalPlatform_{isp} + \gamma_2 Trademark_{isp} + \gamma_3 (DigitalPlatform_{isp} \times Trademark_{isp}) + \gamma_4 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp}$$

where:

- $Patent_{isp}$; $Industrial\ design_{isp}$; $Trademark_{isp}$: (1 = adopted; 0 = not adopted)
- $DigitalPlatform_{isp} \times Patent_{isp}$, $DigitalPlatform_{isp} \times Industrial\ design_{isp}$, $DigitalPlatform_{isp} \times Trademark_{isp}$: Interaction term capturing the amplified association of digital adoption in patent, industrial design and trademark (proxy for trade requirement)

We interpret that γ_1 captures local platform associations and γ_3 captures additional association for firms that adopt patent, industrial design and trademark.

Model 8: Association between digital platforms x cross border trade and firm performance This model investigates the differential association of digital platform and cross border trade on firm performance in Cambodia:

$$Y_{isp} = \gamma_0 + \gamma_1 DigitalPlatform_{isp} x CrossBorderTrade_{isp} + \gamma_2 X_{isp} + \alpha_s + \theta_p + \varepsilon_{isp} \quad (8)$$

where:

- Y_{isp} explain firms' performance in Cambodia
- $DigitalPlatform_{isp} x CrossBorderTrade_{isp}$ capturing the amplified association of digital platform and cross border trade

We interpret that captures platform effects. To improve interpretability and statistical reliability, both revenue and labour productivity are transformed using natural logarithms. Firm-level financial variables are typically right-skewed, with a small number of firms reporting extremely high values. Log transformation helps normalize the distribution, reduce heteroskedasticity and allow estimated coefficients to be interpreted as approximate percentage changes.

Robust standard errors are applied in all models to correct for potential heteroskedasticity, a common feature of micro-level economic data where the variance of residuals may differ across observations. In addition, multicollinearity diagnostics, such as variance inflation factors, are conducted due to the inclusion of interaction terms, which may increase correlations among regressors and affect the precision of coefficient estimates.

The analysis is based on the Economic Census 2022. After excluding observations with missing values, the final dataset includes 724,796 firms. To account for heterogeneity across enterprises, the regression models include firm size, industry and province fixed effects. Each performance indicator is estimated in a separate

regression model to isolate the distinct effects of digital platform adoption. Table 2 presents the descriptive statistics of the key variables.

Table 2. Summary statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
Revenue (US$)	724,796	2,217.45	26,491.26	50	8,591,781.00
Registration status	724,796	0.05	0.21	0	1
Digital platform adoption	724,796	0.01	0.10	0	1
Year of operation	724,796	4.84	0.60	1	6
Sex of firm's owner	724,796	0.70	0.46	0	1
Firm ownership	724,796	1.01	0.09	1	3
Tenure of business	724,796	1.28	0.48	1	3
Business place	724,796	2.34	1.07	1	7
Area of business	724,796	3.25	1.86	1	9

Note. Revenue is measured in US dollars. The variables year of operation, sex of the firm's owner, firm ownership, business tenure, business location and business sector are categorical and coded into ordered ranges based on their respective minimum and maximum values. Registration status and digital platform adoption are binary indicators, coded as 1 = yes and 0 = no.
Source. Authors' elaboration, using Cambodia Economic Census 2022

Limitations and interpretation of results. Despite the strengths of the large nationally representative dataset, several limitations should be acknowledged. First, the reliance on cross-sectional data from the Economic Census 2022, which captures firm characteristics at a single point in time, means the econometric models identify statistical associations rather than causal relationships between digital platform adoption, cross-border trade, and firm performance.

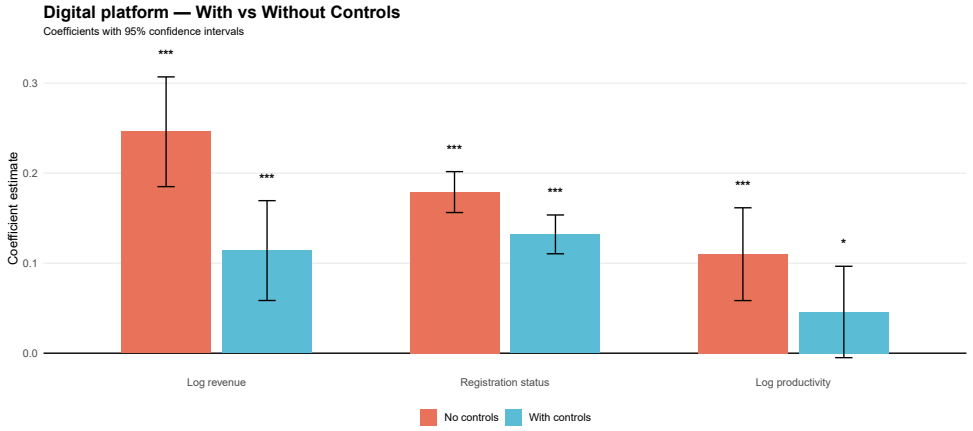
Firms that perform better may be more likely to adopt digital technologies, creating potential reverse causality. Second, unobserved firm characteristics, such as managerial ability, access to networks or prior technological capabilities may influence both digital adoption and performance outcomes, leading to omitted variable bias. Third, the measure of digital platform adoption is based on self-reported responses during COVID-19 and does not capture the intensity or quality of digital usage. Findings should thus be interpreted as correlations that highlight important patterns and relationships rather than definitive causal effects. Careful interpretation is required when drawing policy implications from the results.

V. KEY FINDINGS

Association between digital platforms and firm performance. Figure 6 shows the relationship between digital platform adoption and firm performance. The results indicate that firms adopting digital platforms tend to perform better than those that

do not. Digital adoption is positively associated with revenue growth, improvements in formal registration status and gains in productivity. However, once firm-level characteristics are considered, the positive associations become smaller. This suggests that performance gains reflect both digital adoption and underlying firm attributes, including size, capacity and resources. Digital platforms support firm upgrading, but their effectiveness depends on structural conditions that enable firms to use digital tools productively.

Figure 6. Association between platforms and firm performance

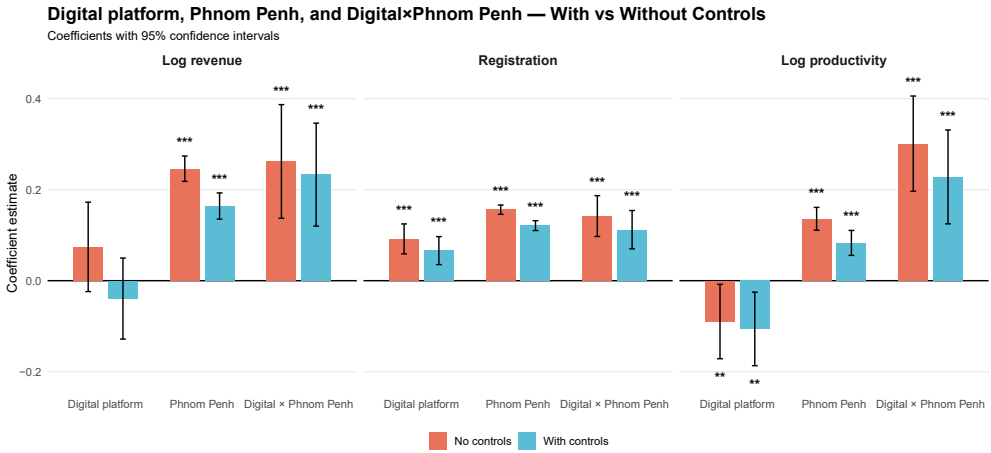


*Note. Province and industry fixed effects included in all specifications. Industry fixed effects include manufacturing, electricity, water, construction, sales and retail, transportation, accommodation, ICT, finance, real estate, professional, admin, education, health, arts and other services. Control variables include provinces, sex of business owners, year of operation, tenure of business, business place and area of business size. Observations = 724,796. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*

Source. Authors' elaboration.

Association between digital platforms and firm performance. A comparative analysis of capital city and provinces. Figure 7 shows that the associations between digital platform adoption and revenue, formal registration and productivity vary by location.

Figure 7. Association between digital platforms and firm performance: A comparative analysis of capital city and provinces



*Note. Firm size and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 724,796. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*
Source: Authors' elaboration

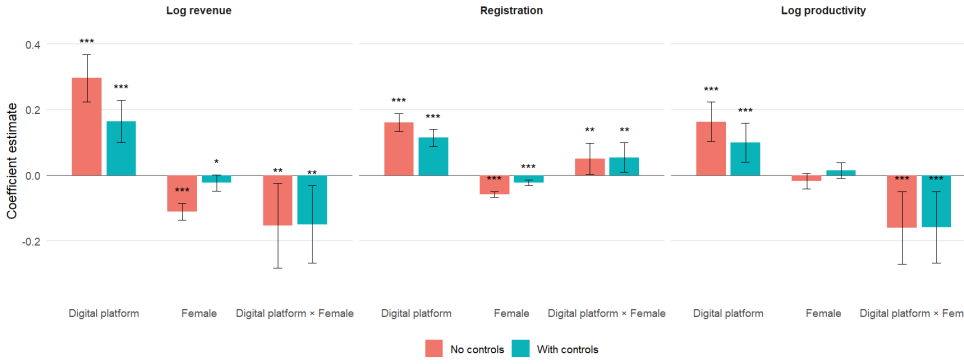
Once firm characteristics are considered, digital adoption alone does not generate a clear revenue premium. However, Phnom Penh firms perform significantly better overall, and the positive interaction between digital adoption and Phnom Penh location suggests that digital tools are more effective when firms operate within the capital's stronger business ecosystem.

A similar pattern appears for formal registration. Digital platform use is positively associated with formalisation, while Phnom Penh firms are more likely to be registered even without digital adoption. Their combined association further increases formal upgrading, suggesting that digitalisation complements the capital's institutional advantages. Productivity associations are more uneven.

Outside Phnom Penh, digital adoption is associated with weaker or negative productivity outcomes, while capital-based firms gain more clearly. Overall, digital platforms do not produce uniform spatial benefits. Their returns depend on infrastructure, skills, market connectivity and local conditions, potentially reinforcing Phnom Penh's agglomeration advantages over other provinces.

Association between digital platforms and firm performance: A comparative analysis of female- and male-owned enterprises. Figure 8 illustrates the association between digital platform adoption and firm performance, comparing women-owned and male-owned enterprises across revenue, formal registration, and productivity.

Figure 8. Association between digital platforms and firm performance: A comparative analysis of female- and male-owned enterprises



*Note. Province and industry fixed effects included in all specifications. Control variables include provinces, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 724,796. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1. Source: Authors' elaboration.*

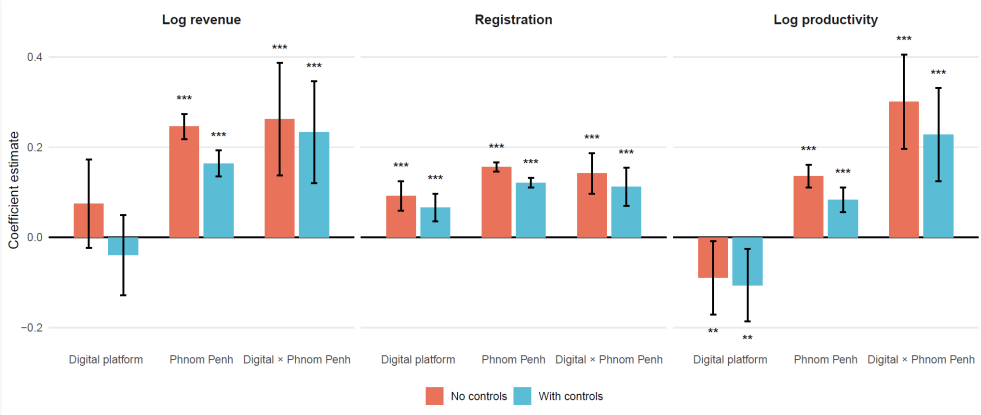
The results show that digital platform adoption is positively associated with revenue growth, even after controlling for firm characteristics. However, female-owned enterprises report weaker revenue performance than male-owned firms, and the interaction effect suggests that women-owned firms gain less from digital adoption. A similar pattern appears for formal registration. Digital adoption increases the likelihood of formalisation, but women-owned firms are generally less likely to be registered, and platform use does not substantially strengthen their formalisation beyond the general adoption effect. The gender gap is most evident in productivity outcomes. While digital adoption is linked to productivity improvements overall, women-owned enterprises do not experience comparable gains. This suggests that digital platforms support firm upgrading, but their benefits are not gender neutral. Structural constraints facing women entrepreneurs limit the extent to which digital adoption improves performance. Digital transformation therefore needs complementary support to address gender-specific barriers.

Association between digital platforms and firm performance: An analysis of firm size. Figure 9 shows that the associations between digital platform adoption and firm performance vary across firm sizes. For revenue, digital adoption is positively associated with firm performance overall, but the gains differ substantially. Small and especially medium-sized firms show stronger positive associations between digital platform adoption and revenue than micro firms. The interaction terms suggest that digital platforms adoption is associated with larger revenue larger revenue differences as form size increases, consistent with larger firms being able to use digital tools for market expansion, customer reach and operational scaling. These results remain

robust after controlling for firm characteristics, although the coefficient sizes become smaller.

For formal registration, digital adoption is also positively associated with a higher likelihood of formalisation. Small and medium firms are more likely to be formally registered than micro firms, and digital use reinforces this pattern. This suggests that digital platforms support business upgrading, especially among firms that have already moved beyond micro scale and are closer to formal business structures.

Figure 9. Association between digital platforms and firm performance: An analysis of firm size



*Note. Province and industry fixed effects included in all specifications. Control variables include provinces, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 724,796. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1. Source: Authors' elaboration.*

The productivity results are more mixed. Digital adoption is linked to productivity improvements overall, but the gains are mainly concentrated among small firms. For medium-sized firms, the productivity associations are weaker and less consistent. This may reflect diminishing marginal returns or the fact that some medium firms already possess stronger technological and managerial capacity.

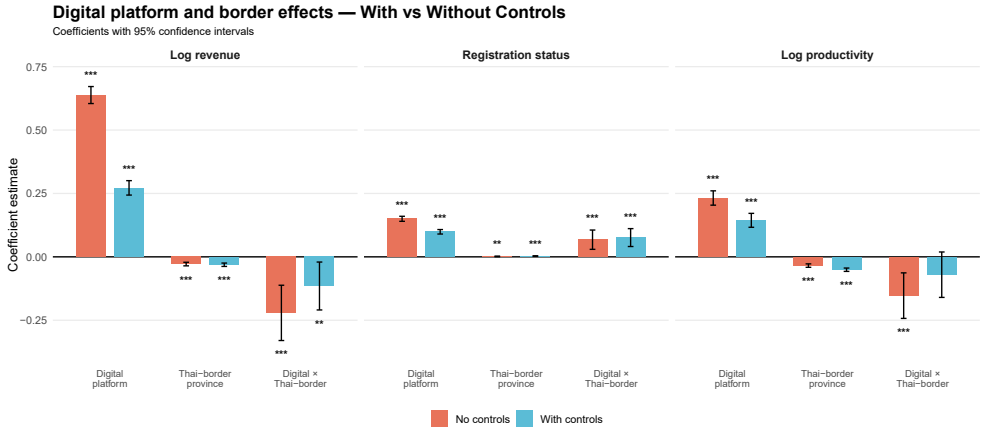
The findings show that firm size strongly shapes the benefits of digital platform adoption. Digitalisation appears to operate as a scaling tool, producing stronger gains for firms with greater organisational capacity, capital and management capabilities. Rather than benefiting all firms equally, digital platforms may reinforce structural differences between micro, small and medium enterprises.

Association between digital platform and firm performance: Analysis of border provinces. Figure 10 illustrates how digital platform adoption is associated with

firm performance in border provinces, focusing on revenue, registration status and productivity while accounting for province and industry fixed effects.

Overall, digital platform adoption is positively and significantly associated with revenue, formal registration and productivity. Even after controlling for firm characteristics, the coefficients remain positive, although smaller in magnitude. However, firms located in border provinces display weaker baseline performance in revenue and productivity. The coefficients for border provinces are negative in these dimensions. In contrast, for registration status, the coefficient is positive.

Figure 10. Association between digital platform and firm performance: Analysis of border provinces



*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 724,796. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1. Source: Authors' elaboration.*

The interaction between digital platform adoption and location next to the border reveals important heterogeneity. For revenue, the interaction term is negative and statistically significant, implying that the revenue gains from digital adoption are smaller in border provinces. In other words, digital tools generate weaker income returns for firms operating near the Thai border.

For registration status, the interaction term is positive and significant. This suggests that digital platform adoption contributes more strongly to formalization in border provinces compared to non-border areas. Digital tools may facilitate compliance, documentation or integration into formal trade networks in these regions.

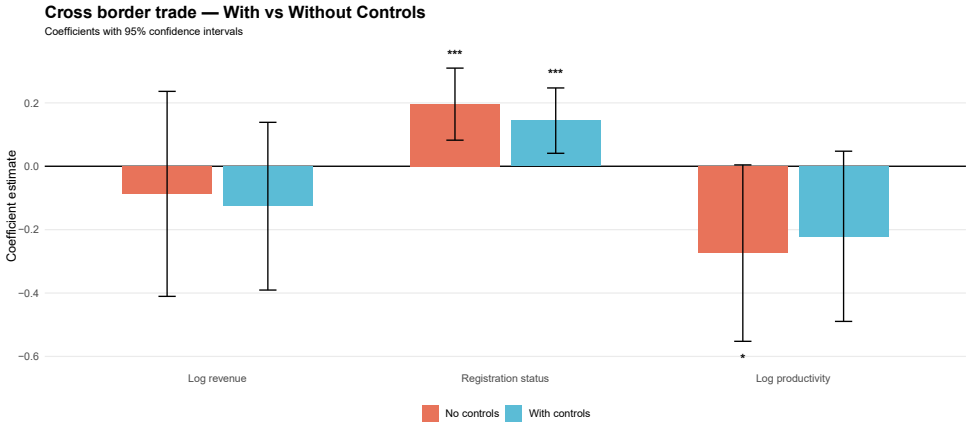
For productivity, the interaction term is negative, indicating that productivity gains from digital adoption are weaker in border provinces. Once controls are included,

the interaction term becomes statistically weaker, reinforcing the idea that firm characteristics partially account for the observed differences.

The evidence suggests that while digital platforms enhance firm performance across Cambodia, their economic returns are spatially uneven. In border provinces, digital adoption supports formalization but does not translate into comparable gains in revenue or productivity. This implies that structural constraints in border regions may limit firms' ability to fully leverage digital technologies for economic upgrading.

Association between cross-border trade and firm performance. As the cross-border trade question was asked only of firms that had already adopted digital platforms, the results below characterize this subsample and are not representative of all Cambodian firms engaged in cross-border trade. Figure 11 shows the relationship between cross-border trade participation and firm performance. The results suggest a mixed pattern across different performance dimensions. Firms engaged in cross-border trade are more likely to be formally registered. This supports the view that participation in international markets requires legal recognition, documentation, and administrative compliance. Engagement in cross-border activities appears to encourage firms to formalize to meet regulatory and contractual requirements.

Figure 11. Association between cross-border trade and firm performance in provinces along the border



*Note. In the existing dataset, the questionnaire was asked the firms who adopted digital platforms. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place and area of business size. Observations = 5,954. Sample limited to firms that answered the cross-border trade question, asked only of firm that had already reported adopting a digital platform during the pandemic (6,680 of 724,796 firms): after matching with model covariates, 5,954 firms have complete data. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*
Source. Authors' elaboration.

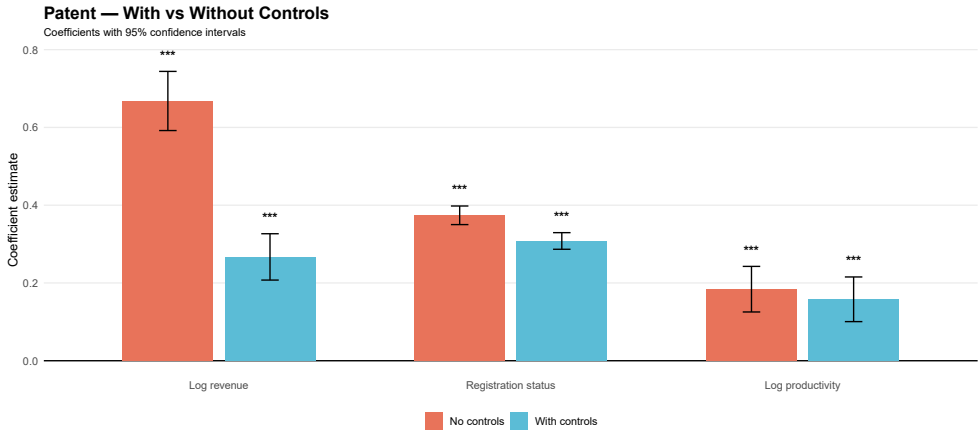
In contrast, cross-border trade is not associated with stronger revenue performance. The estimated relationship is negative and not statistically robust, indicating that firms involved in cross-border trade do not necessarily generate higher income. A similar pattern emerges for labour productivity. Cross-border trading firms tend to exhibit weaker productivity performance, although the strength of this relationship diminishes once firm characteristics are taken into account.

The findings suggest that while Cambodian firms are participating in cross-border trade, this engagement may still be at an early or transitional stage. Firms appear to formalize in order to access external markets, but this does not yet translate into clear gains in revenue or productivity. This pattern may reflect limited value-added integration, dependence on imports, thin profit margins or capacity constraints that prevent firms from fully capturing the benefits of international trade.

Association between intellectual property–trade activities and firm performance. This section examines the relationship between intellectual property ownership, patents, industrial designs, and trademarks, and firm performance, as well as how these assets interact with digital platform adoption.

Figure 12 shows that firms holding patents are consistently associated with stronger performance in revenue, registration status, and labour productivity. Patent ownership appears to signal higher innovative capacity and technological capability. Firms with patents are more likely to generate higher income, operate formally, and achieve productivity improvements compared to firms without patents.

Figure 12. Patent on firm performance in Cambodia



*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 716,440. Slightly below the full 724,796 due to item non-response on the patent, industrial design, and trademark questions. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*

Source. Authors' elaboration, using Cambodia Economic Census 2022.

A similar pattern is observed in Figure 13, where firms with industrial design protection demonstrate better performance across revenue, formalization, and productivity. Industrial design ownership likely reflects product differentiation and market positioning, which enhance competitiveness and upgrading outcomes.

Figure 13. Industrial and creative design on firm performance in Cambodia

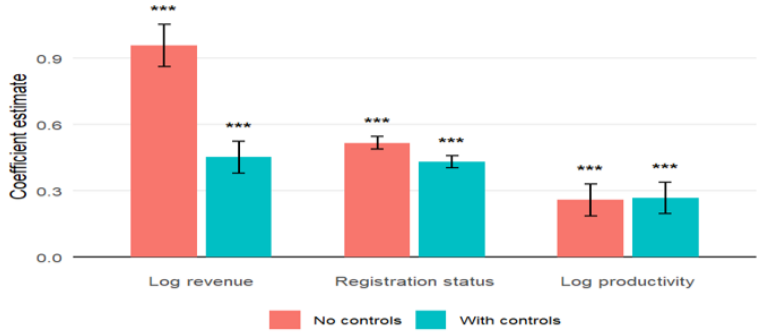


*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 716,231. Slightly below the full 724,796 due to item non-response on the patent, industrial design, and trademark questions. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*

Source. Authors' elaboration, using Cambodia Economic Census 2022.

The strongest associations are found in Figure 14 for trademark ownership. Firms with trademarks exhibit clear advantages in revenue expansion, formal registration and labour productivity. Trademark protection appears closely linked to branding strength, customer recognition, and commercial visibility, all of which contribute to firm growth. When considering the interaction between digital platforms and intellectual property, the results become more nuanced.

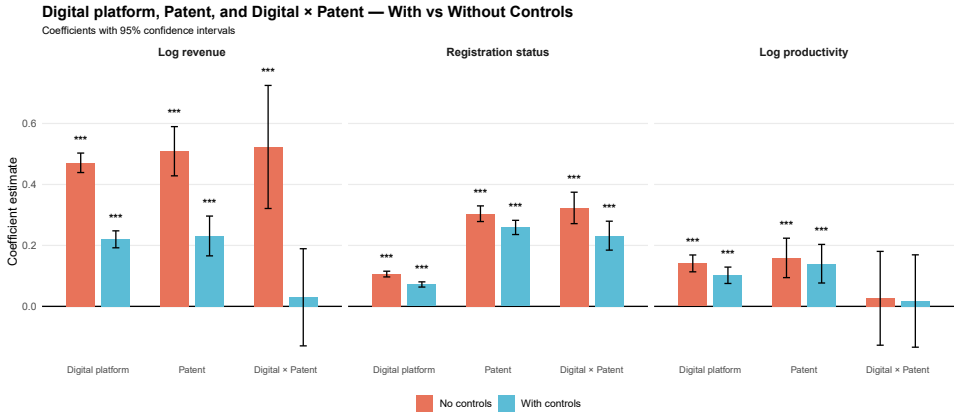
Figure 14. Trademark on firm performance in Cambodia



*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place and area of business size. Observations = 716,475. Slightly below the full 724,796 due to item non-response on the patent, industrial design, and trademark question. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*
Source. Authors' elaboration, using Cambodia Economic Census 2022.

In Figure 15, which shows the interaction between digital platform adoption and patents, both digital adoption and patent ownership independently show positive relationships with firm performance. However, the combined association is not consistently linked to additional revenue gains differences once firm characteristics are accounted for. For registration and productivity, the joint presence of digital platforms and patents remains positively associated with firm upgrading, though the incremental advantage of combining both is relatively limited.

Figure 15. Interaction of digital platforms and patent on firm performance in Cambodia

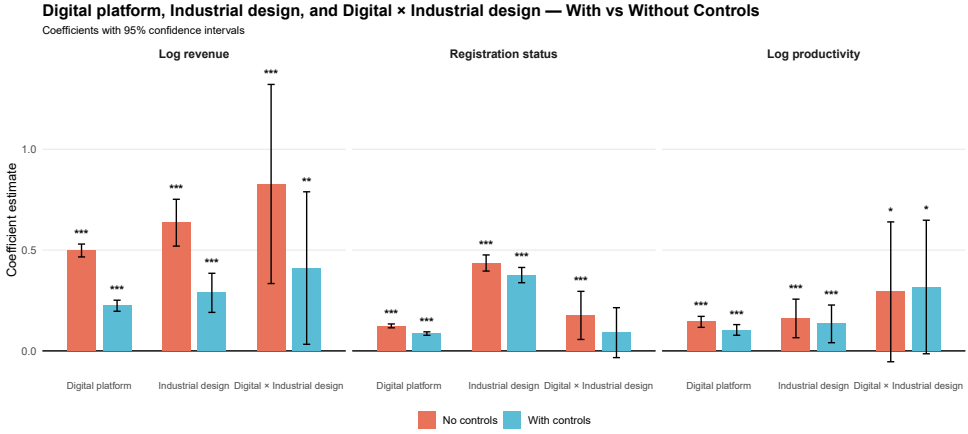


*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 716,440. Slightly below the full 724,796 due to item non-response on the patent, industrial design, and trademark questions. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*
Source. Authors' elaboration, using Cambodia Economic Census 2022.

In Figure 16, digital platform adoption and industrial design ownership each contribute positively to revenue and productivity. Firms combining both tend to show stronger performance. However, after controlling for firm characteristics, the association with registration status becomes less robust. This suggests that industrial design protection is less directly tied to regulatory compliance compared to patents.

Finally, Figure 17 shows the interaction between digital platforms and trademarks. While digital adoption and trademark ownership each show positive associations with revenue, registration, and productivity, their combined association does not consistently correspond to additional differences beyond their individual contributions. This indicates that digitalization and branding may operate through overlapping channels, limiting the marginal benefit of adopting both simultaneously.

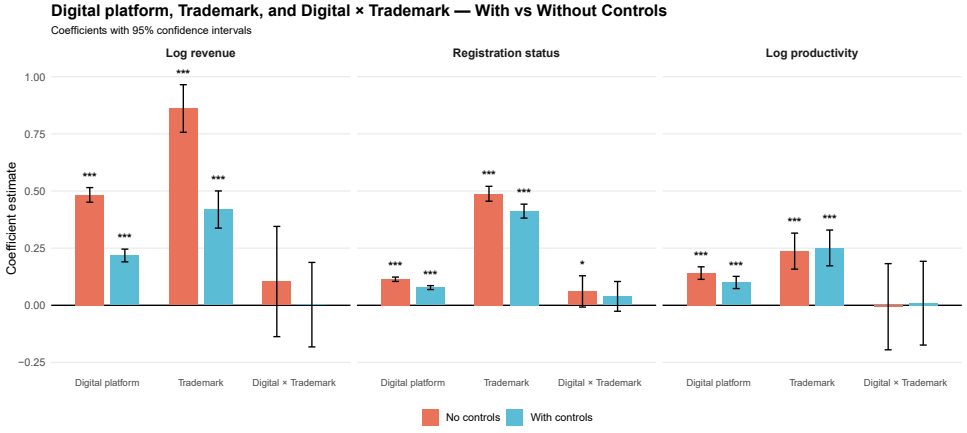
Figure 16. Interaction of digital platforms and industrial design on firm performance in Cambodia



*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 716,231. Slightly below the full 724,796 due to item non-response on the patent, industrial design, and trademark questions. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*

Source. Authors' elaboration, using Cambodia Economic Census 2022.

Figure 17. Interaction of digital platforms and trademark on firm performance in Cambodia



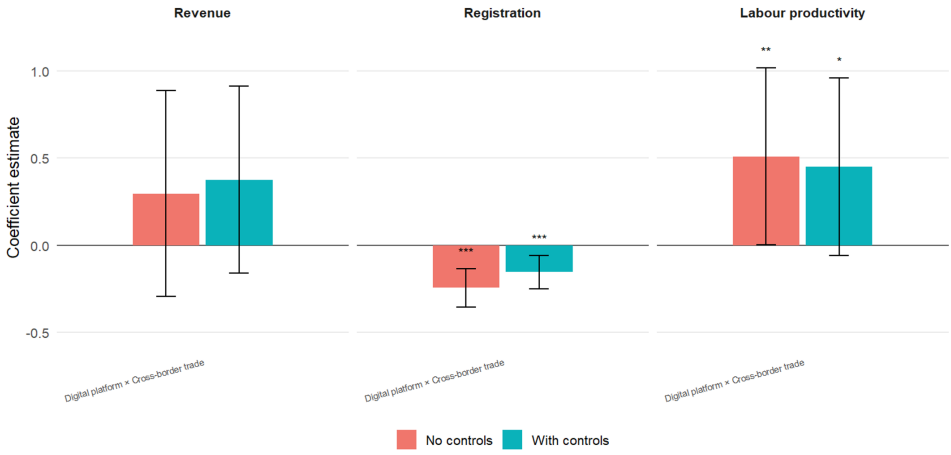
*Note. Province and industry fixed effects included in all specifications. Control variables include firm size, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 716,470. Slightly below the full 724,796 due to item non-response on the patent, industrial design, and trademark questions. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*

Source. Authors' elaboration, using Cambodia Economic Census 2022.

The evidence across figures 12 to 17 suggest that intellectual property ownership is strongly associated with firm upgrading in Cambodia. Patents, industrial designs, and trademarks represent different dimensions of competitiveness, innovation, product differentiation and branding. Digital platform adoption is associated with firm performance, but its interaction with intellectual property is not always associated with additive effects. The findings highlight the importance of underlying firm capabilities in translating digital and intellectual assets into measurable economic outcomes.

Association between digital platforms x cross border trade and firm performance. As with the cross-border trade results above, this analysis is confined to the subsample of digital-adopting firms and should be interpreted accordingly. Figure 18 shows whether digital platform adoption interacts with cross-border trade to influence firm performance. For revenue, the interaction is positive but not statistically robust once controls are included. For registration status, the interaction is negative and statistically significant. For labour productivity, the interaction is positive and statistically significant.

Figure 18. Association between of digital platforms x cross border trade and firm performance

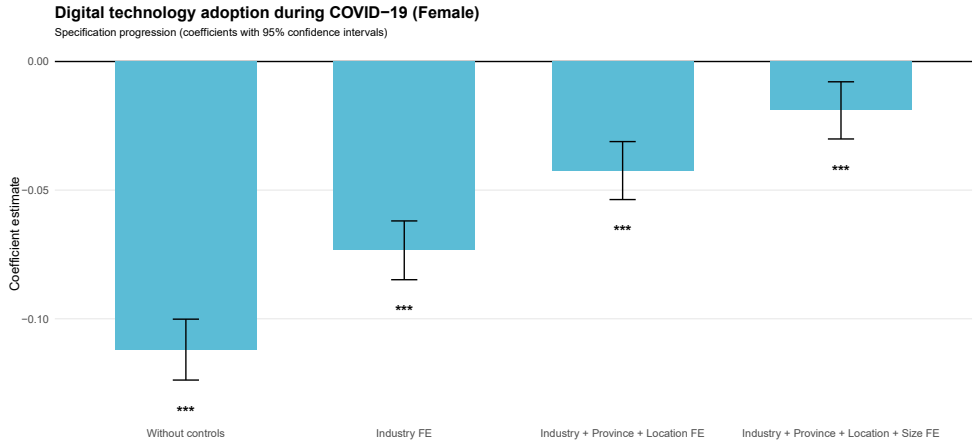


*Note. Province and industry fixed effects included in all specifications. Control variables include provinces, sex of business owners, year of operation, tenure of business, business place, and area of business size. Observations = 6,144. Sample restricted to the same cross-border trade respondents. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*
Source. Authors' elaboration, using Cambodia Economic Census 2022.

Role of structural and gender barriers in firms' adoption of digital technologies[2]
Adopting digital technologies is a key factor that encourages firms to use digital platforms and improve their performance. However, the distribution of the benefits from digital platforms is not even for all firms. This section explores factors that hinder firms' adoption of digital technology.

S**tructural barriers.** Figure 19 shows that female-owned firms are significantly less likely than male-owned firms to adopt digital technologies. However, this gap narrows after controlling for sector, province, business location and firm size, suggesting that gender differences reflect structural firm characteristics, including sectoral concentration, location and smaller scale.

Figure 19. Digital technology adoption and sex of business owner



*Note. Province and industry fixed effects included in all specifications. Control variables include provinces, sex of business owners, year of operation, tenure of business, business place and area of business size. Observations = 414 micro, small and medium-sized enterprises. Robust standard errors *** p<0.01, ** p<0.05, * p<0.1.*
Source. Authors' calculation

Gendered barriers. Drawing from the quantitative and qualitative results of CDRI firm survey, we find that there are 4 main barriers to firms adopting digital technologies.

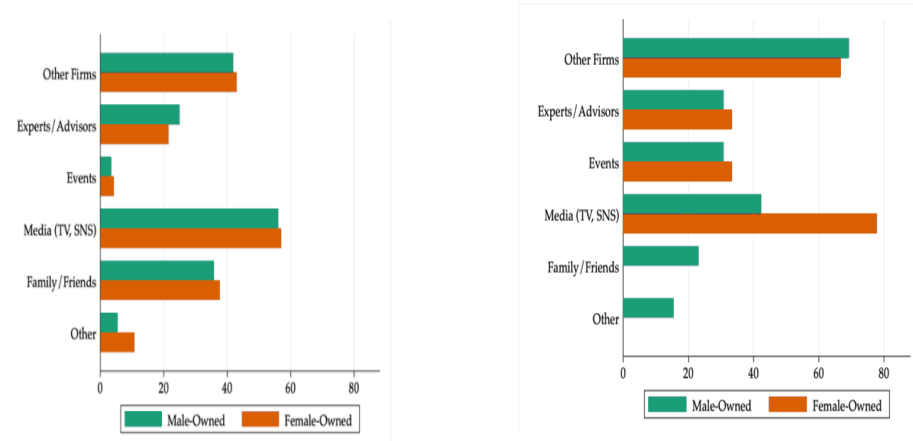
Barrier 1: Limited information access. Figure 20 illustrates the limited information

[2] In addition to the Economic Census 2022, we incorporated the analysis of a primary dataset, collecting from 414 micro, small and medium-sized and 32 key informant interviews conducted by the CDRI. These interviews with business owners, policy officials, platform managers and development partners enable detailed understanding of gendered and structural barriers to digital and green adoption, especially for women- and youth-led enterprises and rural firms. The survey was conducted in three provinces; Battambang, Siem Reap and Phnom Penh.

access of small and medium firms on digital technology by firm size. First, the findings indicate that both small and medium firms obtain information from various sources, but medium firms appear to have greater demand for such information than small firms. Second, the findings suggest that informal networks are the main source of information for female-owned firms. Female-owned firms, for both sizes, have a higher percentage receiving information than their male counterparts, particularly in media.

Figure 20. Source of information by firm size

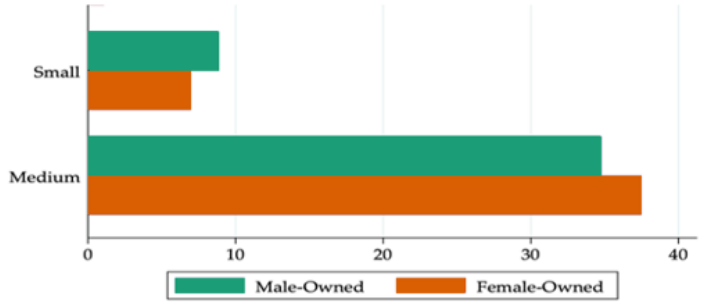
Small (a) Medium (b)



Source. Figures taken from Kanayama, et al. (2025).

In the information networks, participation in business associations is a main factor in determining firms' digital technology adoption. Figure 21 illustrates the large gap between small and medium firms in getting access to information due to business association. In addition, female-owned medium firms have higher participation in business associations than their male-owned counterparts do, while the reverse is true among small firms.

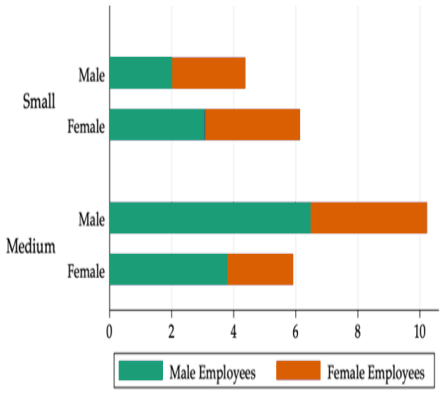
Figure 21. Joining business association by firm size and gender



Source. Kanayama, et al., 2025.

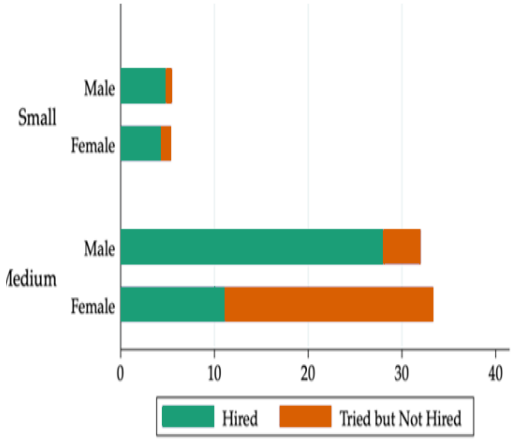
Barrier 2: Gaps in skills and knowledge in small and medium-sized enterprises (SMEs). The main barrier to digital technology adoption among firms is limited skills and knowledge. Figures 22 and 23 indicate notable differences in both employment of ICT qualified workers and related recruitment efforts. Small firms, regardless of ownership, show only limited variation in hiring and recruitment of ICT-skilled employees. In contrast, medium-sized firms, particularly male-owned, employ a higher share of ICT-qualified workers, suggesting relatively stronger recruitment capacity and access to resources than female-owned firms.

Figure 22. Employees with ICT degrees (%)



Source. The figures are taken from Kanayama, Yuki; Houy, Sivly; Veung, Naron. "Gendered Barriers Facing Micro, Small, and Medium-Sized Enterprises in the Digital and Green Economy in Major Cambodian Cities." (2025).

Figure 23. Firms' recruitment efforts



Source. The figures are taken from Kanayama, Yuki; Houy, Sivly; Veung, Naron. "Gendered Barriers Facing Micro, Small, and Medium-Sized Enterprises in the Digital and Green Economy in Major Cambodian Cities." (2025).

Barrier 3: Limited financial access. Limited access to finance is a significant barrier to digital technology adoption. Male-owned small firms rely more on commercial banks, while female-owned small firms depend more on microfinance institutions. Small firms also use informal financing from family or friends, unlike medium firms. Table 3 ranks securing funds among owners' top three priorities.

Table 3. Securing funding as necessary interventions

		Digital (%)
Small	Male	12.1
	Female	18.6
Medium	Male	0.0
	Female	0.0

Note. Respondents were asked to select their top three priority interventions from the provided options for digital transformation.
Source. The table is taken from Kanayama, 2025.

Barrier 4: Additional barriers. Beyond the barriers discussed, the findings also identify inadequate digital infrastructure and cybersecurity concerns as key constraints to digital technology adoption. The persistent gap in digital infrastructure, particularly in access to a reliable electricity supply and internet connectivity, between rural and urban areas leads to varying digital technology adoption among firms. In addition, interviewees highlighted the need to strengthen cybersecurity literacy, including awareness of cyber threats and preventive measures. Women-owned firms may face higher exposure to digital risks where access to cybersecurity training, trusted information and formal support networks are limited.

VI. CONCLUSION AND POLICY RECOMMENDATIONS

This study examined the relationship between digital platform adoption, cross-border trade participation, and firm performance in Cambodia. Using nationally representative firm-level data, the analysis explored how digital platforms influence revenue, formalisation, productivity and trade engagement while also identifying structural constraints that shape firms' ability to benefit from digital technologies. The results provide new empirical evidence on the role of digital platforms in supporting firm development and economic integration in a small open economy.

The findings show that digital platform adoption is positively associated with firm performance. Firms that use digital platforms tend to report higher revenue, greater levels of formalization and stronger productivity outcomes compared with non-adopting firms. Digital platforms expand firms' access to wider markets, facilitate communication with customers and suppliers, and enable more efficient management of business opera-

tions. In addition, digital platform use supports firms' participation in cross-border trade by lowering information and transaction barriers and enabling firms to manage trade-related activities such as online marketing, logistics coordination and intellectual property management, including patents, industrial designs and trademarks.

However, the benefits of digital platform adoption are unevenly distributed across firms and locations. Firms in Phnom Penh and other urban centres gain significantly greater advantages from platform adoption than firms in provincial and border regions. This disparity reflects differences in digital infrastructure, logistics connectivity and access to digital ecosystems. Similarly, gender-based gaps persist: female-owned enterprises tend to benefit less from digital platforms than male-owned firms, suggesting structural barriers in access to digital finance, skills, and networks. The analysis also shows that micro-enterprises often experience stronger marginal gains from platform adoption than larger firms, indicating that digital platforms may serve as an entry point for smaller businesses to participate in the digital economy.

Despite these positive effects, several structural constraints limit the broader association between digital platforms and firm development in Cambodia. Key barriers include limited access to information about digital technologies, financial constraints that restrict investment in digital tools, and insufficient digital skills among entrepreneurs and workers. These constraints are particularly pronounced among firms in rural areas and border provinces, where digital adoption remains in its early stages.

These findings highlight that digital platforms have the potential to become an important driver of firm upgrading, trade participation and inclusive growth in Cambodia. However, realising these benefits requires coordinated policy interventions that strengthen digital ecosystems, reduce structural barriers and support firms' integration into cross-border digital trade networks.

The findings have important implications for SDG-oriented policy design. The positive relationship between digital platform adoption and firm revenue, formalisation and productivity aligns with SDG 8 and SDG 9 (UNDP, 2023; United Nations, 2025), as platforms can improve efficiency, expand markets and support trade-related activities. However, benefits are uneven.

Firms in Phnom Penh and other urban areas gain more than firms in provincial and border areas, suggesting that infrastructure, logistics and digital ecosystem gaps may constrain progress towards SDG 10. Gender gaps also remain important, as female-owned firms benefit less and face barriers in finance, skills, information access and cybersecurity, linking the findings to SDG 5. Cambodia's digital trade policies should therefore combine platform development with targeted support for women-owned firms, micro-enterprises and firms in rural and border areas to ensure more inclusive SDG implementation.

Policy Recommendations

- **Strengthen digital infrastructure and connectivity across regions:** The uneven impact of digital platform adoption reflects disparities in infrastructure and connectivity between the capital city and other provinces. Expanding high-quality broadband infrastructure, improving digital logistics networks, and enhancing last-mile delivery systems are essential to enable firms outside the capital to participate effectively in digital markets. Investments in digital infrastructure should prioritise provincial cities and border economic zones, where digital trade can support regional economic integration.

- **Enhance digital skills and entrepreneurial capabilities:** Limited digital skills remain a major barrier to platform adoption. Policymakers should develop targeted digital skills programmes for entrepreneurs and workers, focusing on practical competencies such as e-commerce operations, digital marketing, online payment systems, and cross-border logistics management. Partnerships between government agencies, universities, and private digital platforms could support training programmes tailored to SMEs and micro-enterprises.

- **Improve access to digital finance for SMEs:** Financial constraints restrict firms' ability to invest in digital technologies and participate in online markets. Strengthening digital financial services, including mobile payments, digital credit, and fintech solutions, can help SMEs adopt digital tools and manage online transactions more effectively. Policies that support fintech innovation and strengthen interoperability among payment systems would further reduce barriers to digital commerce.

- **Promote inclusive digital participation:** The presence of gender gaps in digital platform benefits suggests the need for more inclusive policies. Dedicated programmes to support women-owned businesses, such as digital training initiatives, mentorship programmes, and targeted financing, could help reduce gender disparities in digital adoption and ensure broader participation in the digital economy.

- **Facilitate cross-border digital trade:** Digital platforms can significantly lower barriers to international market access for Cambodian firms. Policymakers should strengthen cross-border digital trade frameworks by improving customs digitalisation, harmonising e-commerce regulations with ASEAN standards, and enhancing logistics coordination for small-parcel exports. Participation in regional digital trade initiatives such as the ASEAN Digital Economy Framework Agreement could further support Cambodia's integration into regional digital markets.

- **Support the development of domestic digital platforms:** While foreign digital platforms dominate many segments of Cambodia's digital economy, local platforms play an important role in supporting domestic transactions and financial inclusion. Policies that encourage innovation, competition, and investment in local digital

platforms, particularly in e-commerce, fintech, and logistics, could help strengthen Cambodia's digital ecosystem and reduce excessive dependence on external platform infrastructure.

Digital platforms represent a transformative opportunity for Cambodia's private sector. By expanding market access, lowering transaction costs, and enabling participation in digital trade networks, these platforms can support firm growth and economic diversification. However, the benefits of digital transformation will not materialise automatically. Addressing structural barriers related to infrastructure, skills, finance, and regulatory coordination is essential to ensure that digital platforms contribute to inclusive and sustainable firm development across Cambodia.

Note on Authors

Dina Chhorn is Centre Director of Development Economics and Trade at the Cambodia Development Resource Institute. He holds a PhD in Economics from the University of Bordeaux and conducted postdoctoral research at the University of Lausanne. His research focuses on economics, finance and development, with publications in leading international journals and active engagement in policy dialogues and academic conferences.

Sivly Houy is a research assistant at the Centre for Development Economics and Trade, Cambodia Development Resource Institute. She holds a bachelor's degree in international relations from Paragon International University, Cambodia. Her work supports policy relevant research and stakeholder engagement on gender inequality, private sector development and the digital economy, contributing to evidence based policy discussions in Cambodia.

Kean Muny Nhim is a research intern at the Centre for Development Economics and Trade, Cambodia Development Resource Institute. She is a master's candidate in Euro-Asian Trade and Economics at the Royal University of Law and Economics (RULE), in partnership with Université Rennes 2. She also holds a dual bachelor's degree in economics and management, awarded in partnership with Université Lumière Lyon 2.

REFERENCES

An, I. Younan, and Chhorn Dina (2025). Firm-Level Performance in Cambodia: An Economic Census-Based Diagnostics. CDRI Working Paper Series No. 152. Phnom Penh: CDRI.

Basu Das, Sanchita, Nishant Jain, Devyani Hari, and Nandini Sharma (2023). A broader trade facilitation approach for resilient and sustainable global value chains. Macroeconomics, Trade, and Livelihoods: Policy Coherence and International Coordination.

Basu Das, Sanchita (2017a). ASEAN Single Window: advancing trade facilitation for regional integration.

Basu Das, Sanchita (2017b). OBOR's digital connectivity offers both benefits and risks.

Basu Das, Sanchita (2017c). The Future of Trade Diplomacy in East Asia. Singapore: ISEAS–Yusof Ishak Institute.

Blut, Markus, Viktorija Kulikovskaja, Marco Hubert, Christian Brock, and Dhruv Grewal (2023). Effectiveness of engagement initiatives across engagement platforms: a meta-analysis. Journal of the Academy of Marketing Science, vol. 51, No. 5, pp. 941–65. https://doi.org/10.1007/s11747-023-00925-7.

Cao, Zengdong, Qin Tu, and Nichola Latoya Williams (2024). E-commerce, pandemic shock, and the survival of small and medium enterprises. China and World Economy, vol. 32, No. 5, pp. 113–39. https://doi.org/10.1111/cwe.12550.

Carballo, Jerónimo, Marisol Rodriguez Chatruc, Catalina Salas Santa, and Christian Volpe Martincus (2022). Online business platforms and international trade. Journal of International Economics, vol. 137, No. July, p. 103599. https://doi.org/10.1016/j.jinteco.2022.103599.

CDRI (2023). The Current State and Role of Digital Technology Adoption in Tourism MSMEs in Cambodia. The Asia Foundation. https://asiafoundation.org/publication/the-current-state-and-role-of-digital-technology-adoption-in-tourism-msmes-in-cambodia/.

CDRI and ERIA (2025). Proposed Programme of Intervention to Integrate Cambodian Returnees into the Cambodian Economy. CDRI Special Report No. 20. Phnom Penh: CDRI.

CDRI and ERIA (2026). Economic Reintegration of Returnees and Border-Province Development Strategies in the Post-Conflict Period. Policy Brief 2026, No. 02 Special Issue. Phnom Penh: CDRI.

Chan, Raksmey (2022). An analysis of Cambodia's e-commerce and way forward. Journal of Management, Economics, and Industrial Organization, vol. 6, No. 3, pp. 88–100.

De Vries, Gaaitzen J. (2010). Small retailers in Brazil: are formal firms really more productive? The Journal of Development Studies, vol. 46, No. 8, pp. 1345–66. https://doi.org/10.1080/00220380903147668.

Deng, Ziliang, Ziyan Zhu, Martin Johanson, and Mikael Hilmersson (2022). Rapid internationalization and exit of exporters: the role of digital platforms. International Business Review, vol. 31, No. 1, p. 101896. https://doi.org/10.1016/j.ibusrev.2021.101896.

Evans, David S., and Richard Schmalensee (2016). Matchmakers: The New Economics of Multisided Platforms. Harvard Business Review Press.

Faisal, Reena, Carl Selasie Amekudzi, Samira Kamran, Beryl Fonkem, Obah Tawo, and Martins Awofadeju (2023). The impact of digital transformation on small and medium enterprises (SMEs) in the USA: opportunities and challenges. vol. 7, No. 6.

Fresh News (2025). How is the Meen Chay international border crossing connected to the history of the country's ancestors? Fresh News.

General Department of Customs and Excise of Cambodia (GDCE) (n.d.). International Merchandise Trade Statistics (online database). Accessed 4 March 2026. https://stats.customs.gov.kh/en?t=1772613642833.

Han, Bing, Miaomiao Li, Yanxia Diao, and Dongri Han (2024). Assessing the effect of digital platforms on innovation quality: mechanism identification and threshold characteristics. Humanities and Social Sciences Communications, vol. 11, No. 1, p. 951. https://doi.org/10.1057/s41599-024-03465-9.

Hing, Vutha, Pide Lun, and Dalis Phann (2011). Irregular migration from Cambodia: characteristics, challenges, and regulatory approach. CDRI, August.

Ho, Mia Hsiao-Wen, Henry F. L. Chung, Russel Kingshott, and Chun-Chen Chiu (2020). Customer engagement, consumption and firm performance in a multi-actor service eco-system: the moderating role of resource integration. Journal of Business Research, vol. 121, No. C, pp. 557–66.

Huang, Jianhong, Raja Nerina Raja Yusof, Azmawani Abd Rahman, and Rozanah Ab Rahman (2025). Determinants of digital technology adoption and its impact on firm performance in manufacturing firms. Journal of Manufacturing Technology Management, vol. 36, No. 5, pp. 1003–25.

International Monetary Fund (IMF), Organisation for Economic Co-operation and Development, United Nations and World Trade Organization (2023). Handbook on Measuring Digital Trade, Second Edition. OECD Publishing.

International Organization for Migration (IOM) (2021). Integration human mobility into cross-border trade, trade facilitation, and border management during COVID-19. IOM.

Jiang, Hong, Jingxuan Yang, and Jinlong Gai (2023). How digital platform capability affects the innovation performance of SMEs—evidence from China. Technology in Society, vol. 72.

Kanayama, Yuki, Sively Houy, and Naron Veung (2025). Gendered barriers facing micro, small, and medium-sized enterprises in the digital and green economy in major Cambodian cities.

Lee, Jeoung Yul, Young Soo Yang, Pervez N. Ghauri, and Byung Il Park (2022). The impact of social media and digital platforms experience on SME international orientation: the moderating role of COVID-19 pandemic. Journal of International Management, vol. 28, No. 4.

Li, Silin, Luwen Gao, Chunjia Han, Brij Gupta, Wadee Alhalabi, and Sultan Almakdi (2023). Exploring the effect of digital transformation on firms' innovation performance. Journal of Innovation and Knowledge, vol. 8, No. 1.

Marzi, Giacomo, Anna Marrucci, Donata Vianelli, and Cristiano Ciappei (2023). B2B digital platform adoption by SMEs and large firms: pathways and pitfalls. Industrial Marketing Management, vol. 114.

Medvedev, Denis, and Ana María Oviedo (2016). Informality and profitability: evidence from a new firm survey in Ecuador. The Journal of Development Studies, vol. 52, No. 3.

Murshid, K. A. S., and Sokphally Tuot (2005). Cambodia's cross-border economy. Cambodia Development Resource Institute.

Nayak, Madhukara, Pushparaj M. Nayak, and Harisha G. Joshi (2025). Digital platforms' use in SMEs – a critical analysis of entrepreneurs' behaviour. Cogent Economics and Finance, vol. 13, No. 1.

National Institute of Statistics (NIS) (2012). Economic Census of Cambodia 2011. National Institute of Statistics.

National Institute of Statistics (NIS) (2023). Economic Census of Cambodia 2022. National Institute of Statistics of Cambodia.

Nucci, Francesco, Chiara Puccioni, and Ottavio Ricchi (2023). Digital technologies and productivity: a firm-level investigation. Economic Modelling, vol. 128.

OECD, and WTO (2017). Chapter 3 – digital connectivity and trade logistics – getting a good shipped across the border and delivered.

OECD (2019). An Introduction to Online Platforms and Their Role in the Digital Transformation. OECD Publishing.

Oeur, Il, and Damnang Nil (2023). Exploring the Social Well-Being of Migrants and Families on the Cambodian-Thai Border in the Period of the COVID-19 Pandemic. Research Report.

Omowole, Bamidele Micheal, Amarachi Queen Olufemi-Phillips, Onyeka Chrisanctus Ofodile, Nsisong Louis Eyo-Udo, and Somto Emmanuel Ewim (2024). Barriers and drivers of digital transformation in SMEs: a conceptual analysis. International Journal of Scholarly Research in Science and Technology, vol. 5, No. 2.

Pholphirul, Piriya, and Pungpond Rukumnuaykit (2010). Economic contribution of migrant workers to Thailand. International Migration, vol. 48, No. 5.

Pitsuwan, Surin, Hidetoshi Nishimura, Ponciano S. Intal, Kavi Chongkittavorn, and Larry Maramis (2017). ASEAN@50 Volume 1: the ASEAN journey: reflections of ASEAN leaders and officials. Economic Research Institute for ASEAN and East Asia (ERIA).

Quach, Sara, Park Thaichon, Kelly D. Martin, Scott Weaven, and Robert W. Palmatier (2022). Digital technologies: tensions in privacy and data. Journal of the Academy of Marketing Science, vol. 50, No. 6.

Rahman, Mohammad Toufiqur, Abdullah Mohammad Shahabuddin, Mostafa Manir Chowdhury, Mohin Uddin, Alifa Mostafa Chowdhury, and Nazrul Islam (2024). Nexus between digital communication platforms and sales performance in Bangladeshi SMEs.

Ratana, Phurik-Callebaut (2020). SME Internationalization in Cambodia: Study on Barriers and Mapping of Supporting Service Providers.

Schreieck, Maximilian, Yongli Huang, Alexander Kupfer, and Helmut Krcmar (2024). The effect of digital platform strategies on firm value in the banking industry. Journal of Management Information Systems, vol. 41, No. 2.

Setthachotsombut, Natpatsaya, Procomet, and Pannarai (2022). Enhancing cross-border transportation capabilities of road freight entrepreneur Chong Chom permanent border crossing, Thailand–Cambodia.

Shah, Naimatullah, Abdul Wahid Zehri, Ummi Naiemah Saraih, Nadia A. Abdelmegeed Abdelwahed, and Bahadur Ali Soomro (2024). The role of digital technology and digital innovation towards firm performance in a digital economy. Kybernetes, vol. 53, No. 2.

Sharabati, Abdel-Aziz Ahmad, Ahmad Ali Atieh Ali, Mahmoud Izzat Allahham, Alhareth Abu Hussein, Ahmad Fathi Alheet, and Abdelaziz Saleh Mohammad (2024). The impact of digital marketing on the performance of SMEs.

Tagaki, Soichiro (2020). Literature survey on the economic impact of digital platforms. International Journal of Economic Policy Studies.

Tajuddin, Imran (2025). Challenges of new technology adoption in improving company growth and competitiveness. Advances in Economics and Financial Studies.

Triyana, Heri, Munawar Rahim, and Endar Purnawan (2024). The impact of online commerce on economic growth. Southeast Asia Journal of Graduate of Islamic Business and Economics.

United Nations (2025). The Sustainable Development Goals Report 2025. New York: United Nations.

UNDP (2023). The Sustainable Development Goals: How to Accelerate Their Achievement in North Macedonia and Leave No One Behind. Skopje: United Nations Development Programme (UNDP) North Macedonia.

Vinutha, H. P., B. Poornima, and B. M. Sagar (2018). Detection of outliers using interquartile range technique from intrusion dataset. In Advances in Intelligent Systems and Computing. Springer Singapore. https://doi.org/10.1007/978-981-10-7563-6_53.

Wang, Nan, Jiahao Wan, Zhenzhong Ma, Yan Zhou, and Jin Chen (2023). How digital platform capabilities improve sustainable innovation performance of firms. Journal of Business Research.

World Bank (2024). Cambodia's regional connectivity: unlocking the full potential of transport corridors. World Bank Group.

Due to length constraints, the appendices are not included in this manuscript. Interested readers may obtain the appendices by contacting the author via email.

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

CONNECTED FOR GROWTH: ANALYZING THE IMPACT OF E-COMMERCE ADOPTION ON FIRM PERFORMANCE AND LABOUR OUTCOMES IN THE PHILIPPINES THROUGH PEER EFFECTS

Ma. Kristina P. Ortiz and Mark Carmelo R. Manguera

Corresponding Author: Ma. Kristina P. Ortiz
Email: makristina.ortiz@house.gov.ph or tina.ortiz.16@gmail.com

E-commerce adoption in the Philippines expanded from 14.4% of firms in 2013 to 31.2% in 2021, yet a digital divide persists across firm sizes and industries. Using matched firm-level data and an instrumental variable approach exploiting peer effects, this paper estimates the causal impact of e-commerce adoption on firm performance and labour outcomes. Results reveal evolving impacts: pre-pandemic adoption increased employment; pandemic-period adoption shifted toward revenue growth; extended horizons show productivity gains, though profitability turns negative as expenses outpace revenues. Findings underscore the need for sustained policies promoting inclusive digital transformation while easing firm-level adjustment costs.

Keywords: e-commerce; digital transformation; peer effects; employment; firm performance

JEL classification: L81, J21, J16, O33, D22, C26

I. INTRODUCTION

The digital transformation of economies has become a key driver of productivity, resilience, and inclusive growth. E-commerce, in particular, enables firms of all sizes to access broader markets, improve efficiency, and remain agile during disruptions, such as the COVID-19 pandemic. Yet, adoption remains uneven across and within economies, including differences by sectors, regions, and firm sizes.

Despite growing attention to digitalization, empirical evidence remains limited on the firm-level impacts of e-commerce adoption in emerging markets. This paper helps address this gap by examining the Philippine experience using matched firm-level data from the Annual Survey of Philippine Business and Industry (ASPBI) and its rider, the Survey on Information and Communications Technology (SICT). The study explores whether e-commerce uptake, through peer influence, translates into measurable gains in revenues, expenses, profits, total and female employment, and labour productivity. To identify causal impacts, the paper employs an instrumental variable (IV) strategy estimated through the two-stage least squares method, leveraging a firm's exposure to neighbouring firms that reached a threshold level of e-commerce adoption, mimicking a peer-effect or network-effect framework.

The findings show that the causal impact of e-commerce adoption evolves. That is, early phases are associated with job creation, particularly for women; middle phases with revenue expansion and scaling-up; and longer horizons with adjustment costs and restructuring pressures. These patterns underscore the importance of policy support to sustain the inclusive benefits while helping firms navigate the operation and labour adjustments that accompany deeper digital integration. Such interventions are especially crucial given the persistent digital divide across firm sizes and industries, with concerns over cybersecurity, skills shortages, and unreliable internet connectivity that continue to constrain broader participation.

The findings also underscore the need for targeted, ecosystem-based support that not only promotes digital adoption but also ensures that its benefits are widely shared. Strengthening peer diffusion through local networks, improving access to infrastructure and skills, and supporting firms in integrating digital tools into their operations can ensure greater participation in the digital economy. Regional initiatives and harmonized data systems further enhance the potential for equitable participation, trust, and evidence-based policymaking. In this context, e-commerce adoption can contribute to the Sustainable Development Goals, specifically Goal 5 (Achieve gender equality and empower all women and girls) and Goal 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all).

The rest of the paper is organized as follows: Section 2 reviews the literature on the factors affecting e-commerce adoption and its effects on firm performance and labour

outcomes, section 3 outlines the empirical strategy, data sources, and identification approach. Section 4 presents stylized facts on e-commerce adoption in the Philippines and the estimation results. This is followed by policy recommendations in section 5 and the conclusion in section 6.

II. RELATED LITERATURE

Factors affecting e-commerce adoption. The technology-organization-environment framework (Tornatzky and Fleischer, 1990) explains how different factors influence how firms identify the need for, search for, and adopt new technology and innovations. This framework is well-suited to examining firms' decisions to adopt e-commerce, defined as the "sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders" OECD (2011, p. 72). Further, "[t]he goods or services are ordered by those methods, but the payment and the ultimate delivery of the goods or services do not have to be conducted online."[1]

Technological context. This context encompasses existing technologies and their perceived usefulness and compatibility. Key determinants of uptake include web functionalities, effective IT integration and perceived benefits (Zhu and others, 2006; Khoo, Ahmi and Saad, 2018). However, perceived risks and obstacles can still hinder adoption (Zhu and others, 2006).

Organizational context. This context refers to the characteristics and resources of the firm, including structures, processes, and size. Management support, IT sophistication and organizational readiness are identified as important drivers of adoption (Chan and Mills, 2003; Khoo, Ahmi and Saad, 2018).

For small and medium enterprises, relative advantage, IT knowledge and technology competence are particularly influential (Looi, 2005; Soares-Aguiar and Palma-dos-Reis, 2008; Rahayu and Day, 2015). In the Philippines, where establishments are predominantly MSMEs, reduced transaction and marketing time remains the most cited benefit among e-commerce adopters (Quimba and Calizo, 2019). In contrast, non-adopters primarily cite a preference to maintain current business models, followed by security concerns, high costs, unreliable internet connection, insufficient customer demand, legal uncertainties, and hardware limitations, underscoring the need to shift mindsets and incentivize adoption (Cecilio and others, 2022).

Environmental context. This context captures industry structure, firm linkages, and the regulatory environment. Government support and policies can facilitate

[1] Different countries apply slightly different definitions on whether the sale or purchase is conducted over all computer networks or only via the internet, and whether they include orders manually typed through email (UN, 2023).

e-commerce uptake (Looi, 2005; Khoo, Ahmi and Saad, 2018), while competitive and customer pressures significantly impact adoption (Chan and Mills, 2003; Looi, 2005; Hendricks and Mwapwele, 2024). This form of social and competitive pressure is closely linked to network externalities, where the value of e-commerce adoption increases as more firms participate (Bonaccorsi and Lamastra, 2002).

Empirical evidence shows that adoption among competitors is a significant predictor of e-commerce implementation, particularly, for e-procurement systems (Soares-Aguiar and Palma-dos-Reis, 2008) and ICT technologies (Crespi, Mahdi, and Patel, 2004). Firms' perceptions of their competitors' success also play a role in adoption (Soares-Aguiar and Palma-dos-Reis, 2008). In the Philippine context, more than half of e-commerce adopters in 2015 reported doing so to keep pace with competitors (Quimba and Calizo, 2019). However, competitive pressure does not always operate uniformly, heightened competition may discourage adoption if resources are diverted toward short-term competitive responses (Meseguer-Artola and Rodríguez-Ardura, 2015). This suggests a more nuanced relationship between competition and e-commerce adoption.

Consistent with this, country- and sector-specific studies show that firms are more likely to adopt technologies when their peers or networks have already done so. Evidence from agriculture and manufacturing highlights the role of social learning and localized spillovers in accelerating adoption (Conley and Udry, 2010; Beaman and others, 2021).

Effects of e-commerce on firm performance and labour outcomes. E-commerce adoption is widely associated with improvements in firm performance, particularly in terms of revenue generation and productivity. Cariolle, Le Goff and Santoni (2019) show that a 10% increase in internet use corresponds to a 36% rise in annual sales, while Cusolito, Lederman and Peña (2020) report modest revenue premiums for firms using email or websites. Sector-specific studies reinforce these gains, including profitability improvements in internet banking (Nelson and Richmond, 2007) and positive profit impacts in the hospitality industry, moderated by firm size (DeFranco, Morosan and Hua, 2017). In Asia, e-commerce adoption is associated with higher productivity and export revenues (Kinda, 2019).

However, not all findings point to clear financial gains. Lorca, De Andres and Garcia-Diez (2019) show that firms with high levels of combined business-to-business (B2B) and business-to-consumer (B2C) e-commerce adoption experience immediate profitability gains, while single-channel adoption, either B2B or B2C, see improvements only in the following year. Wheaton and Tung (2019) similarly note that internet sales do not significantly alter profit margins, because savings in labour and space are offset by shipping costs. These mixed findings suggest that the profitability of e-commerce adoption is highly context-dependent and influenced by firm-specific cost structures.

E-commerce adoption also tends to support employment growth, particularly for women. Studies show increases in overall employment (Gherghina, Botezatu and Simionescu, 2021) and higher female employment rates (Sovbetov, 2018; Ahmad and others, 2024). In developing economies like India and Colombia, e-commerce and ICT adoption raise demand for skilled workers, including women, although effects on unskilled workers are limited (Jain, 2021; Trujillo and Aleán–Romero, 2024). E-commerce can also expand opportunities for female entrepreneurs by lowering entry barriers (Sicat and others, 2020).

The transmission mechanisms through which e-commerce affects employment operate through direct and indirect channels (de Vera, 2004). Direct effects arise from the balance of complementarity, substitution and market size; for instance, e-commerce creates jobs in web design, logistics and software development that complement offline functions, while displacing some traditional retail roles, especially for digital products. Recent projections reflect this shift, with expected declines in traditional retail and growth in logistics, warehousing and delivery (Colato and Ice, 2023; World Economic Forum, 2025). Indirect effects result from upstream and downstream linkages, as e-commerce increases demand for payment infrastructure, advertising and delivery services, generating employment in related industries (de Vera, 2004; Mandel, 2017), such as ICT (Calvino and Virgillito, 2018; de Vera, 2004) and business process outsourcing (IBPAP, 2022). The interplay between disintermediation (i.e., the displacement of traditional intermediaries) and reintermediation (i.e., the emergence of new digital intermediaries such as aggregator platforms and logistics providers) shapes the net employment outcome, with industry-level effects tending to be positive while firm-level effects vary. De Vera's (2004) input-output analysis of 11 Philippine industries corroborates this, finding that e-commerce destroyed 865 jobs but generated 7,528 (8:1 ratio), rising to 12:1 with adjusted coefficients, confirming e-commerce's potential to generate net positive employment outcomes.

Spillover effects further shape firm outcomes. Geographic proximity amplifies technology spillovers in US manufacturing, boosting market value and productivity (Bloom, Schankerman and Van Reenen, 2013). Evidence from Estonian firms shows productivity gains from digital technology adoption within sectors, especially in manufacturing, while spillovers in the services sector, tend to be more firm-specific (Mosiashvili and Pareliussen, 2020).

Overall, the literature suggests that while e-commerce adoption can yield productivity and revenue gains, the effects on profits, employment and inclusion vary across contexts and firm types. Further research is needed to understand these heterogeneous impacts, particularly in developing economies like the Philippines.

III. EMPIRICAL STRATEGY

This study employs an IV-regression framework to estimate the causal impact

of e-commerce adoption on firm performance and employment outcomes in the Philippines. The analysis combines two datasets produced by the Philippine Statistics Authority: the SICT, which defines e-commerce adoption, and the ASPBI, which provides firm-level data on revenues, expenses, profitability, labour productivity, total employment and female employment. The study period spans 2013 to 2021, covering both pre-pandemic and pandemic years. The empirical strategy leverages variation in adoption timing and exposure across firms, using multiple treatment windows constructed from the biennial SICT waves.

Data limitations. While comprehensive, the Philippine Statistics Authority's SICT and ASPBI have several limitations. The SICT is conducted every two years as a rider survey to the ASPBI, but its sampling structure and survey weights differ. The SICT covers both core ICT industries[2] (given broader coverage) and non-core ICT sectors (sampled mainly at the national level and typically include those with 20 or more employees). Both surveys are cross-sectional, although firm identifiers allow matching across rounds, the matched samples are not longitudinal panels by design. Given these constraints, the analysis focuses on internally valid causal inference within the matched sample, providing credible evidence on how e-commerce adoption, through peer influence, affects performance and labour outcomes in the Philippine context.

Variable definition. Following Quimba and Calizo (2019), an establishment is classified as an e-commerce adopter if it responded affirmatively to either:

- "Did this establishment make purchases for goods and/or services via internet, excluding social media in [reference year]?"

- "Did this establishment receive orders for goods and/or services via internet in [reference year]?"

A firm is also considered to have adopted e-commerce if it reported a positive value in response to the question:

- "What per cent of total revenue was generated from e-commerce via internet, excluding social media in [reference year]?"[3]

In capturing an establishment's purchase and sale of goods and services, the identification of e-commerce adoption aligns with existing definitions. Firm-level

[2] As defined under the Information Economy framework, including ICT-producing and ICT-intensive service sectors

[3] In the 2013 to 2019 SICT, there are additional questions that distinguish other network channels, such as "Did this establishment make purchases for goods and/or services via network channels other than internet in [year]?", "Did this establishment receive orders for goods and/or services via network channels other than internet in [year]?", and "What per cent of total revenue was generated from e-commerce via network channels other than internet by this establishment in [year]?" Affirmative answers by firms to these questions were also considered as adoption of e-commerce.

differences in digital readiness and capacity are accounted for using controls on firm age, size, baseline scale, and e-commerce capability, while regional fixed effects partially absorb time-invariant differences in structural connectivity and digital infrastructure; remaining ecosystem factors such as payment systems and technical barriers to trade are discussed as contextual influences. Table 1 presents the indicators and their respective descriptions.

Table 1: Variable definition and description

Variable	Description
Outcome variables (continuous)	
TotRev	Total revenue, in Philippine peso (PHP), in the outcome year, in natural log
TotExp	Total expenditure, in PHP, in the outcome year, in natural log
Profit	Difference between revenue and expenditure, in PHP, in the outcome year, in natural log
RevPEmp	Revenue per employed person, which serves as a proxy indicator for labour productivity
TotEmp	Total number of employed persons, including both the paid and unpaid, in natural log
FemEmp	Total number of employed women, including both the paid and unpaid, in natural log
Endogenous/Causal variable (binary)	
EC Adopt	E-commerce adoption, equal to 1 if the firm transitioned from non-adopter to adopter during the treatment period (i.e., answered "Yes" to any questions reflecting e-commerce activity); 0 if the firm maintained its status
Instrumental variable (binary)	
Exposed	Peer adoption shock, which equals 1 if the firm's neighbouring group's e-commerce adoption growth rate during the defined treatment window exceeds a specified cut-off (e.g., average growth); 0 otherwise.
Explanatory variables (continuous and binary)	
Age	Difference between the survey year and the year the firm started its operations, in natural log
Baseline TotRev	Total revenue, in PHP, in the baseline year, in natural log
Size	Firm size refers to the Philippine Statistics Authority's classification of micro, small and medium enterprises; for this study, micro and small are lumped together in one group, followed by medium, and large sized firm.
EC Capability	E-commerce capability of the firm, which equals 1 if the firm use ICT in any of the following activities: finance and accounting, human resources, logistics, and research and development, following Quimba and Calizo's (2019) work.

Estimation method. This study employs IV-regression, estimated through the two-stage least squares method, with propensity-score weighting to arrive at the causal impact of e-commerce adoption on firm performance and employment outcomes in the Philippines. The IV method addresses the potential endogeneity (i.e., simultaneity or how more profitable firms may be more likely to engage in e-commerce, while

e-commerce itself can simultaneously influence the firm's profitability), along with omitted variable bias, both of which violate the independence assumption. The IV estimates identify a local average treatment effect, which captures the causal effect of e-commerce adoption for firms whose adoption decision is influenced by their exposure to high growth of e-commerce adoption among neighbouring firms.

The IV model yields a consistent estimator of the causal effect of e-commerce adoption, X_i, on the outcome, Y_i, provided there exists an instrument, Z_i, that satisfies two conditions: (i) relevance, meaning Z_i is significantly correlated with X_i (i.e., $cov(Z_i,X_i)\neq 0$); and, (ii) exclusion restriction, meaning Z_i is uncorrelated with the population error term, ε_i (i.e., $cov(Z_i,\varepsilon_i)=0$) and affects Y_i only through X_i (Stock and Watson, 2020). The rule of thumb to satisfy the relevance condition is to have a first-stage F-statistic of at least 10 (Staiger and Stock, 1997).

In this study, the causal variable is a firm's change in e-commerce adoption status over a given period (i.e., new adopters). The treatment takes a value of one if the firm newly adopted e-commerce during the specified treatment period, and zero otherwise (i.e., a firm never adopted e-commerce). This ensures that the causal effect captures only the impact of new adoption, thereby isolating the effect of transitioning into e-commerce. To capture the impact of adoption across different contexts and time horizons, the analysis defines three treatment timing scenarios (table 2).

Table 2: Treatment timing windows

Scenario	Baseline Year	Treatment Period	Outcome Year
1: Pre-pandemic	2015	2017–2019	2019
2: Pandemic	2015	2017–2021	2021
3: Extended period	2013	2015–2021	2021

The instrument, Exposed, is constructed based on the firm's exposure to neighbouring firms, defined as those within the same 1-digit Philippine Standard Industrial Classification and province, that experienced a certain level of growth in the share of e-commerce adopters over the same period. To account for representativeness, the growth in adoption is also computed using weighted shares of adopters based on survey weights. The instrument is a binary variable that equals one if the neighbouring group's adoption growth exceeds a set threshold (e.g., the mean growth rate within each scenario), and zero otherwise.

The identification strategy rests on the two assumptions: relevance, which is tested through robust first-stage F-statistics; and the exclusion restriction, which requires that neighbouring e-commerce growth affects firm outcomes only through its impact on the firm's own adoption. This assumption is robust primarily because the instrument's design as a "shock" or threshold-based indicator explicitly excludes the focal firm from its construction, minimizing the possibility of it being a proxy for

unobserved firm-specific characteristics. Consequently, it is highly unlikely to be directly correlated with the firm's performance and labour outcomes through any channel other than the firm's own e-commerce adoption. In addition, the strategy conditions on regional fixed effects which further mitigate concerns about omitted variables driving both peer adoption and firm outcomes.

To further strengthen the strategy and address potential baseline imbalances, particularly given that a firm's exposure to neighbouring growth might not be purely random, the inverse probability weighting (IPW) is also employed. This method is applied to balance baseline covariates between the exposed and unexposed firms, thus mimicking a random assignment in the instrument and satisfying the independence assumption. A logistic regression model is used to obtain the propensity scores, which are then used as weights in both stages of the IV-regression.

The first-stage regression equation is given as follows:

$$X_{i,(t1\rightarrow t2)} = \alpha_1 + \phi Z_{i,(t1\rightarrow t2)} + \gamma_1 W_{i,t0} + \theta_{1r} + \epsilon_{1i} \quad (01)$$

where $X_{i,(t1\rightarrow t2)}$ is a binary treatment indicator equal to 1 if firm, i, newly adopted e-commerce during the treatment period t_1 to t_2 (e.g., 2017-2019), and 0 otherwise; $Z_{i,(t1\rightarrow t2)}$ is a binary instrument equal to 1 if the firm's neighbouring group experienced at least a certain growth level in adoption over the same period; $W_{i,t0}$ is a vector of baseline firm-level covariates (e.g., age, size) measured at the baseline year, t_0; θ_r denotes region fixed effects; and, ϵ_{1i} is the first-stage error term.

The two-stage least squares second-stage equation is then estimated as:

$$Y_{i,t2} = \alpha_2 + \lambda_{2SLS} \hat{X}_{i,(t1\rightarrow t2)} + \gamma_2 W_{i,t0} + \theta_{2r} + \epsilon_{2i} \quad (02)$$

where $Y_{i,t2}$ refers to the outcome variable (e.g., log revenue in 2019), $\hat{X}_{i,(t1\rightarrow t2)}$ is the predicted treatment from the first stage, θ_{2r} is the second-stage region fixed effects, and ϵ_{2i} is the second-stage error term. Both regressions are estimated using the computed inverse probability weights. Standard errors are clustered to account for potential unobserved correlation between observations within a region, with larger clusters preferred for conservative estimation (Cameron and Miller, 2015).

IV. RESULTS

This section has two parts: an overview of e-commerce adoption in the Philippines, drawing on stylized facts from the SICT and ASPBI datasets, followed by the empirical results.

E-commerce adoption in the Philippines. E-commerce adoption among Philippine firms rose from just 14.4% (5,499 establishments) in 2013 to 31.2% (87,608 establishments) in 2021, with the sharpest increase (8.7 percentage points) occurring between 2019 and 2021, reflecting the acceleration of digitalization during the pandemic.

Historically, establishments used e-commerce for purchasing and receiving goods and/or services rather than selling. In 2013, 57.0% of adopters used it solely for purchasing and receiving goods and/or services, rising to 77.1% in 2019. However, this trend changed by 2021, when the share of firms using e-commerce exclusively for purchases dropped to 38.8%, indicating a shift toward selling online. That year, 61.2% of adopters that purchased and received orders also reported earning revenues from e-commerce (figure 1).

Aside from three firms in 2013, no establishment used e-commerce exclusively for selling. Most establishments engaged in B2B transactions (12.5% in 2013 to 21.6% in 2021), although B2C and B2G transactions have steadily expanded (4.8% to 16.7% and 5.0% to 7.7%, respectively), providing context for differences in adoption mechanisms and outcomes across periods rather than constituting separate causal channels.

Figure 1: E-commerce adoption (%) by purpose, 2013–2021



Sources: Authors' computations using data from the Philippine Statistics Authority.
Note."For selling" category may not be visible due to negligible value in 2013 and no observations in other years.

Perceived benefits of e-commerce adoption. Reduced transaction time is the most consistently cited benefit, with 71.5% of adopting firms reporting so in 2013 and 70.2% in 2021. Other reported gains include reduced paper transactions (49.5% in 2017 to 54.5% in 2021),[4] reduced marketing time (64.1% in 2013 to 39.7% in 2021), as well as more tangible gains, such as increased sales volume and/or number of

[4] This benefit was only included starting in the 2017 SICT

customers (47.9% in 2013 to 38.7% in 2021) and lower business costs (50.7% in 2013 to 35.1% in 2021). Some establishments also viewed e-commerce as a way to keep pace with their competitors (50.6% in 2013 to 24.7% in 2021).

Two patterns stand out. First, while firms consistently value efficiency gains, fewer associate e-commerce with lower costs, from about 50% from 2013 to 2019 down to 35.1% in 2021, suggesting that firms may not directly perceive operational efficiency gains as translating into reduced costs. Second, perceptions of increased sales volume or customers weakened during the pandemic, despite heightened online activity, falling to 38.7% in 2021. Even pre-pandemic, only about half of firms viewed e-commerce as boosting sales, highlighting a disconnect between adoption motives and perceived commercial returns.

Perceived limitations to e-commerce adoption. Among non-adopters, preference to maintain current business models (e.g., face to face interaction) rose sharply from 14.5% in 2013 to 59.8% in 2021. Other constraints were also increasingly cited, including concerns on security and privacy (11.1% in 2013 to 44.4% in 2021), unreliable internet connections (9.4% in 2013 to 18.7% in 2021), and lack of skilled employees to develop, maintain or use the required technology (7.5% in 2013 to 15.1% in 2021). Notably, 72.3% of non-adopters in 2021 already had internet access, indicating that internet connectivity is necessary but insufficient, as organizational readiness and perceptions also shape adoption decisions.

Between 2019 to 2021, however, several barriers were less cited: lack of skilled employees (-19.6 percentage points or pp), uncertainty in the legal and regulatory framework (-17.8 pp), high development or maintenance cost (-17.7 pp), unreliable internet connection (-15.4 pp), and incompatible systems between customer and supplier (-15.1 pp). Even the preference to maintain current business model fell slightly (-3.8 pp). A new constraint was introduced in the 2021 SICT, unreliable or costly partners such as e-payment providers and logistics, was cited as a barrier by 3.2% of the non-adopting firms. This suggests that while internal and traditional constraints have eased, challenges within the e-commerce ecosystem are starting to surface.

Adoption across industries. Industry-level comparisons reveal variation in e-commerce adoption (figure 2). In 2021, construction recorded the highest adoption rate at 56.3%, rising from zero in 2013. This was followed by electricity, gas, steam and air conditioning supply (51.5%) and transportation and storage (48.2%). Agriculture, forestry and fishing had the lowest adoption rate at 17.1% in 2021, up by only 5.8 pp from 2013.

Benefits also differ across industries, despite reduced transaction time and paper transactions remaining as the top benefits. In 2021, firms in real estate activities reported the highest share citing reduced marketing time (48.4%); firms in transportation and storage most frequently cited increased sales volume and/or number of customer

(55.5%) and increased quality of customer service (53.9%), firms in accommodation and food service activities highlighted better customer targeting (39.6%); and firms in professional, scientific and technical activities reported reduced business costs (63.7%) and keeping pace with competitors (42.5%).

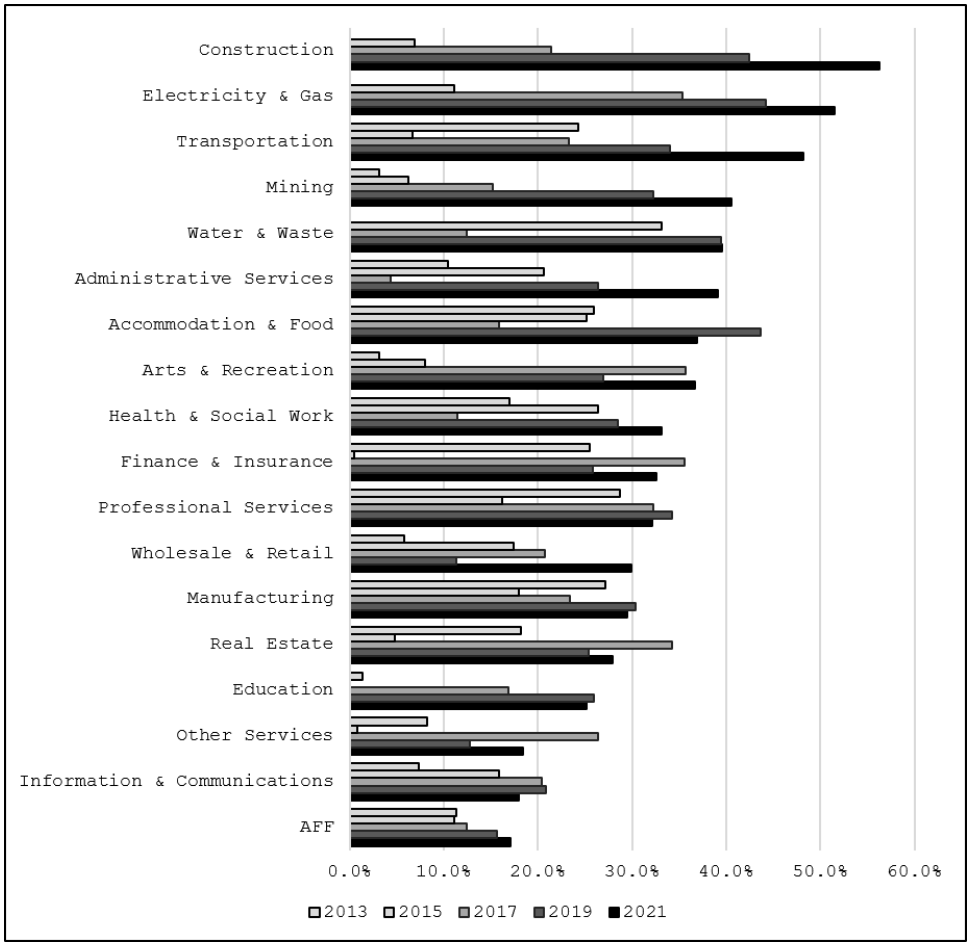
Limitations likewise vary. While maintaining the current business model and security and privacy concerns remain the most reported, transportation and storage industry had the highest share of firms identifying several limitations in 2021, such as insufficient level of customer demand for purchasing via internet (46.2%), too-high cost of development and/or maintenance (25.8%), incompatible computer systems between customer and supplier (22.8%), lack of skilled employees to develop, maintain or use the required technology (22.2%), uncertainty about legal or regulatory dispute framework for selling and buying via Internet (15.1%) and selling over the internet currently under development or planned in the near future (7.9%). Meanwhile many firms in the education industry face unreliable internet connection (52.7%) and ICT infrastructure limitation (11.9%).

Adoption across firm sizes. Micro firms consistently recorded the lowest adoption rates, though adoption still rose from just 6.0% in 2013 to 27.4% in 2021 (figure 3). From 2013 to 2019, small- and medium-sized firms trailed behind large firms. By 2021, medium-sized firms had the highest adoption rate at 51.4%, surpassing large firms (46.9%). This shift reflects an 18.3 pp increase in adoption among medium-sized firms between 2019 and 2021, the sharpest rise across the entire period.

While reduced transaction time and less paper transactions remain the top-cited benefits across all sizes, notable differences emerge. In 2021, 41.6% of large firms reported lower business costs (e.g., reduced transportation/logistics cost) compared to only 30.9% of micro firms. Large firms were also more likely to cite keeping pace with competitors (35.2% vs. 22.4% for micro firms). Barriers also differ by size. Micro and small firms are more likely to prefer maintaining their current business model (59.3% and 62.1%), whereas medium and large firms primarily have security and privacy concerns (56.2% and 62.3%). Skills shortage is a bigger challenge for smaller sized enterprise (15.4% of micro and 14.9% of small) than for medium (10.7%) and large (7.9%) enterprises. Small and medium firms also report greater constraints from unreliable internet (23.4% and 25.3%) and ICT infrastructure limitation (7.1% and 10.8%, respectively) compared to micro (15.4% and 4.7%) and large firms (7.9% and 5.2%).

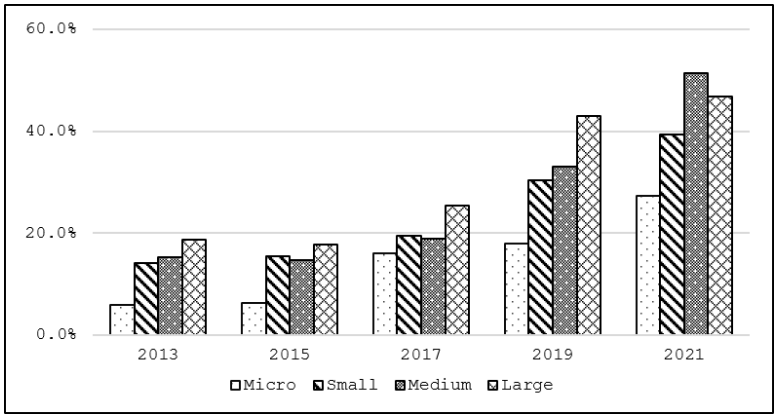
Despite overall growth, a digital divide persists across industries (39.2 pp difference between construction and agriculture, forestry, and fishing in 2021) and firm sizes (24.0 pp gap between medium and micro firms in 2021). These disparities reflect the threats of exclusion from digital opportunities, often linked to low digital skills and limited technology penetration (Dahlman, Mealy and Wermelinger, 2016).

Figure 2: E-commerce adoption (%) by industry, 2013–2021



Source: Authors' computations using data from the Philippine Statistics Authority.

Figure 3: E-commerce adoption (%) by firm size, 2013–2021



Sources: Authors' computations using data from Philippine Statistics Authority.

Description of the matched observations. This section summarizes the matched sample of firms across the three scenarios, based on the availability of all the variables and the instrument—the neighbouring firms' adoption growth. Table 3 presents the cut-offs used to define the binary instrument. To ensure robustness, alternative specifications were considered, including weighted versus unweighted adoption growth and winsorization at the 95th percentile to mitigate the influence of outliers.

Table 3: Cut-off values for instrument construction

Growth in peer adoption rate	Treatment Period S1: 2017-2019	S2: 2017-2021	S3: 2015-2021
Unweighted			
1. Original dataset	0.659	1.193[a]	1.296
2. Winsorized at the 95th percentile	0.655[a]	1.285	1.002[b]
Weighted using survey weights			
1. Original dataset	5.809	26.746[b]	29.540
2. Winsorized at the 95th percentile	2.582	21.340	12.874[a]

Source: Authors' calculations.
Note.
a/ Iteration was not implemented as the baseline covariates failed to achieve balance under the IPW procedure.
b/ This cutoff was not used due to an insignificant first stage estimate (p>0.1).

Most matched firms are concentrated in the sectors of information and communication, manufacturing, and administrative and support service, and other services (table 4). As such, the empirical findings should be examined within the context of these industries and may not be directly generalizable to firms in other sectors.

Table 4: Sectors of matched firms, scenarios 1–3

Sector	S1		S2		S3	
	Obs.	Share	Obs.	Share	Obs.	Share
Information and communication	376	51.9	150	44.3	134	50.0
Manufacturing	134	18.5	80	23.6	51	19.0
Administrative and support service activities	110	15.2	84	24.8	55	20.5
Other service activities	34	4.7	5	1.5	12	4.5
Other sectors	70	9.7	20	5.9	16	6.0
Total	724	100.0	339	100.0	268	100.0

Source: Authors' calculations.

Empirical Findings. The IV strategy described in Section 3 is validated through two conditions: the instrument's relevance (i.e., the instrument predicts adoption) and the exclusion restriction (i.e., the instrument affects outcomes only through adoption), both discussed in turn below.

Relevance condition. The first-stage regression results confirm the instrument's relevance to the endogenous e-commerce adoption variable (tables 5a–5c). The binary exposure indicator has a positive and statistically significant effect on a firm's own adoption behaviour across all scenarios and outcome specifications.

Table 5A: First stage results, by outcome variable, S1

	S1, Original				S1, Absolute				S1, Absolute, Winsorized			
	All	TE/ RE	Profit	FE	All	TE/ RE	Profit	FE	All	TE/ RE	Profit	FE
Exposed, Z	0.173**	0.173**	0.184***	0.174**	0.119**	0.119**	0.110**	0.119**	0.164***	0.163***	0.151***	0.165***
	(0.061)	(0.061)	(0.050)	(0.061)	(0.043)	(0.043)	(0.039)	(0.045)	(0.040)	(0.039)	(0.036)	(0.040)
Age, in Log	0.018	0.017	0.020	0.013	0.048**	0.048**	0.047**	0.045**	0.024*	0.023*	0.026**	0.021*
	(0.015)	(0.014)	(0.014)	(0.014)	(0.022)	(0.022)	(0.023)	(0.022)	(0.012)	(0.012)	(0.013)	(0.012)
Baseline Rev.,	0.004	0.003	0.000	0.000	0.010	0.010	0.013*	0.008	0.007*	0.007*	0.009**	0.004
In Log	(0.008)	(0.009)	(0.014)	(0.008)	(0.017)	(0.007)	(0.007)	(0.008)	(0.004)	(0.004)	(0.004)	(0.005)
Size, Micro	-0.034	-0.037	-0.023	-0.045	-0.042	-0.043	0.019	-0.046	-0.005	-0.007	0.032	-0.015
& Small	(0.085)	(0.086)	(0.115)	(0.085)	(0.065)	(0.065)	(0.072)	(0.064)	(0.036)	(0.035)	(0.053)	(0.035)
Size, Medium	0.157***	0.156**	0.186***	0.152**	0.172**	0.172**	0.221**	0.170**	0.126**	0.125**	0.164**	0.120**
	(0.051)	(0.050)	(0.051)	(0.052)	(0.068)	(0.068)	(0.072)	(0.069)	(0.054)	(0.053)	(0.055)	(0.055)
EC Capability	0.000	-0.001	0.008	-0.001	0.006	0.006	0.020	0.005	-0.013	-0.014	-0.009	-0.014
	(0.013)	(0.013)	(0.010)	(0.013)	(0.030)	(0.030)	(0.033)	(0.031)	(0.013)	(0.014)	(0.016)	(0.014)
Constant	0.133	0.168	0.181	0.242	-0.037	-0.028	-0.161*	0.011	0.077	0.090	0.000	0.163*
	(0.178)	(0.198)	(0.302)	(0.188)	(0.090)	(0.090)	(0.086)	(0.105)	(0.079)	(0.076)	(0.089)	(0.088)
Region, fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	684	681	586	663	675	672	579	654	684	681	586	663
F-Statistic	8.124	8.002	13.697	8.084	7.507	7.471	7.920	6.930	17.107	17.272	18.009	16.700

Source: Authors' calculations.

*Note. Columns represent the first-stage regression results under different outcome variables; Robust clustered standard errors are reported in parentheses; ***Significant at the 1 per cent level; **5 per cent level; and *10 per cent level.*

Table 5B. First stage results, by outcome variable, S2

	S2, Original, Winsorized			S2, Absolute, Winsorized		
	All	Profit	FE	All	Profit	FE
Exposed, Z	0.098*	0.142***	0.101*	0.216***	0.230***	0.220***
	(0.057)	(0.042)	(0.056)	(0.042)	(0.039)	(0.041)
Age, in Log	0.050**	0.030	0.050**	0.038	0.018	0.037
	(0.022)	(0.023)	(0.022)	(0.030)	(0.032)	(0.031)
Baseline Rev.,	0.007	0.011	0.006	0.016	0.016	0.016
In Log	(0.017)	(0.018)	(0.017)	(0.025)	(0.028)	(0.025)
Size, Micro	-0.082	-0.053	-0.088	0.017	0.031	0.013
& Small	(0.059)	(0.075)	(0.062)	(0.076)	(0.110)	(0.073)
Size, Medium	0.038	-0.009	0.036	0.100	0.052	0.100
	(0.067)	(0.091)	(0.066)	(0.078)	(0.100)	(0.077)
EC Capability	-0.032	-0.052*	-0.031	-0.032	-0.045	-0.030
	(0.036)	(0.027)	(0.036)	(0.038)	(0.034)	(0.038)
Constant	0.317	0.298	0.319	0.094	0.162	0.089
	(0.303)	(0.319)	(0.304)	(0.419)	(0.499)	(0.424)
Region, fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	311	263	309	302	255	300
F-Statistic	2.993	11.335	3.227	27.182	34.639	28.791

*Note. Columns represent the first-stage regression results under different outcome variables; Robust clustered standard errors are reported in parentheses; ***Significant at the 1 per cent level; **5 per cent level; and *10 per cent level.*
Source: Authors' calculations

Table 5C. First stage results, by outcome variable, S3

	S3			S3, Absolute, Treat		
	All	Profit	FemEmp	All	Profit	FemEmp
Exposed, Z	0.219***	0.216**	0.225***	0.448***	0.494***	0.449***
	(0.068)	(0.072)	(0.067)	(0.074)	(0.080)	(0.075)
Age, in Log	-0.003	0.008	-0.005	-0.050*	0.004	-0.053*
	(0.045)	(0.054)	(0.046)	(0.029)	(0.027)	(0.028)
Baseline Rev.,	0.042	0.040	0.043	0.035*	0.023	0.037*
In Log	(0.031)	(0.037)	(0.031)	(0.018)	(0.022)	(0.019)
Size, Micro	0.022	0.000	0.018	0.113**	-0.020	0.111**
& Small	(0.095)	(0.132)	(0.094)	(0.056)	(0.075)	(0.056)
Size, Medium	0.241*	0.146	0.240*	0.194***	0.040	0.194***
	(0.148)	(0.139)	(0.145)	(0.053)	(0.104)	(0.054)
EC Capability	-0.036	-0.039	-0.034	-0.018	-0.025	-0.019
	(0.024)	(0.024)	(0.024)	(0.017)	(0.020)	(0.018)
Constant	-0.442	-0.405	-0.460	-0.111	0.072	-0.127
	(0.564)	(0.691)	(0.568)	(0.350)	(0.392)	(0.362)
Region, fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	239	204	236	235	200	232
F-Statistic	10.560	8.981	11.313	36.621	38.642	35.815

Source: Authors' calculations.
*Note. Columns represent the first-stage regression results under different outcome variables; Robust clustered standard errors are reported in parentheses; ***Significant at the 1 per cent level; **5 per cent level; and *10 per cent level.*

In S1 (pre-pandemic), exposure to high neighbour adoption growth increases the probability of adoption by 11.0 to 18.4 pp. In S2 (pandemic), this effect strengthens to 14.2 to 23.0 pp. In S3 (extended period), the effect is largest, ranging from 21.6 to 49.4 pp. All coefficients are statistically significant at the 1% or 5% level.

The strengthening of the first-stage relationship across scenarios is consistent with cumulative peer effects operating over progressively longer treatment windows. As shown, S1 captures only two years of neighbour adoption growth (2017–2019), while S2 captures four years (2017–2021), and S3 captures six years (2015–2021). Longer treatment windows provide more opportunity for firms to observe, learn from, and respond to neighbouring firms' adoption behaviour, allowing peer influence to materialize fully. Additionally, the inclusion of the pandemic period in S2 and S3 may have amplified these spillovers, as e-commerce adoption became more salient and visible when digital channels became essential for business continuity.

Instrument strength. The first-stage F-statistics provide a diagnostic for instrument strength (table 5a-5c). In S2 and S3, the F-statistics exceed the conventional threshold of 10, indicating a strong first stage. In S1, the F-statistic registers approximately 8, slightly below the conventional benchmark. However, recent work by Angrist and Kolesár (2024) demonstrates that in just-identified IV settings with a single instrument, the $F > 10$ rule-of-thumb is overly conservative. In such settings, the IV estimator is median-unbiased and conventional t-tests provide reliable coverage even with relatively low F-statistics. Given the significant first-stage coefficients and the just-identified nature of the study's approach, the estimates remain informative and the inference remains robust.

Notably, the F-statistics increase from S1 to S3 despite the declining sample size across scenarios. Since smaller samples typically yield less precise estimates and lower F-statistics, this pattern suggests that the instrument's relevance genuinely strengthened over time. This is consistent with the cumulative nature of peer effects: firms exposed to at most six years of neighbour adoption growth (S3) exhibit a substantially stronger adoption response than firms exposed to only two years (S1).

Exclusion restriction. The identifying assumption is that neighbouring firms' adoption growth affects focal firm outcomes only through its effect on the focal firm's own adoption decision. Several design features support the plausibility of this assumption. First, region fixed effects absorb unobserved differences in digital infrastructure, economic conditions, regulatory environments, and local demand factors that might otherwise confound the relationship between neighbour adoption and focal firm outcomes. Second, there is no plausible direct effect channel that bypasses own adoption. While neighbours are defined as firms within the same province and 1-digit Philippine Standard Industrial Classification, this classification remains highly aggregated, such that firms sharing a major industry code produce heterogeneous products for distinct customer segments and are not necessarily direct competitors. More fundamentally, even if competitive pressure exists among industry peers, the rational response for profit-maximizing firms is to adopt e-commerce as a countermeasure, which is precisely the mechanism the instrument captures. Third, temporal separation. The instrument is measured using adoption growth over the treatment period, with baseline characteristics measured prior to treatment. This temporal structure reduces the risk of reverse causality or simultaneity. Overall, while the exclusion restriction is inherently untestable, these design features collectively strengthen the credibility of the identification strategy.

Causal effects of e-commerce adoption: Pre-pandemic period (scenario 1). The second stage results consistently show a statistically significant positive effect of new e-commerce adoption on total employment (TotEmp) across several specifications. Across model iterations, estimates associate adoption with an approximate 200.4% to 285.4% increase in employment (1.1 to 1.3 log-points increase).[5] Adoption is also pos-

[5] Conversion formula from log-points to percentage is $(e^{\beta}-1)\times 100\%$.

itively associated with female employment (FemEmp) in unweighted iterations, with coefficients around 1.4, albeit significant only at the 10% level. This suggests that the early stages of e-commerce adoption may have created new opportunities for female workers (table 6).

These magnitudes, while large, are consistent with IV estimates in the technology adoption literature, which typically exceed ordinary least squares estimates due to the local average treatment effect capturing effects among compliers, i.e., firms at the margin of adoption whose decisions are influenced by peer exposure (Imbens and Angrist, 1994). The sample composition further contextualizes these findings: the matched dataset predominantly covers ICT and administrative services, particularly business process outsourcing, where digital integration is central to operations. In ICT, e-commerce adoption drives demand for web developers, software engineers, data analysts, and digital marketing specialists (Calvino and Virgillito, 2018; Hjort and Poulsen, 2019; UNCTAD, 2019). In business process outsourcing and administrative services, e-commerce firms increasingly outsource customer support, order processing, and back-office functions, driving employment growth in service centres (Fernandez-Stark, Bamber, and Gereffi, 2011; IBPAP, 2022; Errighi, Khatiwada and Bodwell, 2016).

Table 6: IV-regression results, S1, cut-off at means

	S1, Original					
	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp
EC Adopt	0.230	1.349**	-0.032	0.494	1.387*	-1.145*
	(0.358)	(0.441)	(0.407)	(0.579)	(0.745)	(0.660)
Age, in Log	0.049	0.012	0.050	0.171	-0.080**	0.032
	(0.070)	(0.056)	(0.074)	(0.108)	(0.038)	(0.039)
Baseline Rev.,	0.957***	0.446***	0.952***	0.820***	0.425***	0.504***
In Log	(0.020)	(0.023)	(0.020)	(0.064)	(0.034)	(0.027)
Size, Micro	-0.155	-1.956***	-0.200	-0.752**	-2.343***	1.788***
& Small	(0.151)	(0.134)	(0.132)	(0.275)	(0.222)	(0.172)
Size, Medium	-0.183	-1.106***	-0.202**	-0.526*	-1.350***	0.924***
	(0.126)	(0.196)	(0.094)	(0.320)	(0.198)	(0.168)
EC Capability	0.072	0.030	0.081	0.004	0.023	0.038
	(0.052)	(0.039)	(0.062)	(0.043)	(0.039)	(0.055)
Constant	0.789	-3.086***	0.825*	0.950	-3.069**	4.025***
	(0.465)	(0.391)	(0.423)	(1.179)	(0.811)	(0.596)
Region, Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	684	681	684	586	663	681

Table 6: IV-regression results, S1, cut-off at means (Continued)

	S1, Absolute						S1, Absolute, Winsorized					
	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp
EC Adopt	0.800	1.894*	0.153	1.757	0.430	-1.135	0.599	1.100**	0.281	1.133	0.727	-0.557
	(0.742)	(1.084)	(0.923)	(1.365)	(1.355)	(0.867)	(0.473)	(0.436)	(0.650)	(0.824)	(0.830)	(0.795)
Age, in Log	-0.017	-0.064	-0.014	0.151	-0.119	0.044	0.023	-0.015	0.016	0.152	-0.084**	0.035
	(0.071)	(0.071)	(0.077)	(0.130)	(0.069)	(0.053)	(0.064)	(0.035)	(0.065)	(0.096)	(0.023)	(0.046)
Baseline Rev.,	0.958***	0.380***	0.972***	0.811***	0.408***	0.576***	0.933***	0.438***	0.925***	0.853***	0.428***	0.491***
In Log	(0.032)	(0.056)	(0.037)	(0.050)	(0.021)	(0.076)	(0.025)	(0.021)	(0.027)	(0.040)	(0.027)	(0.030)
Size, Micro	-0.023	-1.980***	-0.072	-0.621**	-2.413***	1.950***	-0.188	-1.950***	-0.234*	-0.469**	-2.306***	1.749***
& Small	(0.277)	(0.118)	(0.302)	(0.241)	(0.205)	(0.238)	(0.114)	(0.145)	(0.129)	(0.207)	(0.217)	(0.163)
Size, Medium	-0.300***	-1.291***	-0.226*	-0.687*	-1.306***	0.998***	-0.110	-0.919***	-0.177	-0.253	-1.178***	0.809***
	(0.068)	(0.103)	(0.118)	(0.374)	(0.175)	(0.143)	(0.130)	(0.163)	(0.109)	(0.333)	(0.126)	(0.161)
EC Capability	0.041	0.069	0.045	0.015	0.022	-0.030	0.018	-0.003	0.041	-0.088	-0.024	0.017
	(0.067)	(0.089)	(0.073)	(0.119)	(0.027)	(0.067)	(0.041)	(0.028)	(0.053)	(0.057)	(0.021)	(0.035)
Constant	0.792	-1.842**	0.547	0.857	-2.231	2.713*	1.287**	-2.763***	1.406**	0.253	-2.894***	4.169***
	(0.815)	(0.753)	(0.894)	(0.758)	(0.374)	(1.425)	(0.398)	(0.425)	(0.425)	(0.815)	(0.686)	(0.529)
Region, Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	675	672	675	579	654	672	684	681	684	586	663	681

****Significant at the 1 per cent level; **5 per cent level; and *10 per cent level.*

Source: Authors' calculations.
Note: Columns represent the second-stage regression results under different outcome variables. Standard errors are reported in parentheses. Results of regional fixed effects are included in all models but are omitted from the table for brevity. Full results are available upon request.

In contrast, no significant effects are observed on revenues, total expenses, or profitability, suggesting that the immediate measurable gains from adoption were not yet reflected in broader firm performance. Overall, these pre-pandemic findings imply that the tangible benefits of early e-commerce adoption were most visible in job creation, particularly for women, rather than in improved financial performance. This is consistent with the earlier stylized facts that suggested pre-pandemic e-commerce adoption was largely for purchasing and receiving goods and services, indicating initial and less complex stages of digital engagement.

Causal effects of e-commerce adoption: Pandemic period (scenarios 2 and 3). The second-stage results for S2, which extends the treatment window to include the pandemic period, reveal a shift in the nature of e-commerce's impact. Unlike in S1, where effects were concentrated on employment, the employment coefficients in S2 are no longer statistically significant, suggesting that the job creation gains associated with early adoption did not persist, or were disrupted, during the pandemic. Instead, S2 reveals statistically significant positive effects on both revenues (TotRev) and total expenses (TotExp) (table 7). Compared to non-adopters, adoption increases total revenues by approximately 157.8% and total expenses by approximately 108.8%. Both effects are significant at the 10% level and warrant cautious interpretation given the marginal significance threshold. Profitability remains statistically insignificant, suggesting that revenue gains were largely offset by higher expenditures, consistent with firms scaling up digital operations rather than realizing immediate efficiency gains.

Overall, S2 indicates that as adoption deepened, benefits broadened beyond job creation to include revenue growth, albeit accompanied by rising costs. This pattern is consistent with the phase of expansion and investment in digital capability, where firms incur higher expenses while positioning themselves for longer-term gains.

Scenario 3 extends the baseline back to 2013, thereby capturing a longer treatment window than S2. Under the original winsorized specification, e-commerce adoption is associated with substantial increases in both total revenue (1.370 log-points; 293.5%) and total expenses (1.567 log-points; 379.2%), with the latter exhibiting a notably larger magnitude (table 8). This asymmetry, where costs outpace revenue gains, suggests that adopting firms may have invested heavily in e-commerce readiness (e.g., digital infrastructure) without yet realizing commensurate financial returns. Notably, revenue per employee (RevPEmp) also becomes significant at the 10% level (1.153 log-points; 216.8%), indicating that adopting firms may have begun realizing productivity gains over the longer treatment horizon. However, employment effects remain statistically insignificant across both specifications, suggesting that the job creation effects observed in S1 did not re-emerge despite the extended observation period.

Under the absolute winsorized specification, revenue and expense effects lose significance, while profitability becomes significantly negative (–1.362 log-points; –74.4%;). This pattern reinforces the same underlying narrative: while e-commerce adoption generated revenue and productivity gains for some firms, these benefits were offset, or in some cases exceeded, by rising operational costs, resulting in profitability pressures for compliers over the extended treatment window.

Table 7: IV-regression results, S2, cut-off at means

	S2, Original Winsorized						S2, Absolute, Winsorized					
	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp
EC Adopt	0.337	1.801	-0.645	-0.201	0.970	-1.464	0.947*	1.275	0.736*	-0.472	1.591	-0.328
	(1.355)	(1.342)	(1.412)	(2.367)	(2.018)	(2.112)	(0.552)	(0.806)	(0.429)	(1.629)	(1.212)	(1.074)
Age, in Log	-0.130*	-0.241**	-0.076	0.052	-0.261**	0.111	-0.096	-0.120	-0.079	0.092	-0.173	0.025
	(0.062)	(0.094)	(0.059)	(0.132)	(0.111)	(0.073)	(0.083)	(0.098)	(0.073)	(0.134)	(0.112)	(0.067)
Baseline Rev.,	0.909***	0.446***	0.945***	0.712***	0.432***	0.463***	0.897***	0.389***	0.923***	0.709***	0.357***	0.508***
In Log	(0.043)	(0.048)	(0.052)	(0.082)	(0.045)	(0.055)	(0.047)	(0.080)	(0.044)	(0.060)	(0.087)	(0.076)
Size, Micro	-0.390	-1.773***	-0.407	-1.178**	-2.276***	1.383**	-0.317	-2.138***	-0.263	-1.196***	-2.523***	1.821***
& Small	(0.327)	(0.253)	(0.316)	(0.344)	(0.403)	(0.441)	(0.207)	(0.452)	(0.228)	(0.290)	(0.569)	(0.442)
Size, Medium	-0.571**	-1.137***	-0.565***	-0.876***	-1.397***	0.566***	-0.550**	-1.225***	-0.571**	-0.780***	-1.460***	0.676***
	(0.186)	(0.272)	(0.136)	(0.222)	(0.247)	(0.123)	(0.246)	(0.294)	(0.215)	(0.164)	(0.364)	(0.161)
EC Capability	-0.060	-0.053	-0.098	0.122	-0.059	-0.007	-0.064	-0.100**	-0.087	0.082	-0.064	0.035
	(0.052)	(0.063)	(0.062)	(0.102)	(0.078)	(0.065)	(0.051)	(0.045)	(0.056)	(0.076)	(0.054)	(0.046)
Constant	2.577**	-2.682**	2.211	3.689**	-2.580**	5.260**	2.384**	-1.418	1.844**	3.803**	-1.622	3.803**
	(1.198)	(1.141)	(1.386)	(1.151)	(1.285)	(2.049)	(0.771)	(1.746)	(0.781)	(0.982)	(2.036)	(1.778)
Region, Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	311	311	311	263	309	311	302	302	302	255	300	302

Source: Authors' calculations.
Note. Columns represent the second-stage regression results under different outcome variables. Standard errors are reported in parentheses. Results of regional fixed effects are included in all models but are omitted from the table for brevity. Full results are available upon request.

****Significant at the 1 per cent level; **5 per cent level; and *10 per cent level.*

Table 8: IV-regression results, S3, cut-off at means

	S3, Original						S3, Absolute					
	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp	TotRev	TotEmp	TotExp	Profit	FemEmp	RevPEmp
EC Adopt	1.370**	0.218	1.567**	-1.312	0.858	1.153*	0.131	-0.195	0.378	-1.362**	-0.019	0.326
	(0.593)	(0.758)	(0.600)	(1.192)	(0.801)	(0.600)	(0.273)	(0.323)	(0.269)	(0.454)	(0.316)	(0.318)
Age, in Log	-0.180	-0.322***	-0.175	-0.155	-0.396**	0.142	-0.111**	-0.144**	-0.038	-0.008	-0.182**	0.033
	(0.137)	(0.073)	(0.110)	(0.132)	(0.104)	(0.104)	(0.048)	(0.059)	(0.034)	(0.124)	(0.058)	(0.088)
Baseline Rev., In Log	0.888***	0.388***	0.890***	0.792***	0.394***	0.500***	0.972***	0.401***	0.981***	0.753***	0.411***	0.571***
	(0.032)	(0.050)	(0.031)	(0.110)	(0.032)	(0.043)	(0.050)	(0.046)	(0.049)	(0.057)	(0.040)	(0.079)
Size, Micro	-0.093	-2.431***	-0.119	-0.863**	-2.459***	2.339***	0.202	-2.477***	-0.011	-1.425***	-2.556***	2.679***
& Small	(0.170)	(0.265)	(0.142)	(0.256)	(0.328)	(0.287)	(0.304)	(0.293)	(0.302)	(0.333)	(0.465)	(0.392)
Size, Medium	-0.169	-1.161***	-0.237	-0.291	-1.326***	0.992***	0.457	-0.930***	0.235	-0.954**	-0.875**	1.387***
	(0.222)	(0.148)	(0.194)	(0.293)	(0.185)	(0.168)	(0.272)	(0.159)	(0.382)	(0.295)	(0.254)	(0.273)
EC Capability	0.015	-0.065	-0.005	-0.037	-0.017	0.080	0.047	-0.003	-0.016	-0.056	0.035	0.050
	(0.075)	(0.078)	(0.075)	(0.124)	(0.074)	(0.057)	(0.099)	(0.083)	(0.076)	(0.059)	(0.098)	(0.083)
Region, Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	239	239	239	204	236	239	235	235	235	200	232	235

Source: Authors' calculations.
Note. Columns represent the second-stage regression results under different outcome variables. Standard errors are reported in parentheses. Results of regional fixed effects are included in all models but are omitted from the table for brevity. Full results are available upon request.

****Significant at the 1 per cent level; **5 per cent level; and *10 per cent level.*

V. POLICY IMPLICATIONS

Accelerate implementation of the Philippine E-commerce Roadmap. The Philippines has long endeavoured to expand e-commerce through the Philippine E-commerce Roadmap 2016–2020, which targeted a 25% GDP contribution and 100,000 MSMEs online. (DTI, 2016). Of its 52 agenda items, 70% were completed by 2020 (DTI, 2021a). The updated E-commerce Philippines 2022: Madali roadmap refocuses on speed (connectivity and logistics), security (consumers, data, and intellectual property), and structure (policies), outlining 22 action items towards a safe, reliable, easy, and efficient e-commerce ecosystem by 2030 (DTI, 2021b).

Recent milestones include the passage of the Internet Transactions Act (RA No. 11967), the creation of the E-commerce Bureau, the rollout of its PhilSys or national identification system with 93.7 million individuals or 98.4% of the target already registered (Philippine Statistics Authority, n.d.),[6] and the passage of the E-Governance Act (RA No. 12254). A more systematic review of progress is needed to ensure the attainment of its targets, including the share of e-commerce to GDP and the number of enterprises doing e-commerce.

Priority areas include accelerating the implementation of the National Broadband Plan, developing a digitally skilled workforce, strengthening logistics infrastructure, automating and expanding online dispute resolution (ODR) for consumer cases, and modernizing e-commerce statistical systems. These priorities also hold relevance for other Asian economies pursuing similar digital transitions.

Support the implementation of the Magna Carta for Women (RA No. 9710). The study's findings on the positive effects of e-commerce adoption on female employment align with the objectives of the Magna Carta for Women, which mandates gender equality, empowerment and gender mainstreaming across government, and potentially contribute to the achievement of the Sustainable Development Goals, specifically Goal 5 (Achieve gender equality and empower all women and girls). Allocating Gender and Development funds to digital upskilling, MSME support, and firm-level digitalization provides a concrete way to operationalize the law's required allocation of at least 5% of agencies budgets to Gender and Development.

Enhance peer diffusion mechanisms and digital ecosystem. The strong influence of neighbouring firm adoption highlights the value of network-driven strategies. Leveraging existing business ecosystems, such as industry associations, local chambers, or supplier networks can accelerate digital technologies diffusion. This highlights the importance of embedding firms within ecosystems that foster spillovers and localized peer learning.

However, bandwagon adoption can be risky. Firms may adopt digital tools prematurely,

[6] Data as of 30 June 2025.

without adequate skills or infrastructure, leaving them less competitive. Peer and network effects can be a double-edged sword, while they encourage adoption through demonstration, they may also intensify competition or reinforce vulnerabilities.

One location- and sector-based initiative to coordinate innovation and technology transfer in the Philippines is the development of regional inclusive innovation centres—a network of innovation champions from government agencies, academic institutions, private sector groups, enterprises and individuals. Complementing these innovation centres are the shared service facilities that lower the entry cost for digital adoption by providing enterprises, especially MSMEs, with machinery, equipment, tools, systems, accessories and other skills and knowledge under a shared system. These should be complemented by targeted outreach campaigns that highlight localized success stories and demonstrate practical benefits for similar firms. Government can further strengthen adoption by curating and disseminating best practices through seminars, roadshows, and dedicated funding. Beyond initial adoption, firms need support to integrate e-commerce with inventory systems, digital payments, customer analytics, and cross-border logistics. Programs should help firms not only go online but also scale, innovate and compete effectively in digital markets.

Boost Digital Skills and Infrastructure. Robust digital and logistics infrastructure, alongside digital skills upgrading, is essential in e-commerce development (ADB, 2023; ADB, 2018). Closing the digital divide requires continued investments in ICT and logistics infrastructure, particularly in underserved areas, to reduce transaction costs and expand market reach. Upskilling and reskilling are equally important to enable participation and mitigate job displacement risks.

The IMD (2024) report on world digital competitiveness highlights the severity of gaps across Asia. Singapore ranks first globally, with the Republic of Korea and Taipei, China also belonging to the top 10 out of 67 economies; while economies like the Philippines and Mongolia are in the bottom 10, reflecting weaknesses in knowledge, technology and future readiness. Regional efforts like the ASEAN SME Academy and Go Digital ASEAN offer scalable models for inclusive digital capacity building. Member states should support the participation of domestic firms, especially MSMEs and women-led enterprises in such initiatives.

Promote consumer protection and trust in digital market. Trustmark schemes help build consumer confidence and signal compliance with fair e-commerce practices. Malaysia has implemented a national trustmark since 2011, and the Philippines launched the E-commerce Philippine Trustmark in 2025. ASEAN, through its Working Group on E-commerce, has also explored a regional trustmark scheme. Member states are encouraged to establish or strengthen national trustmark programs and align with regional efforts to build a safer and more integrated digital marketplace.

Countries should also strengthen redress mechanisms, particularly through ODR sys-

tems. Only Indonesia, the Philippines and Thailand currently have national ODR systems in the ASEAN (ASEAN Secretariat, 2022). Expanding ODR systems in other member states is critical to realizing the ASEAN ODR Network, which aims to enable cross-border consumer redress. Ensuring interoperability between trustmark schemes and ODR systems will be key to fostering cross-border e-commerce.

Promote competition in digital infrastructure and complementary services. Lowering the cost of e-commerce adoption requires stronger competition across the digital ecosystem. More competitive markets for connectivity, digital payments, and logistics can reduce prices, improve service quality, and expand access, especially for MSMEs. Policies that encourage new entrants, promote open access infrastructure, ensure interoperability, and prevent market dominance can help create a more efficient and affordable environment for firms to adopt and scale e-commerce.

Beyond infrastructure and services, competition policy also shapes firms' ability to sustain e-commerce adoption. The observed profitability pressures among adopting firms point to the importance of reducing switching costs, improving platform transparency, and lowering barriers to entry, particularly for smaller enterprises. Complementary entrepreneurship support, such as mentorship, incubation and digital capability programs, can help firms navigate platform-based markets and translate adoption into more durable performance gains.

Harmonize and Improve Data. Countries should work toward harmonized definitions and data collection methods for the digital economy and e-commerce. Divergent concepts and limited indicators hinder regional benchmarking and evidence-based policymaking. Alignment with frameworks from UNCTAD, OECD and ADB can support consistent measurement, improve policy design and enhance cross-country comparability.

In the Philippines, challenges in the definition exist across both legal and statistical frameworks. The Internet Transactions Act of 2023 (RA No. 11967) defines e-commerce as the sale or lease of digital or non-digital goods and services over the internet but explicitly excludes online media content and consumer-to-consumer transactions. Meanwhile, the Philippine Statistics Authority's SICT-based measures, aligned with the OECD (2011) definition, capture the purchase and sale of goods and services over electronic/digital means, yet similarly exclude social media-based and informal online transactions. This divergence between legal and statistical definitions may understate e-commerce adoption, particularly among micro and small firms that rely heavily on social commerce platforms such as Facebook and Instagram.

To better inform digital economy policy, future data collection efforts should expand survey instruments to capture social commerce and platform-based selling more explicitly, reflecting evolving business practices and improving the measurement of digital adoption.

VI. CONCLUSION

This study contributes new causal evidence on the effects of e-commerce adoption in the Philippines, using an IV approach and matched firm-level data to examine the impacts on firm performance and labour outcomes. While the results are only internally valid to the dataset, the results offer credible insights into how e-commerce adoption, particularly through peer effects, affects firm behaviour in a developing country setting.

Across pre-pandemic horizons, the effects of e-commerce adoption evolve. Early adoption generated significant employment gains, including for women, but limited revenue or profit effects. Extending the treatment period to 2021 showed broader impacts, with increases in firm revenues and expenses. Over the full period, adoption continued to expand revenues and costs but profitability weakened, suggesting adjustment pressures as firms scaled their digital operations. These patterns indicate that e-commerce adoption is dynamic: job creation defines the initial phase, expansion the middle, and cost restructuring the longer horizon. Policy support is therefore essential to sustain inclusive gains and help firms manage the transition.

Survey data reinforces these dynamics. Reduced transaction time remains the most consistent benefit, followed by reduced paper and marketing transactions, increased sales and lower costs, albeit declined in recent years. Non-adopters increasingly cite a preference for traditional business models, security and privacy, lack of skilled employees and unreliable internet as barriers to adoption. Notably, most non-adopters already had internet access, suggesting that connectivity is necessary but not sufficient, and that organizational factors and perceptions weigh heavily in adoption decisions.

A comprehensive policy response is needed to encourage e-commerce adoption and maximize its benefits. Enhancing peer diffusion by leveraging existing business networks and local ecosystems, expanding support for MSMEs through regional inclusive innovation centres and shared service facilities, and helping firms integrate digital tools into their operations are all essential. Equally important are continued investments in digital infrastructure and skills, especially in underserved areas, and the use of regional platforms such as the ASEAN SME Academy and Go Digital ASEAN to build capacity. Increasing competition in digital infrastructure and complementary services and building trust in digital markets through stronger consumer protection, trustmark programs, and interoperable ODR systems will further support participation. Last, harmonizing definitions and improving data collection across countries will enable better regional benchmarking and more effective, evidence-based policymaking.

Addressing these disparities is critical not only for inclusive growth but also for advancing broader development goals. As noted, these findings also relate to SDG 5 through expanded women's employment and entrepreneurial opportunities and SDG 8, through productive employment, firm expansion, and more resilient economic activity.

Future research will benefit from expanding datasets, including the upcoming SICT rounds for 2023 and 2025, which will allow longer-term analysis in the post-COVID-19 pandemic era. As more comparable indicators become available, cross-country analyses on digital technology utilization, not just adoption, will provide deeper insights for policy.

NOTE ON AUTHORS

Ma. Kristina P. Ortiz is a Supervising Legislative Staff Officer II at the Congressional Policy and Budget Research Department of the Philippine House of Representatives. She holds a master's degree in statistics from the University of the Philippines Diliman and a master's in public policy from the National Graduate Institute for Policy Studies, Tokyo. Her research focuses on labour and employment policy.

Email: makristina.ortiz@house.gov.ph or tina.ortiz.16@gmail.com

Mark Carmelo R. Manguera is a Supervising Legislative Staff Officer II at the Congressional Policy and Budget Research Department of the Philippine House of Representatives. He holds a master's degree in development economics and a bachelor's degree in economics from the University of the Philippines Diliman. His research focuses on trade, investments, and industrial policy.

Email: markcarmelo.manguera@house.gov.ph or markmanguera@gmail.com

REFERENCES

Ahmad, Riaz, Fatima Sharif, Sareer Ahmad, Azeem Gul and Zhainagul Abdirasulova Abdirasulovna (2024). Does the digital economy improve female employment? A cross-country panel data analysis. Heliyon, vol. 10, No. 13, e33535. https://doi.org/10.1016/j.heliyon.2024.e33535.

Angrist, Joshua and Michal Kolesár (2024). One instrument to rule them all: the bias and coverage of just-ID IV. Journal of Econometrics, vol. 240, No. 2, 105398. https://doi.org/10.1016/j.jeconom.2022.12.012.

ASEAN Secretariat (2022). ASEAN launches a guideline on online dispute resolution for consumers. 8 April. https://www.aseanconsumer.org/read-publication-asean-launches-a-guideline-on-online-dispute-resolution-for-consumers.

Asian Development Bank (ADB) (2018). Embracing the e-commerce revolution in Asia and the Pacific. Mandaluyong: ADB.

_____ (2023). E-commerce evolution in Asia and the Pacific: opportunities and challenges. Mandaluyong: ADB.

Beaman, Lori, Ariel BenYishay, Jeremy Magruder and Ahmed Mushfiq Mobarak (2021). Can network theory-based targeting increase technology adoption? American Economic Review, vol. 111, No. 6, pp. 1918–1943. https://doi.org/10.1257/aer.20200295.

Bloom, Nicholas, Mark Schankerman and John Van Reenen (2013). Identifying technology spillovers and product market rivalry. Econometrica, vol. 81, No. 4, pp. 1347–1393.

Bonaccorsi, Andrea and Cristina Rossi Lamastra (2002). The adoption of business to business e-commerce: heterogeneity and network externality effects. LEM Working Paper Series, No. 2002/12. Pisa: Laboratory of Economics and Management, Sant'Anna School of Advanced Studies. https://doi.org/10.2139/ssrn.365882.

Calvino, Flavio and Maria Enrica Virgillito (2018). The innovation-employment nexus: a critical survey of theory and empirics. Journal of Economic Surveys, vol. 32, No. 1, pp. 83–117. https://doi.org/10.1111/joes.12190.

Cameron, A. Colin and Douglas L. Miller (2015). A practitioner's guide to cluster-robust inference. Journal of Human Resources, vol. 50, No. 2, pp. 317–372. https://doi.org/10.3368/jhr.50.2.317.

Cariolle, Joël, Maëlan Le Goff and Olivier Santoni (2019). Digital vulnerability and performance of firms in developing countries. France: Banque de France.

Cecilio, Denise Krisha G., Jaime Augusto T. Lee, Ma. Fides D. Puno and Valerie Shaine M. Tolentino (2022). Assessing the influence of the barriers to e-commerce adoption among SMEs in the Philippines. 23 June. https://animorepository.dlsu.edu.ph/etdb_econ/49/.

Chan, Pak Yuen P. and Annette M. Mills (2003). E-commerce adoption in small firms: a study of online share trading. In Managing e-commerce and mobile computing technologies, Julie R. Mariaga, ed. Hershey, PA: IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-93177-746-9.ch003.

Colato, Javier and Lindsey Ice (2023). Industry and occupational employment projections overview and highlights, 2022–32. Washington, D.C.: United States Bureau of Labor Statistics.

Conley, Timothy G. and Christopher R. Udry (2010). Learning about a new technology: pineapple in Ghana. American Economic Review, vol. 100, No. 1, pp. 35–69.

Crespi, Gustavo, Surya Mahdi and Pari Patel (2004). Adoption of e-commerce technology: do

network and learning externalities matter? Brighton: Science and Technology Policy Research, University of Sussex.

Cusolito, Ana Paula, Daniel Lederman and Jorge Peña (2020). The effects of digital-technology adoption on productivity and factor demand. Washington, D.C.: World Bank.

Dahlman, Carl, Sam Mealy and Martin Wermelinger (2016). Harnessing the Digital Economy for Developing Countries. Paris: OECD Publishing. https://doi.org/10.1787/4adffb24-en.

de Vera, Roberto E. (2004). Employment impact of business-to-consumer e-commerce on Philippine workers. Quezon City: Philippine Institute for Development Studies.

DeFranco, Agnes L., Cristian Morosan and Nan Hua (2017). Moderating the impact of e-commerce expenses on financial performance in US upper upscale hotels: the role of property size. Tourism Economics, vol. 23, No. 2, pp. 429–447. https://doi.org/10.5367/te.2015.0510.

Department of Trade and Industry (DTI) (2016). Philippine e-commerce roadmap 2016–2020. Makati: DTI.

_____ (2021a). The need for an updated roadmap. https://ecommerce.dti.gov.ph/madali/the_need.html.

_____ (2021b). 22 for 2022. https://ecommerce.dti.gov.ph/madali/22for2022.html.

Errighi, Lorenza, Sameer Khatiwada and Charles Bodwell (2016). Business process outsourcing in the Philippines: challenges for decent work. Geneva: International Labour Organization.

Fernandez-Stark, Karina, Penny Bamber and Gary Gereffi (2011). The offshore services value chain: upgrading trajectories in developing countries. International Journal of Technological Learning, Innovation and Development, vol. 4, Nos. 1/2/3, pp. 206–234. https://doi.org/10.1504/IJTLID.2011.041905.

Gherghina, Stefan Cristian, Mihai Alexandru Botezatu and Liliana Nicoleta Simionescu (2021). Exploring the impact of electronic commerce on employment rate: panel data evidence from European Union countries. Journal of Theoretical and Applied Electronic Commerce Research, vol. 16, No. 7, pp. 3157–3183. https://doi.org/10.3390/jtaer16070172.

Hendricks, Saarah and Samwel Dick Mwapwele (2024). A systematic literature review on the factors influencing e-commerce adoption in developing countries. Data and Information Management, vol. 8, No. 1, 100045. https://doi.org/10.1016/j.dim.2023.100045.

Hjort, Jonas and Jonas Poulsen (2019). The arrival of fast internet and employment in Africa. American Economic Review, vol. 109, No. 3, pp. 1032–1079. https://doi.org/10.1257/aer.20161385.

Imbens, Guido W. and Joshua D. Angrist (1994). Identification and estimation of local average treatment effects. Econometrica, vol. 62, No. 2, pp. 467–475. https://doi.org/10.2307/2951620.

International Institute for Management Development (IMD) (2024). IMD World Digital Competitiveness Ranking 2024. Lausanne: IMD World Competitiveness Center.

IT & Business Process Association of the Philippines (IBPAP) (2022). The big PH IT-BPM leap: the Philippine IT-BPM industry roadmap 2028. Taguig: IT and Business Process Association, Philippines.

Jain, Ritika (2021). Information and communication technology adoption and the demand for female labor: the case of Indian industry. The B.E. Journal of Economic Analysis and Policy, vol. 21, No. 2, pp. 695–722. https://doi.org/10.1515/bejeap-2020-0295.

Khoo, Vivian, Aidi Ahmi and Ram Al-Jaffri Saad (2018). E-commerce adoption research: a review of

literature. The Journal of Social Sciences Research, Special Issue 6, pp. 90–99. https://doi.org/10.32861/jssr.spi6.90.99.

Kinda, Tidiane (2019). E-commerce as a potential new engine for growth in Asia. Washington, D.C.: IMF.

Looi, Hong Cheong (2005). E-commerce adoption in Brunei Darussalam: a quantitative analysis of factors influencing its adoption. Communications of the Association for Information Systems, vol. 15, No. 1, pp. 61–81. https://doi.org/10.17705/1CAIS.01503.

Lorca, Pedro, Javier De Andres and Julita Garcia-Diez (2019). Impact of e-commerce sales on profitability and revenue: the case of the manufacturing industry. Engineering Economics, vol. 30, No. 5, pp. 544–555. https://doi.org/10.5755/j01.ee.30.5.21254.

Mandel, Michael (2017). How e-commerce creates jobs and reduces income inequality. Washington, D.C.: Progressive Policy Institute.

Meseguer-Artola, Antoni and Inma Rodríguez-Ardura (2015). Learning from customer interaction: how merchants create price-level propositions for experience goods in hybrid market environments. Computers in Human Behavior, vol. 51, Part B, pp. 952–959. https://doi.org/10.1016/j.chb.2014.10.013.

Mosiashvili, Natia and Jon Pareliussen (2020). Digital technology adoption, productivity gains in adopting firms and sectoral spill-overs: firm-level evidence from Estonia. Paris: OECD Publishing. https://doi.org/10.1787/ba9d00be-en.

Nelson, Paul and William Richmond (2007). Internet banking: gold mine or money pit? Academy of Banking Studies Journal, vol. 6, Nos. 1 and 2, pp. 1–25.

Organisation for Economic Co-operation and Development (OECD) (2011). Guide to measuring the information society. Paris: OECD Publishing. https://doi.org/10.1787/9789264113541-en.

Philippine Statistics Authority (PSA) (n.d.). Philippine identification system. https://philsys.gov.ph.

Quimba, Francis Mark A. and Sylwyn C. Calizo Jr. (2019). Determinants of e-commerce adoption of Philippine businesses. Quezon City: Philippine Institute for Development Studies.

Rahayu, Rita and John Day (2015). Determinant factors of e-commerce adoption by SMEs in developing country: evidence from Indonesia. Procedia – Social and Behavioral Sciences, vol. 195, pp. 142–150. https://doi.org/10.1016/j.sbspro.2015.06.423.

Sicat, Marie, Ankai Xu, Ermira Mehetaj, Michael Ferrantino and Vicky Chemutai (2020). Leveraging ICT technologies in closing the gender gap. Washington, D.C.: World Bank Group.

Soares-Aguiar, Antonio and António Palma-dos-Reis (2008). Why do firms adopt e-procurement systems? Using logistic regression to empirically test a conceptual model. IEEE Transactions on Engineering Management, vol. 55, No. 1, pp. 120–133. https://doi.org/10.1109/TEM.2007.912806.

Sovbetov, Yhlas (2018). Impact of digital economy on female employment: evidence from Turkey. International Economic Journal, vol. 32, No. 2, pp. 256–270. https://doi.org/10.1080/10168737.2018.1478868.

Staiger, Douglas and James H. Stock (1997). Instrumental variables regression with weak instruments. Econometrica, vol. 65, No. 3, pp. 557–586. https://doi.org/10.2307/2171753.

Stock, James H. and Mark W. Watson (2020). Introduction to Econometrics, 4th ed. New York: Pearson Education.

Tornatzky, Louis G. and Mitchell Fleischer (1990). The processes of technological innovation.

Lexington, MA: Lexington Books.

Trujillo, Manuel Pérez and Andrés Aleán-Romero (2024). The impact of ICT and e-commerce on employment in Colombia. Electronic Commerce Research and Applications, vol. 65, 101378. https://doi.org/10.1016/j.elerap.2024.101378.

United Nations (UN) (2023). Measuring the Value of E-commerce. Geneva: United Nations.

UN Trade and Development (UNCTAD) (2019). Digital Economy Report 2019. New York: United Nations.

Wheaton, William C. and Edward Tung (2019). Bricks or clicks? The efficiency of alternative retail channels. Cambridge: MIT Center for Real Estate.

World Economic Forum (WEF) (2025). Future of jobs report 2025: global employment trends and digital transformation. Geneva: World Economic Forum.

Zhu, Kevin, Shutao Dong, Sean Xu and Kenneth L. Kraemer (2006). Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies. European Journal of Information Systems, vol. 15, No. 6, pp. 601–616. https://doi.org/10.1057/palgrave.ejis.3000650.

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

UNLOCKING ECONOMIC GAINS: HOW E-COMMERCE ENHANCES EFFICIENCY, PRODUCTIVITY, AND MARKET ACCESS IN INDONESIA (EVIDENCE FROM THE 2024 E-COMMERCE SURVEY)

Sri H. Rachmad, Andri Yudhi Supriadi, Kennith G.C. Dillena, Devi Asiati, Roosganda Elizabeth, Haning Romdiati, Okki Navarone Wibisono

Corresponding Author: Andri Yudhi Supriadi[1] and S.H. Rachmad
Email: andri@bps.go.id

The rapid diffusion of digital technologies and internet access has transformed Indonesia's economy, making e-commerce a key driver of business performance. Using nationally representative data from the 2024 Statistics Indonesia E-commerce Survey of 40,011 MSMEs across 38 provinces, this study assesses the effects of e-commerce adoption on economic efficiency, employment, and market access. Logistic regression shows that maintaining formal financial statements significantly increases the likelihood of stable or rising revenues, while digital marketing training and exclusive reliance on non-cash payments are negatively associated with revenue growth. The findings highlight that financial management and digital capabilities matter more than technology adoption alone, supporting inclusive digital policies.

Keywords: e-commerce, MSMEs, digital economy, productivity, market access, digital divide, Indonesia

JEL classification: L81. O33. D24. O17. O18. F14. L26.

[1] The authors are thankful to Dr. Yose Rizal Damuri from the Centre for Strategic and International Studies Jakarta for his insightful critiques that enhanced this paper's rigor, and to Dr. Rachita Gulati of the ADB Institute for her invaluable feedback as a discussant.

I. INTRODUCTION

Digital transformation has become a major driver of global economic growth, with digital trade and e-commerce emerging as the most dynamic sectors, particularly in the Asia-Pacific region (Oh, 2021; Mohamed, 2023; Lukmanova et al., 2024; Phan, 2021; Mishra and Valencia, 2023). Empirical evidence shows that the digital economy, supported by information and communication technology expansion, positively affects total factor productivity, indicating that strategic digital infrastructure investments can promote economic cohesion and growth (Rehman and Nunziante, 2023). Regional initiatives such as the Digital Silk Road further emphasize the role of digital connectivity through big data, cloud computing, and digital currencies (Cheng, 2022).

Indonesia is undergoing a rapid digital transition driven by technological advances and widespread internet penetration. Small and medium-sized enterprises (SMEs) dominate the economy, representing over 99% of firms and employing around 97% of the workforce, making e-commerce central to inclusive growth strategies (Silaban et al., 2024). E-commerce bridges geographic barriers and connects remote producers to larger markets. [BPS] Statistics Indonesia (2023) reports that e-commerce accounts for about 72% of the digital economy's value and is projected to reach $146 billion by 2025, or 9–10% of GDP. The number of e-commerce businesses increased by 27.40% in 2023, reflecting rapid sectoral expansion (Wirdiyanti et al., 2023).

Despite this growth, firm-level evidence on micro, small and medium-sized enterprises (MSME) impacts remain fragmented. Existing studies show that e-commerce adoption improves efficiency, productivity, turnover, and profits (Ubaidillah et al., 2024; Martini et al., 2023), streamlines operations, and reduces costs through automation and digital integration (Rolando and Mulyono, 2025; Soeyatno et al., 2024; Paul et al., 2024; Tangwaragorn et al., 2024). E-commerce also enhances supply chain coordination (Mashalah et al., 2022), brand recognition (Wirdiyanti et al., 2023), and access to imported inputs, supporting export growth (Pane and Patunru, 2022).

Digital platforms expand market access domestically and internationally, enabling MSMEs to scale without physical expansion (Santoso et al., 2024; Islam Bhuiyan, et al., 2024; Mirzaye and Mohiuddin, 2025; Vasani and Abdulkareem, 2024; Dung et al., 2026; Pathirana, 2023). Cross-border collaborations strengthen trade and infrastructure development (Zhu et al., 2021), while the digital economy promotes financial inclusion, employment, resilience, and gender equality (Fashola and Kusuma, 2024; Simamora and Ningsih, 2020; Zhang et al., 2024).

However, MSMEs face persistent barriers, including logistical complexity, low digital literacy, regulatory challenges, limited IT capabilities, cybersecurity risks, platform concentration, and weak export participation (Macca et al., 2024; Wulandari et al., 2026; Rupeika-Apoga and Petrovska, 2022; Panko et al., 2025; Triandini et al., 2023; Sindhwani et al., 2024; Suyanto et.al., 2023; Shahadat et al., 2023; Ollerenshaw et al.,

2021; Mustafa et al., 2022;). Geopolitical dynamics further shape digital trajectories (Cheng, 2022; Wang and Chen, 2022). This study addresses these gaps through a comprehensive, data-driven assessment of e-commerce impacts on MSMEs, supporting evidence-based policies aligned with sustainable development goals (Elfaki and Ahmed, 2024).

II. THEORETICAL FRAMEWORK OF E-COMMERCE

Theoretical foundations. The analysis of e-commerce's economic impacts is grounded in several complementary theoretical frameworks, particularly transaction cost economics and the resource-based view), which explain how digital technologies function as strategic assets that reduce costs and enhance productivity in Indonesian e-commerce contexts (Wulan and Reni, 2024; Jawad and Mohammed, 2024; Sari and Anggraweni, 2024). Coase's The Nature of the Firm (1937) argues that firms exist to minimise transaction costs; e-commerce lowers search, negotiation, and contracting costs through digitalization, reducing the need for large organizational structures. Williamson (1975, 1985) extends this framework by emphasizing asset specificity, opportunism and bounded rationality, showing that digital platforms reduce information asymmetry and coordination costs while necessitating new governance mechanisms for digital contracts. Transaction cost economics thus explains how e-commerce enables Indonesian SMEs to overcome traditional market inefficiencies and access wider markets.

The resource-based view, in Barney (1991), further posits that e-commerce capabilities constitute strategic, hard-to-imitate resources when integrated with organizational competencies. Digital platforms transform data, algorithms and networks into sources of competitive advantage, expanding market access and productivity. Empirical studies support these frameworks, highlighting the mediating roles of digital orientation, technology readiness, entrepreneurial competence, and top management support in shaping e-commerce outcomes (Barragan and Becker, 2024; Harini et al., 2023).

Complementary perspectives include market access theory, which explains how digital platforms expand geographic and demographic reach—highly relevant in Indonesia's archipelagic setting—and digital divide theory, which underscores how infrastructure and capability gaps constrain inclusivity (Norris, 2001). Emerging frameworks, such as the technology acceptance model, help explain adoption of tools like cashless payments (Syafaastuti, Delfina and Syahchari, 2024), while sustainable digital transformation research emphasizes aligning digital maturity with long-term strategic goals (Mick et al., 2024).

Empirical evidence on e-commerce economic impacts. Recent empirical studies provide strong evidence that e-commerce adoption generates positive economic impacts for Indonesian MSMEs. National surveys report revenue increases of 10.9% and profit growth of 11.8% among e-commerce adopters (Wirdiyanti et al., 2023).

Efficiency gains arise through reduced transaction costs, process automation, and improved supply chain management, with the SMEs adopting experiencing operational cost efficiency improvements of 8–15% (Unggara and Sadono, 2021). Digital bookkeeping further strengthens financial management and business control (Amara et al., 2024).

Theoretically, the Solow growth model (1956) and total factor productivity (TFP) theory emphasize productivity gains beyond capital and labour inputs. E-commerce enhances total factor productivity by automating operations and integrating digital technologies across value chains. Romer's endogenous growth theory (1986, 1990) reinforces this view, highlighting how knowledge diffusion and innovation via digital platforms stimulate sustained productivity growth. Although Solow's IT productivity paradox (1987) cautions that digital benefits may not immediately appear, subsequent evidence since the 2000s confirms productivity gains from logistics efficiency, supply chain automation and cross-border trade.

Stephen Oliner and Daniel Sichel's new economy productivity theory (Oliner and Daniel Sichel, 2000) positions e-commerce as a core driver of market efficiency, while network effect theory explains how expanding platform participation increases productivity through scale and data-driven matching (Katz and Shapiro, 1985). Brynjolfsson and McAfee's digital platform productivity theory (2014) further underscores the role of automation, big data and AI in accelerating productivity. Empirical studies confirm that these gains are strongest among micro and small enterprises (Silaban et al., 2024), supported by big data utilization (Kgakatsi et al., 2024) and market expansion of 40–60% through digital platforms (Alia et al., 2024), including social media-driven e-commerce models (Putra and Fakhrina, 2024).

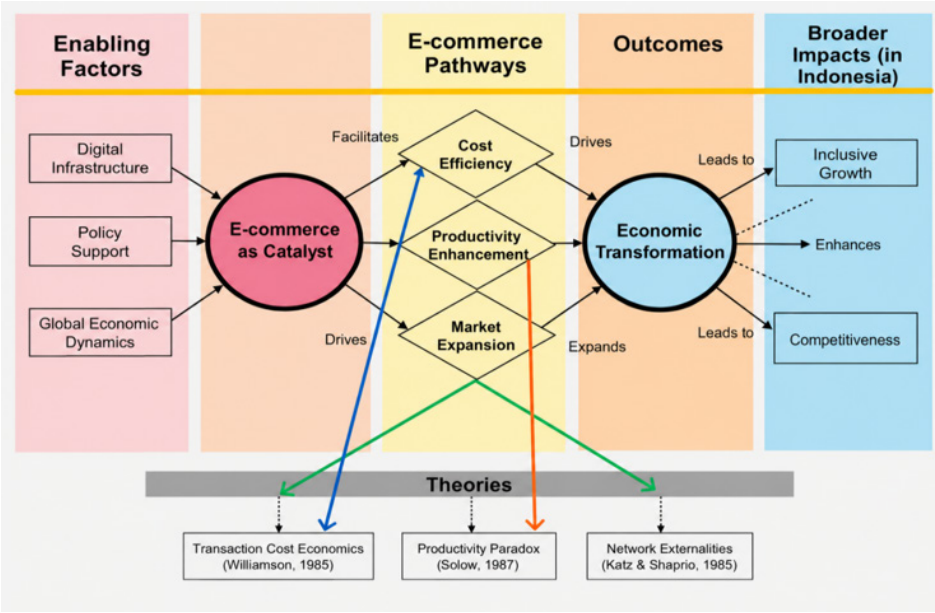
Regional variations and inclusive growth challenges. Empirical evidence reveals significant heterogeneity in e-commerce impacts across different contexts. Firm size effects show micro enterprises experiencing the largest relative gains, while sectoral variation indicates that manufacturing SMEs demonstrate stronger productivity effects and service sector firms show stronger market access benefits. Regional differences represent a critical challenge, with urban areas showing higher adoption rates and larger economic impacts, highlighting persistent digital divide challenges. Recent studies in West Papua, for instance, identified limited capital, low financial literacy and inadequate infrastructure as primary barriers (Suharyanto et al., 2024), though integration challenges remain in areas with limited infrastructure (Quansah, 2024; Kokkoli, 2023). Moreover, e-commerce expands market access and increases farmers' incomes in rural areas of the People's Republic of China by allowing consumers to substitute local merchants with online options, thereby enhancing consumer surplus and optimizing information infrastructure (Ye et al., 2024; Dolfen et al., 2023).

E-commerce role in the digital economy. Theoretical foundations on competitive

advantages and market accessibility highlight how e-commerce reshapes global trade dynamics. David Ricardo's comparative advantage theory (Ricardo 1817) posits that global market access enables specialization in goods and services with relatively lower production costs. In digital commerce, this logic extends to firms directly reaching international consumers. Michael Porter's competitive advantage theory (1985) further argues that competitiveness depends on cost efficiency and differentiation, which e-commerce strengthens by reducing distribution and transaction barriers, broadening domestic and global reach.

Figure 1 illustrates how e-commerce acts as a catalyst for economic transformation by leveraging digital infrastructure, policy support and global economic dynamics. Through cost efficiency, productivity enhancement and market expansion, e-commerce promotes inclusive growth and strengthens national competitiveness, underpinned by transaction cost, productivity, and network externalities theories.

Figure 1. Conceptual framework of e-commerce's catalyst



Source: Developed by authors based on theories: transaction cost economics (Williamson, 1985); Productivity paradox (Solow, 1987) and Network externalities (Katz and Shapiro, 1985)

Paul Krugman's new trade theory (Krugman, 1989) highlights economies of scale and product differentiation as sources of competitiveness, where e-commerce lowers entry barriers, enabling SMEs and larger firms alike to capture new markets. Transaction cost economics (Williamson, 1975, 1985) underlines the importance of search, negotiation, and distribution costs, all of which e-commerce significantly

reduces, thereby enhancing competitiveness relative to traditional trade. Finally, global value chain theory (Gereffi, 1994; Gereffi et al., 2005) shows that integration into global supply chains enhances competitiveness through access to markets, technology, and knowledge; e-commerce accelerates this integration by connecting smaller producers directly to global networks. Together, these theories imply that e-commerce not only facilitates market accessibility but also transforms structural sources of competitive advantage, making digital participation a critical determinant of firm and national competitiveness.

The impact of e-commerce on productivity can be explained through several theoretical frameworks, including total factor productivity (Solow), endogenous innovation (Romer), dynamic capabilities (Teece), learning by doing, and network effects (Arrow, Katz and Shapiro), as well as creative destruction (Schumpeter) and transaction cost economics (Coase, Williamson). All of these theories emphasize that e-commerce significantly contributes to enhancing efficiency and output at both the micro (firm) and macro (economic) levels.

III. METHODOLOGY

This research adopts a descriptive and inferential quantitative approach, focusing on secondary data from the 2024 E-commerce Survey conducted by BPS Statistics Indonesia. This method provides an empirical overview of the dynamics and impacts of e-commerce on economic efficiency, productivity and market accessibility in Indonesia for 2023.

The descriptive analysis is presented in Chapter 4 of the survey through a set of summary statistics and distribution tables that illustrate the characteristics of respondents and the key variables used in the study. These tables describe, among other things, variations in digital technology adoption, firm characteristics and distribution of e-commerce usage across different segments. Such descriptive information is intended to help readers gain a clearer understanding of the data structure before proceeding to the inferential analysis. Although cross-sectional and cross-tabulation tables are not included explicitly, the descriptive summary tables in Chapter 4 similarly offer an overview of the underlying patterns in the survey data.

Data and Coverage. The survey encompasses 38 provinces and 365 districts/municipalities, covering 6,372 census blocks. A census block represents an enumeration area within a village or urban administrative region (desa/kelurahan) across Indonesia, facilitating the collection of nationally representative data on business practices and digital adoption. The survey focuses on businesses that received orders or conducted sales via the internet in 2023.

Given the varying numbers of e-commerce enterprises across districts and census blocks, the potential for online trade also differs regionally. To ensure representative

coverage of e-commerce enterprises, stratification was employed at both the district and census block levels. A multi-stage stratified sampling method was utilized, comprising three stages. Stage 1 involved selecting districts/cities within each stratum using the probability proportional to size method, based on the number of e-commerce businesses. Stage 2 systematically selected census blocks within each chosen district/city according to allocated numbers. Stage 3 involved sampling e-commerce businesses based on updated listings.

The sample size for the E-commerce Survey was determined with a margin of error of 15%, resulting in 40,066 e-commerce business samples and 6,372 census block samples. Following data cleaning, 39,736 eligible e-commerce businesses were retained for analysis. This extensive geographic coverage and large sample size provide a solid empirical foundation for examining how digital practices influence MSME performance in Indonesia's dynamic e-commerce landscape. The distribution of e-commerce businesses and census block samples by province is detailed as follows:

Table 1. Number of samples census block and e-commerce enterprises by province

Province	Number of districts	Number of block census	Number of enterprises
Aceh	14	225	1.098
Sumatera Utara	14	219	1.408
Sumatera Barat	12	191	1.301
Riau	8	158	1.073
Jambi	8	158	1.104
Sumatera Selatan	10	229	1.289
Bengkulu	7	176	996
Lampung	10	156	1.356
Kep. Bangka Belitung	6	135	954
Kepulauan Riau	5	141	1.118
Dki Jakarta	5	129	1.132
Jawa Barat	27	247	1.855
Jawa Tengah	35	261	1.759
Di Yogyakarta	7	171	1.048
Jawa Timur	36	271	1.648
Banten	11	174	1.063
Bali	9	177	1.343
Nusa Tenggara Barat	9	186	1.229
Nusa Tenggara Timur	11	256	1.085
Kalimantan Barat	10	202	1.281
Kalimantan Tengah	11	173	1.040

Province	Number of districts	Number of block census	Number of enterprises
Kalimantan Selatan	11	165	1.052
Kalimantan Timur	9	190	1.377
Kalimantan Utara	4	122	807
Sulawesi Utara	8	171	1.033
Sulawesi Tengah	9	191	1.034
Sulawesi Selatan	15	195	1.305
Sulawesi Tenggara	9	175	975
Gorontalo	5	128	737
Sulawesi Barat	5	120	813
Maluku	4	104	784
Maluku Utara	4	135	587
Papua Barat	4	49	621
Papua Barat Daya	3	92	448
Papua	4	162	752
Papua Selatan	3	68	250
Papua Tengah	3	135	198
Papua Pegunungan	3	48	717
TOTAL		6.372	40.066

Source. 2024 BPS E-commerce Survey.

Measures. Guided by the conceptual framework, this study operationalizes MSME performance through three interrelated dimensions: economic efficiency, productivity and market accessibility. Economic efficiency is closely linked to the adoption of digital payment systems, which have been shown to improve retailer performance by 9.6% in emerging markets (Adhikary et al., 2021), promote financial inclusion (Mavlutova et al., 2022), and enhance operational efficiency through digital transformation and data analytics without increasing costs (Kausar et al., 2025). However, the magnitude of these effects varies by firm size and sector (Oduro et al., 2023; Kokkoli, 2023). In this study, economic efficiency serves as a proxy for digital adoption and managerial formalization, measured using indicators from the 2024 E-commerce Survey, including the use of digital payment systems, delivery mechanisms and the maintenance of financial records. In bottom of the pyramid contexts that consider "lower-income settings", digital technologies help bridge institutional gaps and reduce investment disparities among small enterprises (Quansah, 2024; Chen and Jiang, 2023).

Productivity reflects business dynamics related to employment absorption and annual revenue changes, capturing how digital engagement contributes to labour utilization and income stability. Digital transformation enhances labour productivity

by improving production management and decision-making, particularly in non-state-owned enterprises (Zhou et al., 2025). Evidence from sub-Saharan Africa shows that e-commerce adoption improves SME performance by strengthening trust, customer relationships, and operational flexibility (Anabila et al., 2024). However, employment shifts across sectors may generate adjustment costs, underscoring the need for targeted upskilling and digital literacy policies (Chun et al., 2023; Pérez Trujillo and Aleán–Romero, 2024). Accordingly, productivity is measured through employment absorption, business revenue and participation in digital training, although the survey does not capture pre- and post-training income effects.

Market accessibility captures the breadth of customer and geographic reach by distinguishing between Business-to-consumer (B2C), business-to-business (B2B), and business-to-government (B2G) transactions. This classification enables a comprehensive assessment of e-commerce market orientation in Indonesia.

To evaluate MSME performance determinants, a binary logistic regression model is estimated using revenue stability or growth as the dependent variable (r315 = 1). Explanatory variables include financial recordkeeping (r308), participation in digital marketing training (r323A), and the use of non-cash payments (r318). The model is estimated on 39,736 valid observations, constituting the largest firm-level dataset on Indonesia's e-commerce sector. This is simply the exponential form of the logit model:

$$\text{logit}(p) = \ln(p/(1-p)) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$$

Exponentiation both sides gives the odds ratio form shown above.

Each coefficient β_i corresponds to an odds ratio of $e^{\beta i}$

If $\beta_i > 0$, then $e^{\beta i} > 1$, indicating an increase in odds when X_i increases

If $\beta_i < 0$, then $e^{\beta i} < 1$, indicating a decrease in odds

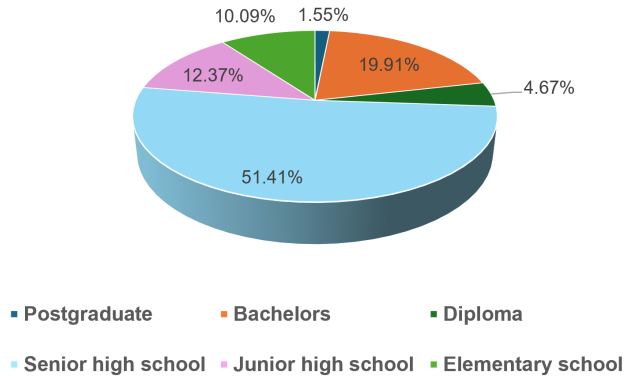
IV. RESULTS AND FINDINGS

Demographics respondent E-commerce Survey. The demographic analysis from the 2024 E-commerce Survey reveals compelling insights into the distribution of gender and educational attainment among participants. Out of the 39,736 respondents, males slightly outnumber females, constituting 52.07% compared to 47.93%. However, in regions such as North Sulawesi, Gorontalo, North Kalimantan and East Kalimantan, the number of female respondents surpasses males. This trend highlights a significant increase in women's participation in e-commerce across diverse areas, extending well beyond major urban centres.

In educational qualifications, the majority of respondents (51.41%) possess a high school diploma, indicating that e-commerce users primarily come from the secondary education demographic. Those with higher education degrees (D4/S1) account

for 19.91%, while vocational graduates (D1–D3) represent 4.67%. Interestingly, a notable 10.09% of respondents have only basic education (≤SD), followed by 12.37% with junior high school diplomas. In contrast, the representation of individuals with postgraduate degrees (S2/S3) is minimal, at just 1.55%. This educational distribution illustrates that e-commerce penetration is not confined to highly educated individuals; rather, it has also reached those in middle and lower educational tiers. The significant presence of high school graduates signals considerable market expansion potential, as this group is generally more adaptable to digital technologies yet requires further enhancement in digital literacy.

Figure 2. Distribution of respondents by education level



Source: Authors' calculations from micro dataset of the 2024 BPS E-commerce Survey.

Moreover, the increasing participation of women in various regions presents strategic opportunities for the development of gender-inclusive products, services and marketing initiatives. Overall, the demographic profile of respondents underscores the extensive growth of e-commerce in Indonesia, transcending geographic, gender, and educational boundaries. These findings emphasize the importance of targeted policies and programs to support this expanding demographic, ultimately fostering a more inclusive and robust e-commerce landscape.

Economic efficiency. Analysis of year-over-year performance data shows that e-commerce adoption generates substantial economic benefits for MSMEs. Adopters experience average revenue growth of 23.4% and profit margin increases of 15.2% ($p<0.001$), aligning with evidence on positive digital return on investment (Amalia, 2024). Employment effects are also significant, with adopting firms hiring an average of 2.3 additional workers and recording 28% higher female employment rates. Market access expansion emerges as a key mechanism, as 67% of adopters sell beyond their immediate region and expand their customer base by an average of 156%.

At the macro level, Indonesia's e-commerce transaction value reached 1,100.87 trillion rupiah in 2023, growing by approximately 40% year-on-year. Marketplaces accounted for 32.74% of transactions, while the remainder occurred through instant messaging and social media, highlighting the dominance of informal or semi-formal platforms in MSME digital trade. This pattern reflects a gradual and uneven digital integration process shaped by both adaptability and structural constraints.

MSMEs strongly prefer low-cost and accessible digital transaction media. Instant messaging is the most widely used channel (3,636,746 units), followed by social media (1,269,887 units), whereas marketplaces (679,319 units), e-mail (127,498 units) and websites (67,720 units) remain less prevalent. This reliance on simple tools reflects adaptive efficiency based on flexibility rather than advanced infrastructure, consistent with international findings that emphasize the role of instant messaging in building trust, improving customer satisfaction and increasing conversion rates (Cao et al., 2020; Mero, 2016; Bailey, 2020; Chrisos, 2021).

Payment systems further illustrate the transitional nature of digital transformation. Cash-on-delivery remains dominant (2,868,024 units), driven by trust considerations, while adoption of bank transfers, e-wallets, credit cards, and QRIS signals gradual progress toward digital finance.[2] Cash-on-delivery continues to be perceived as safer in developing contexts (Ajay et al., 2023; Surya and Nasution, 2024; Nasution and Surya, 2024; Sauki, 2023; Daily Trust, 2022).

Delivery mechanisms vary widely, from direct delivery and pickup to courier services and limited digital goods distribution. However, a major efficiency gap persists in financial record-keeping: only 578,702 MSMEs maintain proper records, constraining performance evaluation, profitability assessment, and access to formal finance, thereby limiting long-term efficiency gains.

Overall, the findings imply that MSMEs' efficiency gains are largely derived from the pragmatic use of accessible digital tools rather than from comprehensive digital transformation. Instant messaging and social media have become crucial enablers of low-cost, rapid interaction, but the limited use of structured e-commerce platforms, digital payments, and formal record management continues to constrain broader efficiency outcomes. Enhancing digital literacy, promoting secure digital finance, and strengthening managerial practices could therefore serve as key strategies to advance the economic efficiency and resilience of MSMEs in the digital era.

[2] Quick Response Code Indonesian Standard (QRIS) is Indonesia's QR code payment system.

Table 2. Economic efficiency of MSMEs 2023

	Description	Estimation (unit)
1.	Digital transaction media	
	a. Website	67,720
	b. E-mail	127,498
	c. Instant messaging	3,636,746
	d. Social media	1,269,887
	e. Marketplace	679,319
2.	Payment system	
	a. Cash on delivery	2,868,024
	b. Bank transfer	665,564
	c. Credit card	16,467
	d. e-wallet	225,697
	e. QRIS	39,047
3.	Delivery mechanism	
	a. Delivery directly to the buyer by the seller	1,940,291
	b. Delivery directly to the buyer using delivery services (Post, TIKI, GoSend, etc.)	324,878
	c. Order pickup directly at the store or at a designated pickup point	1,517,719
	d. Download from a website, application, software, email, or other sources	31,911
4.	The presence of financial records.	
	a. Yes	578,702
	b. No	3,236,097
Total E-commerce business		3,814,799

Source. Authors' calculation from micro dataset of the 2024 BPS E-commerce Survey.

Productivity. Table 3 comprehensively reviews productivity indicators in Indonesia's e-commerce sector, covering employment absorption, business revenue dynamics, and digital training participation. The data underscore both the sector's potential and its structural weaknesses that influence overall productivity performance.

Table 3. Productivity indicators

Description	Estimation
1. Employment absorption	
a. Paid	21,613,703
b. Unpaid	2,464,743
c. Male	12,498,874
d. Female	11,579,573
2. Business revenue	
a. Stabil	858,703
b. Increase	1,860,289
c. Decrease	1,095,807
3. Digital training	
a. Yes	146,406
b. No	3,668,394
4. Level of training (multiple entry)	
a. Basic	114,728
b. Skilled	40,651
c. Expert	17,372

Source: Authors' calculation from micro dataset of the 2024 BPS E-commerce Survey.

First, employment absorption reaches over 24 million workers, with 21.6 million in paid positions. This indicates that e-commerce has evolved into a major generator of formal and income-based employment. The gender distribution—12.5 million male and 11.6 million female—reveals near parity, suggesting that digital platforms have expanded inclusive job opportunities. High levels of paid employment also point to an increase in labour productivity, as workers in digital commerce are more likely to be engaged in output-oriented, technology-driven tasks compared to traditional retail.

Second, the business revenue distribution reflects productivity heterogeneity. While 1.86 million businesses reported increased revenue, 1.09 million experienced a decline, and 858,703 remained stable. This uneven performance indicates that productivity gains are not uniform firms with stronger digital integration, better logistics management, or enhanced online marketing likely achieved higher growth. Meanwhile, the segment with stagnant or decreasing revenue may reflect firms that lag in adopting digital tools, thus facing lower operational efficiency.

The most striking productivity challenge lies in digital training. Only 146,406 businesses (less than 4%) have participated in training, while 3.67 million have not. Among trained participants, the majority (114,728) remain at the basic level, with far fewer at skilled (40,651) and expert (17,372) levels. This imbalance highlights a critical skills gap that

constrains productivity improvement. Businesses with limited digital competencies are less able to leverage e-commerce platforms, data analytics, and automation to optimize performance.

In essence, the table reveals a dual reality of Indonesia's e-commerce productivity: rapid employment and revenue growth on one hand, but constrained human capital and digital capability on the other. The data imply that productivity gains depend not only on digital access but also on the depth of digital skill adoption. Expanding targeted digital training, especially at the skilled and expert levels, will be key to transforming Indonesia's large e-commerce base into a more efficient, innovative, and globally competitive digital economy.

Market accessibility. Table 4 illustrates the landscape of market accessibility in e-commerce, focusing on both market coverage and customer types. The data reveals that e-commerce activities are overwhelmingly concentrated in the domestic market, with an estimated 3,780,276 participants compared to only 34,523 engaging in international trade. This means that nearly 99% of e-commerce operations are domestically oriented. However, even within the domestic sphere, market reach remains relatively limited—only 11.81% of businesses serve customers across provinces, indicating that most e-commerce actors still operate within local or regional boundaries rather than reaching a nationwide scale. Such a pattern suggests that while domestic digital infrastructure and consumer adoption are well-developed, significant barriers—such as logistics, regulatory challenges, and cross-border payment systems—continue to constrain international expansion.

Table 4. Market accessibility

	Description	Estimation
1.	Coverage	
	a. Domestics	3,780,276
	b. International	34,523
2.	Customer type	
	a. B2C	71.88%
	b. B2C+B2B	19.07%
	c. B2C+B2B+B2G	9.05%

Source: Authors' calculation from micro dataset of the 2024 BPS E-commerce Survey.

In terms of customer segmentation, the majority of e-commerce businesses (71.88%) operate under the B2C model, directly serving individual consumers. Meanwhile, 19.07% combine B2C with B2B activities, and only 9.05% engage across B2C, B2B, and B2G markets. This distribution reflects the predominance of consumer-driven commerce in the digital economy, while business-to-business and government-related e-commerce remain relatively underdeveloped. Nonetheless, these emerging

segments represent considerable growth potential, particularly as digital procurement and enterprise integration gain traction.

Overall, the data indicates that e-commerce in this context is still primarily domestically focused and consumer oriented. To enhance market accessibility, stakeholders should aim to strengthen cross-border capabilities, expand digital infrastructure, and encourage diversification into B2B and B2G models. Doing so would not only broaden market opportunities but also position local e-commerce players for sustainable participation in the global digital economy.

Statistical inference analysis of the shift in e-commerce revenue for entrepreneurs. The results, adjusted with robust standard errors, are presented in Table 5. The model yields a Wald $\chi^2(3) = 121.93$ ($p < 0.001$) and Pseudo $R^2 = 0.0030$, indicating statistical significance though modest explanatory power—typical for behavioural and cross-sectional microdata models. The Pearson Goodness-of-Fit test ($\chi^2(4) = 3.39$, $p = 0.495$) confirms that the model is well-calibrated, with no evidence of misspecification or poor fit.

Table 5. Logistic regression results (robust standard errors)

Variable	Coef (β)	Odds ratio	p-value	Average marginal effect/ AME (ΔPr)
Financial reporting (r308)	0.362***	1.44	0,000	0,063
Digital marketing training (r323A)	–0.221***	0.80	0,000	-0,038
Non-cash payment (r318)	–0.107***	0.90	0,000	-0,018
Constant	1.216***	3,37	0,000	

*Note: N = 39,736; Robust standard errors used; *** p < 0. 001.Abbreviations: AME = average marginal effect.*

Source: Authors' calculation from the micro dataset of the 2024 BPS E-commerce Survey

The inferential results reveal three statistically significant determinants of MSMEs performance, each pointing to distinctive dimensions of digital readiness. First, maintaining financial statements emerges as the strongest predictor of stable or increasing revenue. Firms that record and manage their financial transactions formally have 44% higher odds of maintaining or improving their income levels (Odds Ratio = 1.44, AME = +0.063). This finding underscores the centrality of financial literacy and governance in digital transformation. As predicted by transaction cost economics (Coase, 1992; Williamson, 1985), structured financial management reduces internal coordination costs and enhances strategic decision-making. Moreover, in line with the resource-based view (Barney, 1991), accounting systems constitute valuable organizational assets that enable firms to translate digital adoption into tangible performance outcomes.

Second, digital marketing training shows a statistically significant negative association

with revenue improvement (Odds Ratio = 0.80, AME = –0.038). While counterintuitive, this result suggests that training programs may not yet align with practical business needs or market dynamics. Many MSMEs report that digital training sessions emphasize basic technical content rather than actionable marketing strategies, leading to limited post-training behavioural change. This gap between capacity building and real-world application supports prior evidence by Affandi et al. (2024) and Ubaidillah et al. (2024), who found that MSME training effectiveness depends heavily on follow-up mentoring, contextual relevance and integration with supply-chain platforms.

Third, the use of non-cash payment systems also exhibits a modest but significant negative effect (Odds Ratio = 0.90, AME = –0.018). This pattern likely reflects implementation frictions, such as transaction fees, unreliable payment gateways, or customer preferences for cash-based transactions. Particularly in lower-income regions, digital payment adoption often lags behind platform participation, producing partial rather than full digitalization effects. The result highlights the importance of trust infrastructure and financial inclusion, consistent with findings from Mustafa et al. (2022) and Reardon et al. (2021).

As a robustness and model adequacy, although the Pseudo R^2 value (0.0030) is relatively low, this is not uncommon in logistic models dealing with binary outcomes in heterogeneous firm-level data. The Goodness-of-Fit statistic ($p = 0.495$) indicates that predicted probabilities are consistent with observed frequencies, confirming the reliability of model calibration. The robustness check using heteroscedasticity-consistent standard errors ensures that the significance levels of all coefficients remain stable. Collectively, the model offers credible inferential evidence that formalization and capability dimensions of digital adoption, rather than mere technological access, are critical in shaping MSME performance trajectories.

Impact on market accessibility

Domestic market. In Indonesia, online sales are predominantly driven by the domestic market, primarily focusing on B2C transactions. However, the penetration of business-to-business B2B sales remains limited. This situation arises from several challenges, including inadequate infrastructure, insufficient digitalization among B2B stakeholders, and a strong emphasis on individual transaction volumes in e-commerce (Sumiyana and Ghina, 2021; Ni Luh Putu, et al., 2025).

Recent surveys show that Indonesia's e-commerce ecosystem remains heavily concentrated in the business-to-consumer (B2C) segment. In 2023, 71.88% of e-commerce businesses sold directly to end consumers, while business-to-business (19.07%), government (2.83%), and other market segments (3.15%) accounted for only a small share. This pattern reflects the strength of Indonesia's consumer market and the relatively low barriers for MSMEs to access customers through digital platforms. However, it also reveals limited capacity to engage with larger institutional markets

that require stronger business legitimacy, administrative compliance, production capability, and supply-chain integration. Expanding MSMEs' participation in B2B and government procurement through targeted capacity-building and formalisation policies would enhance the long-term economic contribution of e-commerce.

Regional disparities are equally pronounced. Approximately 75.17% of e-commerce shipments originate from Java, whereas Maluku and Papua each account for less than 1%. Although this concentration partly reflects Java's dominance in population and economic activity, it also highlights persistent inequalities in logistics infrastructure, internet connectivity, and market accessibility. Without strategic investment in transport networks, digital infrastructure, and export facilitation beyond Java, e-commerce risks reinforcing rather than reducing regional inequality.

Global market. Despite the global reach theoretically offered by digital platforms, only 0.82% of Indonesian e-commerce businesses export their products. This limited international participation is primarily driven by inadequate knowledge of export procedures and regulations, high international logistics costs, and weak capabilities in global branding and marketing. These findings suggest that Indonesia has yet to fully capitalise on the export potential of competitive products such as fashion, handicrafts, and processed foods. Strengthening export-oriented logistics, simplifying regulations, and providing targeted support for international market development would enable more MSMEs to participate in global value chains.

BPS surveys further identify three major constraints facing e-commerce businesses: insufficient demand for goods and services (41.24%), limited capital (29.03%), and shortages of skilled labour (11.48%). Weak demand reflects deficiencies in marketing, branding, and market expansion strategies, while capital constraints are associated with limited access to formal finance and inadequate financial reporting systems. Meanwhile, the shortage of skilled workers highlights the continuing need for digital literacy, technical skills development, and managerial training. Addressing these interconnected challenges through coordinated policies that combine infrastructure investment, institutional support, financial inclusion, and human capital development is essential to ensure that Indonesia's digital economy grows in a more inclusive, competitive, and sustainable manner.

Limitations. This study is limited by its use of cross-sectional data, which captures observations at a single point in time and cannot fully identify trends, causal relationships, unobserved heterogeneity, or omitted variables. Consequently, the findings should be interpreted as associations rather than causal effects. Nevertheless, the survey's nationally representative sample of more than 40,000 businesses and broad geographic coverage provide the most comprehensive evidence currently available on Indonesia's e-commerce economy.

V. DISCUSSION AND POLICY RECOMMENDATIONS

The findings reveal a central paradox in Indonesia's digital transformation: rapid e-commerce expansion has not generated equal productivity gains across firms and regions. Digital access alone is insufficient, as business performance depends on complementary managerial, institutional, and infrastructural capacities. In particular, strong financial recordkeeping significantly improves MSME resilience by enhancing cash-flow management, profitability assessment, and investment decisions. This confirms that digitalisation delivers greater benefits when supported by formal financial governance.

The results also highlight a two-speed digital transition. While e-commerce has contributed to substantial revenue growth and employment creation, its benefits remain uneven across regions, gender, and firm capability. The estimated 23.4% increase in revenue and employment of approximately 24 million workers among e-commerce adopters directly supports SDG 8.3 on MSME growth and formalisation. However, the persistence of a productivity paradox—where digital adoption does not automatically improve efficiency—indicates that achieving SDG 8.5 requires integrating financial and managerial literacy into digital transformation rather than focusing solely on technology adoption.

Several structural weaknesses further limit inclusive digital development. The negative outcomes associated with digital marketing training suggest that many programs remain fragmented and tool-oriented, lacking sustained mentoring and strategic business integration. Likewise, the concentration of 75.17% of e-commerce shipments in Java, compared with limited participation from eastern Indonesia, reflects a persistent digital divide that conflicts with the inclusiveness envisioned in SDG 10. Without improvements in logistics infrastructure, payment interoperability, and institutional readiness, digitalisation risks reinforcing regional economic disparities.

The evidence also shows that productivity gains from digital payments depend on reliable connectivity, affordable transaction costs, interoperable platforms, and public trust. Java's dominance therefore illustrates that digitalisation succeeds only when technology is accompanied by financial governance, human capital, and institutional capacity.

From a gender perspective, increased participation of women entrepreneurs, particularly in North Sulawesi and East Kalimantan, demonstrates that digital platforms can reduce traditional barriers to market access and contribute to SDG 5 on gender equality. Expanding women-led digital enterprises through targeted financial products and digital security training would strengthen these gains.

Meanwhile, the continued reliance on instant messaging for transactions and the prevalence of Cash-on-Delivery indicate that Indonesia's digital ecosystem remains in

a transitional stage. Achieving SDG 9.3 requires stronger digital trust through improved cybersecurity, interoperable payment systems such as QRIS, and modern logistics.

These findings suggest that sustainable digital transformation follows a progression from digital access to market participation, but only produces broad development outcomes when mediated by institutional readiness, including financial literacy, infrastructure, and trust.

Policy recommendations

Accordingly, Indonesia's e-commerce strategy should shift from accelerating adoption toward improving effectiveness. Three policy priorities emerge from the findings.

First, institutionalise simplified digital financial management by integrating accounting tools into digital commerce platforms and national digital literacy programmes, enabling MSMEs to strengthen financial governance.

Second, redesign digital capacity-building from one-off technical training into mentoring-based learning ecosystems that emphasise business strategy, peer learning, and sector-specific support.

Third, expand secure and interoperable digital payment ecosystems beyond Java by improving logistics infrastructure, reducing transaction costs, strengthening cybersecurity, and increasing consumer trust.

Collectively, these measures emphasise that effective digital transformation depends not merely on expanding technology adoption but on strengthening institutional capacity, regional equity, and governance to ensure that digitalisation contributes to SDGs 5, 8, 9, and 10.

VI. CONCLUSION

This study provides empirical evidence that, despite the rapid expansion of e-commerce in Indonesia, its potential to drive inclusive productivity remains constrained. Using nationally representative data from the 2024 E-commerce Survey, the findings show that MSME performance depends more on managerial capability and institutional support than on technology adoption alone. Financial recordkeeping has a significant positive effect on business stability, highlighting the importance of governance and strategic discipline, while digital training and non-cash payment adoption exhibit negative marginal effects, reflecting weaknesses in programme design, ecosystem readiness, and digital trust.

These findings support transaction cost economics and the resource-based view by demonstrating that digital transformation is fundamentally an institutional reform rather than simply technological adoption. Productivity gains emerge only when digitalisation is reinforced by organisational capability and coherent institutions.

Persistent regional disparities further reveal a digital divide that could deepen inequality without coordinated and inclusive policy interventions. Indonesia's experience suggests that sustainable digital growth requires synergy among government, the private sector, and human capital development. Future research should examine sectoral differences, longitudinal dynamics, and regional digital ecosystems to strengthen evidence-based policies and advance inclusive digital development.

Note on Authors

Sri H. Rachmad is a researcher at the National Research and Innovation Agency (BRIN) Indonesia, and formerly at BPS, lectured at the Statistics Polytechnic. She holds degrees in Statistics-Mathematics, and a postgraduate qualification from the Australian National University. Her research focuses on socio-economic demography, labour, gender, health, migration, SDGs, and social protection.

Andri Yudhi Supriadi is the Chief of the BPS Representative Office in Denpasar, Bali Province. He graduated cum laude in Economic Planning and Public Policy and earned a postgraduate degree in Economics with the Best Dissertation award. His research focuses on household welfare, electricity subsidies, and business–ICT integration.

Kennith G.C. Dillena is a senior research scientist and manager at De Salle University, The Philippines. Currently, he is pursuing his PhD from Shanghai University, the People's Republic of China. He has published several papers in renowned journals and has received several awards.

Devi Asiati is a researcher at BRIN and previously at LIPI for more than 13 years (Indonesian Institute of Sciences). Her research interests on economic development, geography and spatial analysis.

Roosganda Elizabeth is a Senior Researcher at BRIN, focusing on socioeconomic issues, rural development, and MSMEs management. She actively disseminates her research findings to stakeholders in academia and society, contributing to the understanding of innovation and empowerment within the community.

Haning Romdiati is a senior researcher at BRIN's Research Centre for Population, a position she has held since 2019. Previously, she served for over 35 years at the Indonesian Institute of Sciences. She graduated from Flinders University, Australia. on Population Studies and Human Resources Development.

Okki Navarone Wibisono has been a researcher at the Directorate of Political, Legal, Defence, and Security Policy, National Research and Innovation Agency (BRIN), Indonesia, since 2022. He holds a postgraduate degree from Diponegoro University, and his research interests focus on public administration and national security policy.

REFERENCES

Adhikary, A., K. S. Diatha, S. B. Borah, and A. Sharma (2021). How does the adoption of digital payment technologies influence unorganized retailers' performance? An investigation in an emerging market. Journal of the Academy of Marketing Science, Vol. 49, No. 5, 882–902. https://doi.org/10.1007/S11747-021-00778-Y

Affandi, Y., M. M. Ridhwan, I. Trinugroho, and D. Hermawan (2024). Digital adoption, business performance, and financial literacy in ultra-micro, micro, and small enterprises in Indonesia. Research in International Business and Finance. https://doi.org/10.1016/j.ribaf.2024.102376

Ajay, S., B. Summit, K. Shyam Sundar, Anuj (2023). An examination of adoption of cash on delivery payment method among e-shoppers in India: role of perceived security, risk, privacy and trust. International Journal of Electronic Business. https://doi.org/10.1504/IJEB.2023.134118

Alia, R., A. Susanto, D. Wulandari, and N. Fitriani (2024). Analysis of e-commerce utilization in consumers as culinary MSMEs in East Jakarta. INCOME Innovation of Economics and Management, Vol. 4, No. 1. https://doi.org/10.32764/income.v4i1.4628

Amalia, R. (2024). Analisis return on investment (ROI) digital pada UMKM: sebuah pendekatan metodologis. Al-Kharaj: Jurnal Ekonomi, Keuangan dan Bisnis Syariah, Vol. 6, No. 10. https://doi.org/10.47467/alkharaj.v6i10.5115

Amara, G., L. Nurhalisa, P. Nadia, and W. A. Sulistyowati (2024). The mediating role of intention in the digital bookkeeping adoption among MSMEs in Indonesia. International Journal of Academe and Industry Research, Vol. 5, No. 2. https://doi.org/10.53378/353074

Anabila, P., D. K. Kumi, L. E. K. Ameyibor, and M. Allan (2024). E-commerce adoption among entrepreneurial firms in Sub-Saharan Africa. Journal of Small Business and Enterprise Development. https://doi.org/10.1108/jsbed-08-2023-0358

Bailey, P. E. (2020). Emerging digital marketing strategies using mobile instant messaging. Doctoral dissertation, Walden University. https://scholarworks.waldenu.edu/dissertations/8670

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, Vol. 17, No. 1, 99–120. https://doi.org/10.1177/014920639101700108

Barragan, K. E., and F. Becker (2024). Keeping pace with the digital transformation — exploring the digital orientation of SMEs. Small Business Economics, Vol. 64, 1361–1385. https://doi.org/10.1007/s11187-024-00947-7

Cao, H., Z. Chen, M. Cheng, S. Zhao, T. Wang, and Y. Li (2020). You recommend, I buy: how and why people engage in instant messaging based social commerce. https://arxiv.org/abs/2011.00191

Chen, Z., and K. Jiang (2023). Digitalization and corporate investment efficiency: evidence from China. Journal of International Financial Markets, Institutions and Money. https://doi.org/10.1016/j.intfin.2023.101915

Cheng, G. (2022). China's Digital Silk Road in the age of the digital economy: political analysis. Vestnik RUDN: International Relations, Vol. 22, No. 2, 271–287. https://doi.org/10.22363/2313-0660-2022-22-2-271-287

Chrisos, M. (2021). 6 reasons instant messaging can boost your e-commerce conversion rates. https://www.techfunnel.com/information-technology/6-reasons-instant-messaging-can-boost-.

Chun, H.-C., H. H. Joo, J. Kang, and Y. Lee (2023). E-commerce and local labor markets: is the "retail apocalypse" near? Journal of Urban Economics. https://doi.org/10.1016/j.jue.2023.103594

Coase, R. H. (1937). The Nature of the Firm. Economica, New Series, Vol. 4, No. 16. (Nov., 1973), 386–405.

Coase, R. H. (1992). The Institutional structure of production. The American Economic Review, Vol. 82, No. 4. 713–719.

Daily Trust (2022). Cash-on-delivery: obstacles and benefits. https://dailytrust.com/cash-on-delivery-obstacles-and-benefits

Dolfen, P., E. Liran, J. K. Peter, K. Benjamin, D. L. Jonathan, L. Larry, and B. Wayne (2023). Assessing the gains from e-commerce. American Economic Journal: Macroeconomics, Vol. 15, No. 1, 342–370. https://doi.org/10.1257/mac.20210049

Dung L.T., H.T. Tien, T.M. Linh, N.T.N. Diep, H.V. Hieu, L.V Chon (2026). Going International by Going Digital: Digital Capabilities, Transformation, and Leadership in Export Performance. Global Business and Organizational Excellence, Vol. 45, No. (3). https://doi.org/10.1002/joe.70021

Elfaki, K. E., and E. M. Ahmed (2024). Digital technology adoption and globalization innovation implications on Asian Pacific green sustainable economic growth. Journal of Open Innovation. https://doi.org/10.1016/j.joitmc.2024.100221

Gereffi , G. (1994). The Organization of Buyer-Driven Global Commodity Chains: How U.S. Retailers Shape Overseas Production Networks. In Commodity Chains and Global Capitalism , Edited by , G. Gereffi and M. Korzeniewicz, 95–122. Westport: Praeger.

Gereffi, G., J. Humphrey, and T. Sturgeon (2005). The governance of global value chains. Review of International Political Economy, Vol. 12, No. (1), 78–104. https://doi.org/10.1080/09692290500049805

Gupta, A. K. (2022). Managing resilience of micro, small and medium enterprises (MSMEs) during COVID-19: analysis of barriers. Benchmarking. https://doi.org/10.1108/bij-11-2021-0700

Harini, S., D. Pranitasari, M. Said, and E. Endri (2023). Determinants of SME performance: evidence from Indonesia. Problems and Perspectives in Management, Vol. 21, No. 2, 471–481. https://doi.org/10.21511/ppm.21(1).2023.40

Islam Bhuiyan M.R., M.R. Faraji, M. Rashid, M.K. Bhuyan, R. Hossain, P. Ghose (2024). Digital Transformation in SMEs Emerging Technological Tools and Technologies for Enhancing the SME's Strategies and Outcomes. Journal of Ecohumanism, Vol. 3, No. 4. https://doi.org/10.62754/joe.v3i4.3594

Jawad, S. G., and A. H. Mohammed (2024). Cost reduction and efficiency boost through e-commerce strategies. Indonesian Journal of Law and Economics Review. https://doi.org/10.21070/ijler.v19i3.1154

Kausar, A., J. Lim, and Y. Park (2025). Data analytics and operational efficiency. Accounting Horizons, 1–19. https://doi.org/10.2308/horizons-2022-164

Katz, Michael L. and Carl Shapiro. (Jun., 1985). Network Externalities, Competition, and Compatibility. The American Economic Review, Vol. 75, No. 3, pp. 424-440. American Economic Association. http://www.jstor.org/stable/1814809 .

Kgakatsi, M., O. Galeboe, K. Molelekwa, and B. A. Thango (2024). The impact of big data on SME performance: a systematic review. Businesses, Vol. 4, No. 4. https://doi.org/10.3390/

businesses4040038

Kokkoli, E. (2023). How does digital finance affect energy efficiency? Characteristics, mechanisms, and spatial effects. Sustainability, Vol. 15, No. 9, 7071. https://doi.org/10.3390/su15097071

Krugman, P. (1989). New Trade Theory and the Less Developed Countries, in G. Calvo et al. Ed., Debt, Stabilization and Development, Essays in Memory of Carlos Diaz-Alejandro, Basil Blackwell.

Kurniasari, F., E. D. Lestari, and H. Tannady (2023). Pursuing long-term business performance: investigating the effects of financial and technological factors on digital adoption to leverage SME performance and business sustainability — evidence from Indonesian SMEs in the traditional market. Sustainability. https://doi.org/10.3390/su151612668

Lukmanova, I., N. Saini, P. P. Singh, C. Mohan, and Y. Kumar (2024). Quantifying the impact of digital transformation on economic growth: a longitudinal analysis. BIO Web of Conferences, Vol. 86, art. no. 01079. https://doi.org/10.1051/bioconf/20248601079

Macca, L. S., N. Shehzad, M. Kovacova, and G. Santoro (2024). Unlocking e-commerce potential: micro and small enterprises strike back in the food and beverage industry. European Journal of Innovation Management. https://doi.org/10.1108/ejim-01-2023-0023

Martini, D. S., A. Desi, H. Iman, and W. Mulyo (2023). E-commerce and micro and small industries performance: the role of firm size as a moderator. Journal of Open Innovation. https://doi.org/10.1016/j.joitmc.2023.100142

Mashalah, H., E. Hassini, A. Gunasekaran, and D. Bhatt Mishra (2022). The impact of digital transformation on supply chains through e-commerce: literature review and a conceptual framework. Transportation Research Part E: Logistics and Transportation Review, Vol. 165, 102837. https://doi.org/10.1016/j.tre.2022.102837

Mavlutova, I., A. Spilbergs, A. Verdenhofs, A. Nātriņš, I. Arefjevs, and T. Volkova (2022). Digital transformation as a driver of the financial sector sustainable development: an impact on financial inclusion and operational efficiency. Sustainability, Vol. 15, No. 1, 207. https://doi.org/10.3390/su15010207

Mero, J. (2016). Effect of instant messenger use on purchase decision of consumers. https://www.researchgate.net/publication/306063348

Mick, M. M. A. P., J. L. Kovaleski, and D. M. d. G. Chiroli (2024). Sustainable digital transformation roadmaps for SMEs: a systematic literature review. Sustainability, Vol. 16, No. 19, 8551. https://doi.org/10.3390/su16198551

Mirzaye S., and M. Mohiuddin (2025). Digital Transformation in International Trade: Opportunities, Challenges, and Policy Implications. Journal of Risk and Financial Management, 18 (8), art. https://doi.org/10.3390/jrfm18080421

Mishra, N., and A. M. P. Valencia (2023). Digital services and digital trade in the Asia Pacific: an alternative model for digital integration? Asia Pacific Law Review, Vol. 31, No. 2, 489–513. https://doi.org/10.1080/10192557.2023.2216058

Mohamed, H. A. (2023). The role of digital transformation in the socio-economic recovery post COVID-19. Applied Economics, Vol. 55, No. 32, 3716–3727. https://doi.org/10.1080/00036846.2022.2117779

Mustafa, S., T. Hao, Y. Qiao, S. K. Shah, and R. Sun (2022). How a successful implementation and sustainable growth of e-commerce can be achieved in developing countries: a pathway towards green economy. Frontiers in Environmental Science, Vol. 10. https://doi.org/10.3389/fenvs.2022.940659

Nasution, M. D. T. P., and D. H. Surya (2024). Why consumers prefer COD. https://talenta.usu.ac.id/jba/article/view/19089

Ni Luh Putu, I., J.S., Keshminder, N.I., Wiratama, G.S., Amertha (2025). Unlocking e-commerce potential in SMEs: an integrative framework for adoption in emerging markets. Humanities and Social Sciences Communications, 12 (1), art. no. 766. DOI: 10.1057/s41599-025-04952-3

Norris, P. (2001). Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781139164887

Oduro, S., A. De Nisco, and G. Mainolfi (2023). Do digital technologies pay off? A meta-analytic review of the digital technologies/firm performance nexus. Technovation. https://doi.org/10.1016/j.technovation.2023.102836

Oh, E. (2021). Digital trade regulation in the Asia-Pacific: where does it stand? Comparing the RCEP e-commerce chapter with the CPTPP and the JSI. Legal Issues of Economic Integration, Vol. 48, No. 4, 403–430. https://doi.org/10.54648/LEIE2021032

Oliner, Stephen D. and Daniel Sichel (2000). The Resurgence of Growth in the Late 1990s : Is Information Technology the Story ?. Journal of Economic Perspectives, American Economic Association, vol. 14(4), pages 3-22, Fall. https://doi.org/10.1257/jep.14.4.3

Ollerenshaw A., J. Corbett, and H. Thompson (2021). Increasing the digital literacy skills of regional SMEs through high-speed broadband access. Small Enterprise Research, 28 (2). https://doi.org/10.1080/13215906.2021.1919913

Pane, D., and A. A. Patunru (2022). The role of imported inputs in firms' productivity and exports: evidence from Indonesia. Weltwirtschaftliches Archiv — Review of World Economics, Vol. 159, No. 3, 629–672. https://doi.org/10.1007/s10290-022-00476-z

Panko M., L. Šafár, and M. Meštan (2025). Small Firms, Big Threats: Cybersecurity Research and the Role of Public Policy in the SME Sector. Central European Journal of Public Policy, 19 (2). https://doi.org/10.2478/cejpp-2025-0010

Pathirana, G. Y. (2023). Does e-commerce really matter on international trade of Asian countries: evidence from panel data. PLOS ONE, Vol. 18, No. 4, e0284503. https://doi.org/10.1371/journal.pone.0284503

Paul, J., A. Ueno, C. Dennis, E. Alamanos, L. Curtis, P. Foroudi, A. Kacprzak, W. H. Kunz, J. Liu, R. Marvi, S. Nair, O. Ozdemir, E. Pantano, T. Papadopoulos, O. Petit, S. Tyagi, and J. Wirtz (2024). Digital transformation: a multidisciplinary perspective and future research agenda. International Journal of Consumer Studies. https://doi.org/10.1111/ijcs.13015

Pérez Trujillo, M., and A. Aleán-Romero (2024). The impact of ICT and e-commerce on employment in Colombia. Electronic Commerce Research and Applications. https://doi.org/10.1016/j.elerap.2024.101378

Phan, S. T. (2021). The effect of PESTLE factors on development of e-commerce. International Journal of Data and Network Science, Vol. 5, No. 1, 37–42. https://doi.org/10.5267/j.ijdns.2020.11.005

Putra, A. E. R., and A. Fakhrina (2024). Analisis media monitoring Shopee Barokah pada bulan April–Mei 2024 menggunakan analysis tools Brand24. Jurnal Ilmiah Bisnis Digital: Bisnistek. https://doi.org/10.69533/yt3k9b71

Quansah, E. (2024). Digitalization the necessary evil: integrating digital technologies in businesses of BOP countries. Information Technology for Development, 1–29. https://doi.org/10.1080/02681102.2024.2432890

Romer, P. (1986). Increasing Returns and Long-run growth. Journal of Political Economy, Vol. 94, No. 5, 1002–1037.

Romer, P. (1990). Endogenous technological change. Journal of Political Economy, Vol. 98 No. 5, Part 2, S71–S107.

Reardon, T., B. Belton, L. S. O. Liverpool-Tasie, L. Lu, C. S. R. Nuthalapati, O. Tasie, and D. Zilberman (2021). E-commerce's fast-tracking diffusion and adaptation in developing countries. Applied Economic Perspectives and Policy, Vol. 43, No. 4, 1243–1259. https://doi.org/10.1002/AEPP.13160

Rehman, N. U., and G. Nunziante (2023). The effect of the digital economy on total factor productivity in European regions. Telecommunications Policy. https://doi.org/10.1016/j.telpol.2023.102650

Ricardo, D. (1817). On the principles of political economy and taxation. P. Sraffa (Ed.), The work and correspondence of David Ricardo, vol.1, Cambridge University Press, Cambridge

Rolando, B., and H. Mulyono (2025). E-commerce as a catalyst for digital economy development: a study of marketing strategies and their impact. Journal of Distribution Science, Vol. 23, No. 4, 61–79. https://doi.org/10.15722/jds.23.04.202504.61

Rupeika-Apoga R., and K. Petrovska (2022). Barriers to Sustainable Digital Transformation in Micro-, Small-, and Medium-Sized Enterprises. Sustainability (Switzerland), 14 (20), art. https://doi.org/10.3390/su142013558

Sumiyana, S., and S. Ghina. F.A. (2021). Beneficial explanation for SME's e-commerce adoption: The sequential stages of organizational, industrial and national readiness. Economics and Sociology, Vol. 14 No. 2, 252–273. DOI: 10.14254/2071-789X.2021/14-2/14

Sari, D., and Y. Anggraweni (2024). Impact of information technology implementation on operational efficiency in UMKM. Smart International Management Journal, Vol. 1, No. 3, 21–28. https://doi.org/10.70076/simj.v1i3.42

Santosa, I, D. Aisyah, and Dinda (2024). The Raising Digital Literacy: An Alternative for Empowering Rural Communities. Social Science and Human Research Bulletin. 01. https://doi.org/10.55677/SSHRB/2024-3050-0701.

Sauki (2023). Trust in using COD in Jakarta. https://vm36.upi.edu/index.php/JBME/article/view/74580

Shahadat M.M.H., Nekmahmud M., Ebrahimi P., Fekete-Farkas M (2023). Digital Technology Adoption in SMEs: What Technological, Environmental and Organizational Factors Influence SMEs' ICT Adoption in Emerging Countries?. Global Business Review. https://doi.org/10.1177/09721509221137199

Sindhwani R., Behl A., Sharma A., Gaur J (2024). What makes micro, small, and medium enterprises not adopt Logistics 4.0? A systematic and structured approach using modified-total interpretive structural modelling. International Journal of Logistics Research and Applications, 27 (6). https://doi.org/10.1080/13675567.2022.2081672

Silaban, S., N. Kusnadi, and F. Feryanto (2024). The impact of e-commerce implementation on the performance of micro and small businesses. Journal of Distribution Science, Vol. 23, No. 4, 1–10. https://doi.org/10.15722/jds.23.04.202404.1

Simamora, C. M., and R. Ningsih (2020). Inklusivitas ekonomi digital di Indonesia: perspektif gender dan penciptaan lapangan kerja. Journal of Communications and Networks, Vol. 4, No. 2, 39–53. https://doi.org/10.52391/JCN.V4I2.507

Soeyatno, R. F., Y. Syaukat, R. Nurmalina, and S. Suprehatin (2024). The impact of e-commerce on

digital farmers' vegetable sales in Jakarta metropolitan area. Journal of the International Society for Southeast Asian Agricultural Sciences, Vol. 30, No. 2, 14–32. https://www.researchgate.net/publication/387306118

Suharyanto, T., V. Febriani, P. Irwan, F. Faridotul, and Chasanah (2024). Optimizing the role of MSMEs in regional economic growth: challenges and opportunities. Journal of Economic Education and Entrepreneurship Studies. https://doi.org/10.62794/je3s.v5i3.4310

Suyanto B., Sugihartati R., Egalita N., Mas'udah S., Singgih D.S., Sudarso (2023). Digital literacy and survival mechanism of micro-small enterprises in practicing sharing economy. Cogent Social Sciences, Vol. 9, No. 2, https://doi.org/10.1080/23311886.2023.2245691

Syafaastuti, S., Y. Delfina, and D. H. Syahchari (2024). The use of the technology acceptance model (TAM) to analyze the effects of social influence on the interest in implementing cashless payment (QRIS). Proceedings of the 2024 International Conference on ICT for Smart Society. https://doi.org/10.1109/ic2ie63342.2024.10748219

Tangwaragorn, P., N. Charoenruk, W. Viriyasitavat, C. Tangmanee, P. Kanawattanachai, D. Hoonsopon, V. Pungpapong, R.-P. Pattanapanyasat, S. Boonpatcharanon, and P. Rhuwadhana (2024). Analyzing key drivers of digital transformation: a review and framework. Journal of Industrial Information Integration, Vol. 42, 100680. https://doi.org/10.1016/j.jii.2024.100680

Triandini E., Wijaya I.G.N.S., Suniantara I.K.P (2023). Analysis of Technology Adoption by SMEs Using Technology Organization Environment Model. Journal of System and Management Sciences, Vol. 13, No. 2. https://doi.org/10.33168/JSMS.2023.0216

Ubaidillah, M. R. S., M. J. F. Shalah, and M. Yasin (2024). UMKM dan e-commerce pada teknologi. MENAWAN: Jurnal Riset dan Publikasi Ilmu Ekonomi, Vol. 2, No. 5, 07–11. https://doi.org/10.61132/menawan.v2i5.757

Unggara, I., and E. D. Sadono (2021). The productivity of Indonesian e-commerce: evidence from a digital merchant survey. International Journal of Economics, Business and Accounting Research, Vol. 5, No. 4, 226–234. https://jurnal.stie-aas.ac.id/index.php/IJEBAR

Vasani S. and A.M. Abdulkareem (2024). MSME market presence and competitiveness in a global economy. Cogent Economics and Finance, Vol. 12, No. 1, https://doi.org/10.1080/23322039.2024.2416992

Wang, D., and S. Chen (2022). Digital transformation and enterprise resilience: evidence from China. Sustainability, Vol. 14, No. 21, 14218. https://doi.org/10.3390/su142114218

Williamson, O. E. (1975). Markets and Hierarchies: Some Elementary Considerations. New York: Free Press.

Williamson, O. E. (1985). The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. New York: Free Press.

Wirdiyanti, R., I. Yusgiantoro, A. Sugiarto, A. D. Harjanti, I. Y. Mambea, S. Soekarno, and S. M. Damayanti (2023). How does e-commerce adoption impact micro, small, and medium enterprises' performance and financial inclusion? Evidence from Indonesia. Electronic Commerce Research, Vol. 23, No. 4, 2485–2515. https://doi.org/10.1007/s10660-022-09547-7

Wulan, T. S., and R. Reni (2024). Digital transformation as a catalyst for SMEs productivity and profitability in the digital era. Journal of Economic Education and Entrepreneurship Studies, Vol. 5, No. 4. https://doi.org/10.62794/je3s.v5i4.4543

Wulandari S.S., F.I. Maula, T. Pahlevi, L. Hakim, S. Handayani, F. Rahmawati, Muhlisin, M.F.B. Zulkifli (2026). Determinants of digitalized MSME competitiveness in improving export capacity to achieve sustainable development goals (SDGs). Cogent Business and Management, Vol. 13, No. 1, https://doi.org/10.1080/23311975.2025.2598929

Ye, Y., J. Fang, and J. Ye (2024). Does e-commerce construction boost farmers' incomes? Evidence from China. Sustainability, Vol. 16, No. 11, 4595. https://doi.org/10.3390/su16114595

Zhang, X., X. Zhang, and X. Zhang (2024). Can urban e-commerce transformation improve economic resilience? A quasi-natural experiment from China. PLOS ONE, Vol. 19, No. 5, e0304014. https://doi.org/10.1371/journal.pone.0304014

Zhou, Y., J.-Y. Lyu, and L. Li (2025). Can digital transformation enhance labor productivity in enterprises: an analysis from the perspective of business process reengineering. PLOS ONE, Vol. 20, No. 6, e0325484. https://doi.org/10.1371/journal.pone.0325484

Zhu, J. J., W. Lan, and X. Zhang (2021). Geographic proximity, supply chain and organizational glocalized survival: China's e-commerce investments in Indonesia. PLOS ONE, Vol. 16, No. 9. https://doi.org/10.1371/JOURNAL.PONE.0256837

Appendix

The two tables present the demographic data of respondents surveyed in the 2024 E-commerce Survey

Demographic data of respondents' survey by sex and province

Province	Male	Female	Total	Male (%)	Female (%)	Total (%)
Aceh	504.00	594.00	1,098.00	45.90	54.10	100.00
Sumatera Utara	811.00	649.00	1,460.00	55.55	44.45	100.00
Sumatera Barat	614.00	686.00	1,300.00	47.23	52.77	100.00
Riau	601.00	590.00	1,191.00	50.46	49.54	100.00
Jambi	540.00	475.00	1,015.00	53.20	46.80	100.00
Sumatera Selatan	685.00	618.00	1,303.00	52.57	47.43	100.00
Bengkulu	613.00	579.00	1,192.00	51.43	48.57	100.00
Lampung	847.00	498.00	1,345.00	62.97	37.03	100.00
Kep. Bangka Belitung	470.00	483.00	953.00	49.32	50.68	100.00
Kepulauan Riau	510.00	625.00	1,135.00	44.93	55.07	100.00
DKI Jakarta	1,149.00	732.00	1,881.00	61.08	38.92	100.00
Jawa Barat	1,075.00	675.00	1,750.00	61.43	38.57	100.00
Jawa Tengah	931.00	729.00	1,660.00	56.08	43.92	100.00
D.I. Yogyakarta	879.00	581.00	1,460.00	60.21	39.79	100.00
Jawa Timur	914.00	721.00	1,635.00	55.90	44.10	100.00
Banten	956.00	626.00	1,582.00	60.43	39.57	100.00
Bali	810.00	522.00	1,332.00	60.81	39.19	100.00
Nusa Tenggara Barat	633.00	596.00	1,229.00	51.51	48.49	100.00
Nusa Tenggara Timur	535.00	545.00	1,080.00	49.54	50.46	100.00
Kalimantan Barat	678.00	604.00	1,282.00	52.89	47.11	100.00
Kalimantan Tengah	490.00	552.00	1,042.00	47.02	52.98	100.00
Kalimantan Selatan	504.00	546.00	1,050.00	48.00	52.00	100.00
Kalimantan Timur	606.00	770.00	1,376.00	44.04	55.96	100.00
Kalimantan Utara	361.00	436.00	797.00	45.29	54.71	100.00
Sulawesi Utara	365.00	509.00	874.00	41.76	58.24	100.00
Sulawesi Tengah	478.00	555.00	1,033.00	46.27	53.73	100.00
Sulawesi Selatan	656.00	737.00	1,393.00	47.09	52.91	100.00
Sulawesi Tenggara	414.00	501.00	915.00	45.25	54.75	100.00
Gorontalo	277.00	460.00	737.00	37.58	62.42	100.00
Sulawesi Barat	431.00	381.00	812.00	53.08	46.92	100.00

Province	Male	Female	Total	Male (%)	Female (%)	Total (%)
Maluku	364.00	419.00	783.00	46.49	53.51	100.00
Maluku Utara	245.00	339.00	584.00	41.95	58.05	100.00
Papua Barat	122.00	115.00	237.00	51.48	48.52	100.00
Papua Barat Daya	207.00	242.00	449.00	46.10	53.90	100.00
Papua	283.00	238.00	521.00	54.32	45.68	100.00
Papua Selatan	131.00	119.00	250.00	52.40	47.60	100.00
Total	20,689.00	19,047.00	39,736.00	52.07	47.93	100.00

Demographic data of respondents' surveys By Educational Attainment and Province

Province	Elementary or lower		Junior high school		Senior high school		Diploma		Under graduate		Graduate		Total	
	Person	%	Person	%	Person	%	Person	%	Per-son	%	Person	%	Person	%
Aceh	41	3.73	88	8.01	556	50.64	89	8.11	297	27.05	27	2.46	1,098	100
Sumatera Utara	97	6.64	123	8.42	904	61.92	54	3.70	262	17.95	20	1.37	1,460	100
Sumatera Barat	82	6.31	134	10.31	662	50.92	79	6.08	318	24.46	25	1.92	1,300	100
Riau	100	8.40	126	10.58	628	52.73	62	5.21	254	21.33	21	1.76	1,191	100
Jambi	101	9.95	153	15.07	503	49.56	40	3.94	206	20.30	12	1.18	1,015	100
Sumatera Selatan	118	9.06	177	13.58	699	53.65	57	4.37	235	18.04	17	1.30	1,303	100
Bengkulu	126	10.57	144	12.08	581	48.74	47	3.94	271	22.73	23	1.93	1,192	100
Lampung	146	10.86	226	16.80	711	52.86	48	3.57	199	14.80	15	1.12	1,345	100
Kep. Bangka Belitung	142	14.90	115	12.07	487	51.10	53	5.56	142	14.90	14	1.47	953	100
Kepulauan Riau	125	11.01	138	12.16	600	52.86	45	3.96	211	18.59	16	1.41	1,135	100
DKI Jakarta	181	9.62	262	13.93	1,104	58.69	78	4.15	239	12.71	17	0.90	1,881	100
Jawa Barat	288	16.46	304	17.37	824	47.09	83	4.74	234	13.37	17	0.97	1,750	100
Jawa Tengah	267	16.08	268	16.14	775	46.69	76	4.58	263	15.84	11	0.66	1,660	100
D.I. Yogyakarta	130	8.90	206	14.11	741	50.75	80	5.48	283	19.38	20	1.37	1,460	100
Jawa Timur	193	11.80	252	15.41	837	51.19	47	2.87	288	17.61	18	1.10	1,635	100
Banten	188	11.88	225	14.22	884	55.88	57	3.60	199	12.58	29	1.83	1,582	100
Bali	114	8.56	131	9.83	683	51.28	108	8.11	269	20.20	27	2.03	1,332	100
Nusa Tenggara Barat	124	10.09	153	12.45	598	48.66	70	5.70	270	21.97	14	1.14	1,229	100
Nusa Tenggara Timur	90	8.33	95	8.80	532	49.26	47	4.35	303	28.06	13	1.20	1,080	100
Kalimantan Barat	126	9.83	168	13.10	659	51.40	70	5.46	241	18.80	18	1.40	1,282	100

Province	Elementary or lower		Junior high school		Senior high school		Diploma		Under graduate		Graduate		Total	
	Person	%	Person	%	Person	%	Person	%	Per-son	%	Person	%	Person	%
Kalimantan Tengah	109	10.46	121	11.61	550	52.78	28	2.69	217	20.83	17	1.63	1,042	100
Kalimantan Selatan	127	12.10	154	14.67	528	50.29	38	3.62	191	18.19	12	1.14	1,050	100
Kalimantan Timur	145	10.54	161	11.70	745	54.14	73	5.31	241	17.51	11	0.80	1,376	100
Kalimantan Utara	112	14.05	128	16.06	368	46.17	33	4.14	145	18.19	11	1.38	797	100
Sulawesi Utara	74	8.47	101	11.56	478	54.69	34	3.89	171	19.57	16	1.83	874	100
Sulawesi Tengah	71	6.87	125	12.10	503	48.69	45	4.36	257	24.88	32	3.10	1,033	100
Sulawesi Selatan	144	10.34	145	10.41	650	46.66	73	5.24	337	24.19	44	3.16	1,393	100
Sulawesi Tenggara	76	8.31	79	8.63	451	49.29	41	4.48	246	26.89	22	2.40	915	100
Gorontalo	103	13.98	103	13.98	330	44.78	31	4.21	163	22.12	7	0.95	737	100
Sulawesi Barat	135	16.63	98	12.07	347	42.73	30	3.69	188	23.15	14	1.72	812	100
Maluku	33	4.21	42	5.36	374	47.77	56	7.15	260	33.21	18	2.30	783	100
Maluku Utara	43	7.36	50	8.56	332	56.85	30	5.14	118	20.21	11	1.88	584	100
Papua Barat	9	3.80	25	10.55	120	50.63	4	1.69	73	30.80	6	2.53	237	100
Papua Barat Daya	16	3.56	34	7.57	250	55.68	17	3.79	122	27.17	10	2.23	449	100
Papua	14	2.69	27	5.18	302	57.97	21	4.03	146	28.02	11	2.11	521	100
Papua Selatan	20	8.00	35	14.00	134	53.60	10	4.00	51	20.40	-	-	250	100
Total	4,010	10.09	4,916	12.37	20,430	51.41	1,854	4.67	7,910	19.91	616	1.55	39,736	100

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

AN ANALYTICAL FRAMEWORK TO ESTABLISH CONVERGENCE IN CROSS-BORDER DIGITAL TRADE RULES

Paul R. Baker and Loan Le

Corresponding Author: Paul R. Baker
Email: baker@tradeeconomics.com

Global digital trade is growing at an unprecedented pace as digitally delivered services outpace goods and traditional services trade. This rapid transformation underscores the need for international frameworks to effectively govern cross-border digital trade. This paper explores the scope and depth of digital trade provisions among countries with known differing policy approaches, especially on digital sovereignty. It proposes a three-dimensional analytical framework based on the zone of possible agreement to identify negotiation synergies. The framework maps provision coverage across seven clusters, assesses commitment depth using a five-level scale, and identifies convergence areas, complemented by political analysis outcomes.

Keywords: Digital trade, digital economy, e-commerce, trade negotiation, ZOPA

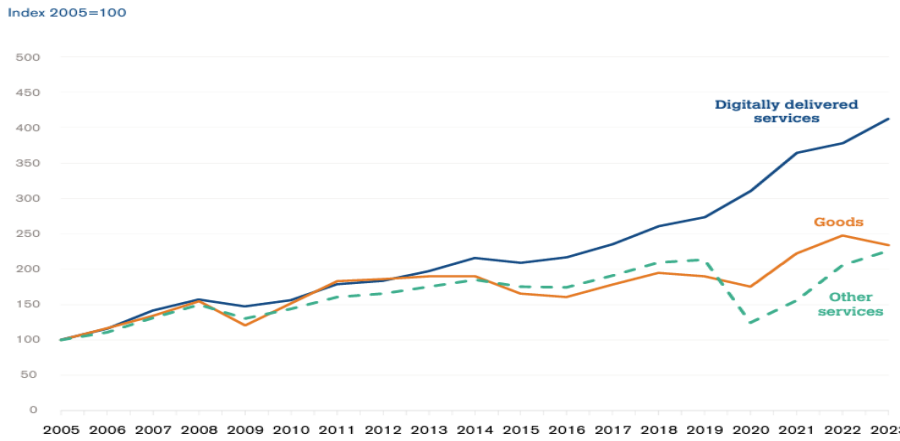
JEL classification: F13, F15, O33, L86 C78, D74

I. INTRODUCTION

Global digital trade is growing at an unprecedented pace. According to the OECD, by 2020, digital trade represented 25% of global trade, or approximately USD 5 trillion (OECD, 2023). Digitally delivered services are now the fastest-growing channel for international trade, far outstripping the growth of trade in goods or non-digitally delivered services (Figure 1). According to the World Trade Organization (WTO, 2024), global exports of digitally delivered services reached USD 4.25 trillion in 2023, up 9.0% year-on-year over the 2005–2023 period, and accounting for 13.8% of world exports of goods and services (Figure 1).

As economies increasingly shift toward digitalization, digital trade enables businesses to access global markets without the need for physical presence in another country. Furthermore, Baker and Le (2023) emphasize the emphasise cross-border digital trade as a channel through which trade can contribute to several sustainable development goals (SDGs)[1] by lowering information, transaction, and market-entry costs, making trade more accessible to firms and workers and facilitating better integration into global value chains.

Figure 1: Growth in goods, digitally delivered services, and other services



Source: WTO (2024).

Using firm-level export performance, Clarke (2008) finds that enterprises with internet access in low and middle-income countries export more as part of their total sales

[1] For example, SDG 5 on gender equality, SDG 8 on decent work and growth, SDG 9 on innovation and infrastructure, SDG 13 on climate action, and SDG 17 on partnerships. For a full mapping of linkages between digital trade and SDGs, see Baker & Le (2023).

(Clarke, 2008). López-González and Ferencz (2018) also point to the correlation between internet use and higher market and product diversification as digital connectivity facilitates more sectors to find more customers in foreign markets (López-González and Ferencz, 2018). Digital trade also brings efficiencies for intra-corporate operations, which often involve sending data cross-border.

Furthermore, it contributes to economic resilience, as demonstrated during the COVID-19 pandemic (Wirjo, Nguyen and Calizo, 2022), when digital platforms helped sustain business operations, public services, and employment through remote work. Using firm-level data in the Middle East and Central Asia region, Abidi, Herradi and Sakha (2022) find that digitally enabled firms experienced a lower decline in their sales in 2020 compared to digitally-constrained firms.

The rapid digitalization of economies across the globe has led to an urgent need for international frameworks to catch up in effectively governing and facilitating digital trade. As digital technologies transform traditional business models and blur the boundaries between goods, services, and data flows, policymakers need to craft future-proof trade rules in fast-evolving policy areas that nonetheless reflect national interests.

In traditional trade negotiations, identifying areas of common interest and red lines typically revolves around market access conditions. However, in the context of digital trade, the negotiation space has become more complex due to varying levels of digital readiness and divergent interests, which affect the approach taken to issues such as data privacy and digital sovereignty across countries.

For these reasons, negotiating digital trade rules is considered essential to prevent or address trade barriers in digital trade and improve efficiency and opportunities in markets while engendering trust and confidence among businesses and consumers. While the "zone of possible agreement" (ZOPA) has been widely applied in negotiation theory,[2] its application to emerging and sensitive topics like digital trade remains underexplored. This paper seeks to fill that gap by providing an analytical framework for establishing ZOPA for digital trade provisions to help countries navigate and identify convergences in digital trade negotiations.

The paper will explore the negotiation dynamics of digital trade provisions in recent digital economy cooperation and/or trade agreements signed by countries with known differences in digital trade policy, especially in digital sovereignty. To reveal that pattern, the following research question will guide the paper: How can the approach used to identify common interests in negotiation theory be applied to identify and expand areas of consensus in negotiating digital trade provisions in free trade agreements (FTAs). Several sub-questions are considered:

[2] See for example Shonk (2025); Merino (2017). Fisher, Ury and Parron (2011).

- What are the key digital trade issues that shape the scope of the digital trade regulation framework under existing digital economy cooperation and/or trade agreements?
- How do different FTAs reflect varying levels of agreement or disagreement among parties on digital trade?
- What factors influence the expansion or narrowing of the acceptable areas under consideration for digital trade negotiations?
- What is the ZOPA among selected parties on digital trade provisions, and what factors influence its scope?

In answering these research questions, this paper examines trade agreements concluded by the Association of Southeast Asian Nations (ASEAN) and the European Union, considering their relative economic influence in the global trade landscape. Furthermore, the different approaches adopted by the two regional blocs in trade negotiations offer insights into how institutional dynamics affect the outcomes of negotiated digital trade provisions.

The paper is structured in five sections. Section 1 (Introduction) reviews the global rise of digital trade and the need for international rules to manage its complexity. Section 2 (Methodology) outlines the data sources and analytical methods used, including mapping and scoring techniques for assessing digital trade commitments. Section 3 presents findings from the analytical steps under the proposed methodology to identify the ZOPA through points of convergence and divergence in digital trade provisions across selected agreements by the two regional blocs. Section 4 examines how domestic priorities, institutional capacities, and strategic alignments influence negotiating positions and outcomes. Finally, Section 5 (Conclusion) synthesises key findings and reflects on their implications for negotiators and policymakers seeking cooperative approaches in digital trade governance.

II. METHODOLOGY

The paper focuses on identifying common ground among parties in a negotiated trade agreement. Previous analytical models have been helpful in decoding the coverage of digital trade policy areas in trade agreements, but they may not provide insight into how negotiating parties can possibly reach a deal.

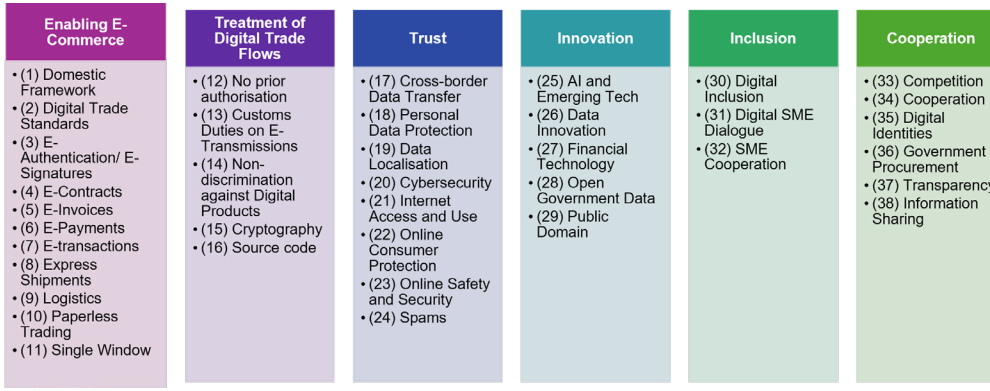
Existing databases use either a binary system[3] (0 - No, 1 - Yes) or a 3-level scoring system (0 – Non-inclusion of the area, 1 – Non-binding, 2 – Binding) to score whether

[3] Where 0 relates to a situation where there is no reference to a provision, and 1 related to a situation where there is a provision in the agreement.

certain digital trade policy areas are covered in an agreement or not.[4] However, whether certain commitments are binding and can be disputed is a factor negotiators must consider when negotiating a deal, as the outcomes will affect domestic regulatory reforms or result in punitive consequences if challenged by the other party. As such, the paper proposes a new approach comprising three analytical steps.

The first step analyses the scope of coverage of digital trade provisions through a mapping exercise of the most comprehensive digital economy cooperation/trade agreements concluded so far. This maps 38 provisions under 6 broad clusters: enabling e-commerce, digital products treatment, trust, innovation, inclusion, and cooperation (Figure 2).

Figure 2: Clusters of digital trade provisions

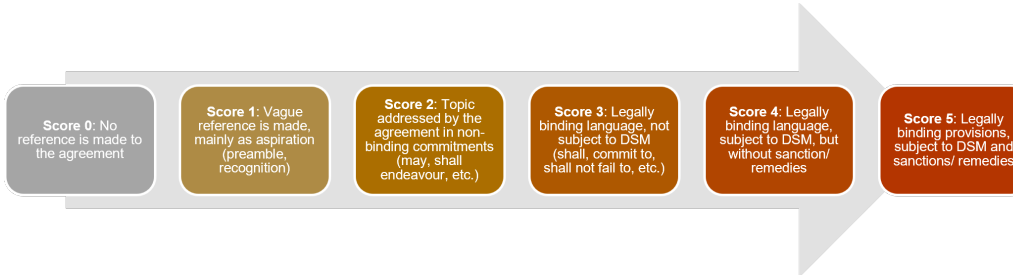


Source: Authors' conceptualization.

The second step examines the depth of commitments utilising a 5-level scoring system that, in combination with holistic coverage mapping, provides an overall landscape of the width and depth of digital trade provisions. Having collected the provisions, we classified the enforceability of each digital trade provision in the agreements using a scoring methodology adapted from Baker (2021) (Figure 3). This analysis was made to understand the depth of the commitments, i.e., the implications for implementation and enforcement of the provisions.

[4] For example, see Burri, Vasquez Callo-Müller and Kugler (2024); Dür, Baccini and Elsig (2014); Hofmann, Osnago and Ruta (2017).

Figure 3. Scoring methodology for the level of enforceability of commitment



Note. Where an article covers multiple commitments on the same policy areas, the enforceability of the most strongly worded commitment is taken.
Source: Baker (2021).

By overlapping the scope and depth of analysed agreements signed by different parties, the third step reveals possible areas of convergence among parties, especially in areas of much difference, like cross-border data transfer and data localization.

Finally, the analysis of political economy factors supplements the above analysis. While countries may generally agree on promoting digital trade and reducing digital barriers, the outcomes of negotiated digital trade agreements can be shaped by factors such as domestic regulatory priorities, capacity and infrastructure gaps, geopolitical alignments, and strategic partnerships. These factors are analysed in connection with the findings of the patterns of negotiated digital trade provisions (width and depth) for selected partners to identify the negotiation "space" available and the conditions under which it can be widened.

As the study takes a forward-looking approach, the analysis covered agreements by ASEAN (including by all ASEAN member states and each member state) as well as the EU that are (i) recently signed and (ii) more ambitious in digital trade commitments. These two regions were chosen for their advanced agreements and seemingly divergent approaches to negotiated outcomes.

On this basis, this paper analysed selected trade agreements, including the EU-Japan Comprehensive Economic Partnership Agreement and its Data Protocol, and the EU-New Zealand FTA for the EU, the ASEAN-Australia-New Zealand Free Trade Agreement (AANZFTA) (Upgrade) and the Regional Comprehensive Economic Partnership (RCEP for ASEAN. These agreements are benchmarked against the WTO Agreement on E-commerce to illustrate how these regional frameworks have moved beyond the new minimum threshold to be established under the most recently

released plurilateral agreement on digital trade.[5] Maximum scores were based on the most ambitious commitments in each of the 38 policy areas (Figure 2) included in the selected agreements to indicate the most forward-looking options.

III. ANALYTICAL FRAMEWORK: NAVIGATING THE COMPLEXITY OF DIGITAL TRADE NEGOTIATIONS

Global digital trade frameworks. The global framework on digital trade comprises the E-commerce Work Programme and the E-commerce Joint Statement Initiative (eJSI) at the World Trade Organisation. E-commerce was introduced into the work programme of the WTO in 1998, with its key achievement being the moratorium on customs duties on electronic transmissions, which has been renewed every two years since the Uruguay Round.

The moratorium has helped global digital trade grow (Andrenelli and Lopez-Gonzalez, 2023) by providing certainty and predictability to cross-border electronic transactions. However, support for the moratorium has not been unanimous among WTO member states: opponents raise concerns about lost government revenues, while proponents claim the benefits of digital trade outweigh the cost of revenue loss (IIDS, 2020). For a broader scope of issues, the plurilateral eJSI was officially launched in January 2019 by 76 WTO members to negotiate trade-related aspects of e-commerce. On 26 July 2024, after five years of negotiations, a stabilized text was achieved among 91 WTO members[6] together accounting for over 90% of global trade (WTO, 2024).

Compared to its much broader scope of negotiation, the stabilized text of the WTO E-Commerce Agreement covers only a more limited number of areas, excluding challenging topics such as cross-border data transfer, the location of computing facilities (data localization), non-discrimination for digital products, cryptography, source code, etc. However, the text also covers several measures to promote an enabling environment, openness, trust, transparency, cooperation, and development for e-commerce (Figure 4. It leaves appropriate policy space for members to regulate emerging issues in the digital economy through exceptions.

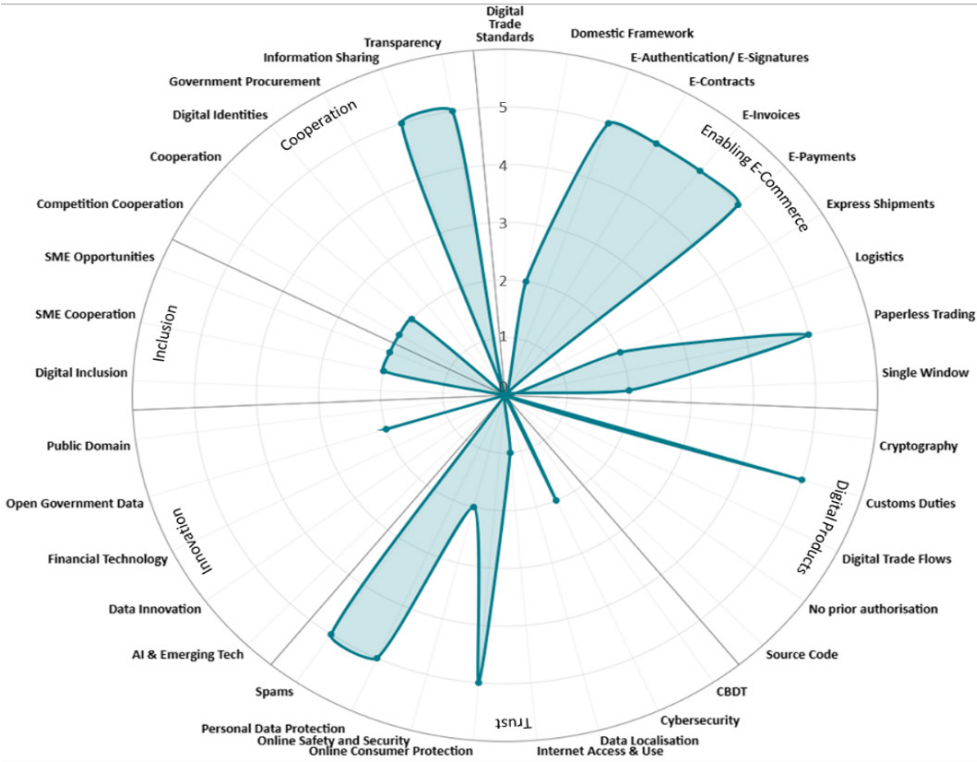
---

[5] The stabilized text of the WTO Agreement on Electronic Commerce was the result of the E-commerce Joint-Statement Initiative (JSI) Negotiating Process, launched in January 2019. The text of the Agreement on E-commerce is now pending integration into Annex 4 of the WTO Agreement in line with Article X.9 of the WTO Agreement, following a multilateral decision by consensus. The multilateral decision to add the Agreement to Annex 4 of the WTO Agreement will then enable domestic procedures for acceptance of the Agreement by WTO Members to proceed. The Agreement will enter into force on the 30th day following the date of deposit of the 45th instrument of acceptance with the Director-General of the WTO. See (WTO, 2024).

[6] At the conclusion, the eJSI was joined by 91 WTO members. However, 9 members (Brazil, Colombia, El Salvador, Guatemala, Indonesia, Paraguay, Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu (Chinese Taipei), Türkiye and the United States) abstained from the final declaration of the agreement, citing ongoing domestic consultations and considerations. See (WTO, 2024).

In addition to the two key e-commerce initiatives, the WTO Trade Facilitation Agreement also provides several measures relevant to digital and paperless trade (Sánchez, 2018), such as provisions on electronic customs forms, electronic payment, and de minimis thresholds, expedited shipments, etc. All these provisions can help reduce costs and delays for e-commerce traders and consumers and encourage more participation in e-commerce. However, among the three initiatives, the WTO E-Commerce Agreement will face challenges in being included in the plurilateral framework of the WTO (Ungphakorn, 2024).

Figure 4: Coverage and strength of the WTO eJSI by section and provision



Source: Authors' illustration based on electronic commerce joint statement initiative stabilized text and Baker (2021).

Note: Score 0: No reference is made to the agreement; Score 1: Vague reference is made, mainly as aspiration (preamble, recognition); Score 2: Topic addressed by the agreement, but mainly in non-binding commitments (may, shall endeavour, etc.); Score 3: Legally binding language, not subject to DSM (dispute settlement mechanism) (shall, commit to, shall not fail to, etc.); Score 4: Legally binding language, subject to DSM, but without sanction/remedies; Score 5: Legally binding provisions, subject to DSM and sanctions/ remedies.

Regional and bilateral digital trade frameworks. In parallel to the plurilateral efforts under the WTO framework, many countries have also taken initiatives to include and expand the scope of digital trade provisions under bilateral and regional trade frameworks. In this area, one notable development has been the rise of digital-only trade agreements, starting with the Digital Economic Partnership Agreement concluded in 2020 between Chile, New Zealand and Singapore (Taheri, Adams and Stern 2021).

Since then, a number of digital economy agreements have been concluded, including the UK-Singapore Digital Economy Agreement (2022), the Korea-Singapore Digital Partnership Agreement (KSDPA) (2023), and the EFTA–Singapore Digital Economy Agreement (2025). These digital-only agreements have much broader coverage with a modular structure that allows countries to adopt specific chapters independently (Sävenborg, 2022).

The EU has proactively pursued negotiation of digital trade provisions in its trade agreements, and its trade policy actively supports its digital transition. In its 2021 Trade Policy Review, An Open, Sustainable and Assertive Trade Policy, the EU affirms that the Union's trade policy should, as a priority, support Europe's digital agenda and aim to position the EU as a leader in digital trade (European Commission 2021).

This is evidenced in the EU's engagement in digital trade rule setting in multilateral and bilateral trade forums, contributing to setting up international standards and common digital trade rules at the WTO and through free trade agreements. In the WTO, the EU has actively participated in the eJSI and remains committed to the initiatives, as reflected in the bloc's engagement for the stabilized text released on 26 July 2024 (WTO, 2024).

Under bilateral frameworks, the EU has been incorporating digital trade provisions into its trade agreements since the 2000s. However, those early digital trade-related provisions were not included in a standalone digital trade or e-commerce chapter but instead incorporated into trade facilitation and intellectual property sections (Köhler-Suzuki, 2023). The first EU trade agreement to include a dedicated e-commerce chapter was the EU-CARIFORUM Economic Partnership Agreement signed in 2008 (European Commission, 2025). Since then, the coverage and depth of digital trade provisions in EU FTAS have expanded, with comprehensive and substantial provisions being incorporated for the EU–UK Trade and Cooperation Agreement (TCA), the EU-Chile FTA, and the EU-New Zealand FTA.

Overall, the EU now has an extensive network of 24 trade agreements with digital trade provisions, 15 of which feature dedicated chapters for such issues (Köhler-Suzuki, 2023) and has been negotiating or updating digital trade agreements to strengthen its digital ties with like-minded partners (EPRS, 2024), including Japan, Singapore, and South Korea (European Commission, 2025).

ASEAN has pursued objectives similar to those of the EU and has progressively sought to include digital trade provisions in several of its FTAs with its trading partners. This indicates the region's efforts to adapt to the increasing importance of the digital economy, albeit at varying scopes and levels of commitment. Currently, ASEAN has eight regional trade agreements in place, seven of which have provisions on e-commerce.[7] The region is also negotiating its own regional digital economy agreement, namely the Digital Economy Framework Agreement, following the mandate set out in the Bandar Seri Begawan Roadmap on ASEAN's Digital Transformation Agenda (ASEAN, 2021).

Whilst ASEAN and the EU have not concluded an FTA and digital partnership agreement, the EU's and ASEAN's respective advancements in digital trade could play a pivotal role in bridging the digital and regulatory gaps between the two regions. In fact, the digital economy was one of the three areas selected for sectoral trade cooperation at the 18th ASEAN Economic Ministers - EU Trade Commissioner Consultation in 2022 (ASEAN, 2022) and was further reiterated at the subsequent high-level meetings between the two regional blocs (ASEAN, 2023). EU–ASEAN trade negotiations, including digital trade issues, could gain momentum as both regions seek to diversify their economic partnerships amid rising trade tensions with the United States in 2025. Strengthening EU–ASEAN ties would not only offer mutual economic benefits and resilience but also help shape global digital trade norms through collaborative, middle-ground approaches.

Points of convergence and divergence. Based on the analytical steps provided in section 2, Table 1 indicates the ZOPA for ASEAN and the EU in negotiating a bloc-to-bloc digital trade chapter. The analysis uses a sample of four FTAs focused on the most recent trade agreements that showcase the evolving digital trade policy directions of ASEAN and the EU (see Figure 5). For ASEAN, the RCEP (2020) and the upgraded AANZFTA (2023) represent the region's current regional commitments and modernization efforts in digital trade.

[7] These are ASEAN Economic Community (Upgrade); ASEAN-Australia-New Zealand FTA (Upgrade); ASEAN-People's Republic of China (PRC) FTA (Upgrade); ASEAN-Hong Kong, PRC FTA; ASEAN-India FTA (Upgrade); ASEAN-Japan FTA; Regional Comprehensive Economic Partnership (RCEP). The ASEAN-Republic of Korea FTA is under process for updating and will likely cover digital trade/e-commerce provisions.

Table 1: Coverage and Strength of Digital Trade Provisions in Selected EU and ASEAN Free Trade Agreements

Cluster	Provision	WTO EA	RCEP (2020)	AANZFTA (2023)	EU-NZ (2023)	EU-JP (2024)	EU-SG (2024)	ZOPA	Preliminary level of Convergence/ Divergence
Enabling E-commerce	Domestic Framework	2	3	5	0	5	2	[5;5]	Strong Convergence
	E-Authentication/ E-Signatures	5	3	5	5	5	5	[5;5]	Strong Convergence
	E-Contracts	5	0	0	5	5	5	[0;5]	High Divergence
	E-Invoices	5	0	2	5	0	5	[2;5]	Moderate Divergence
	E-Payments	5	0	0	0	0	2	[0;2]	No Convergence
	Logistics	2	0	0	0	0	0	[0;0]	No Convergence
	Express Shipments	0	5	5	0	0	0	[0;5]	High Divergence
	Paperless Trading	5	3	2	2	5	2	[3;5]	Partial Convergence
	Single Window	2	0	0	0	0	5	[0;5]	High Divergence
	Digital Trade Standards	0	0	2	0	0	2	[2;2]	Low Convergence
Treatment of Digital Trade Flows	No prior authorisation	0	0	0	2	2	5	[0;5]	High Divergence
	Customs Duties	5	3	5	5	5	5	[5;5]	Strong Convergence
	Digital Products Non-Discrimination	0	0	0	0	0	0	[0;0]	No Convergence
	Cryptography	0	0	0	0	0	0	[0;0]	No Convergence
	Source Code	0	1	0	5	5	5	[1;5]	Moderate Divergence
Trust	Cross-Border Data Flows	0	3	5	5	5	5	[5;5]	Strong Convergence
	Data Localization	0	3	5	5	5	5	[5;5]	Strong Convergence
	Personal Data Protection	5	3	5	5	5	5	[5;5]	Strong Convergence
	Online Consumer Protection	5	3	5	5	1	5	[5;5]	Strong Convergence
	Spams	5	3	5	5	5	5	[5;5]	Strong Convergence
	Cybersecurity	2	1	1	1	1	2	[1;2]	Low Convergence
	Online Safety and Security	2	0	0	0	0	1	[0;1]	No Convergence
	Internet Access & Use	1	0	0	1	0	1	[0;1]	No Convergence

Cluster	Provision	WTO EA	RCEP (2020)	AANZFTA (2023)	EU-NZ (2023)	EU-JP (2024)	EU-SG (2024)	ZOPA	Preliminary level of Convergence/ Divergence
Innovation	Financial Technology	0	0	0	0	0	0	[0;0]	No Convergence
	AI & Emerging Tech	0	0	0	0	0	1	[0;1]	No Convergence
	Data Innovation	0	0	0	0	0	0	[0;0]	No Convergence
	Open Government Data	2	0	2	0	0	2	[2;2]	Low Convergence
	Public Domain	0	0	0	0	0	0	[0;0]	No Convergence
Inclusion	Digital Inclusion	0	0	2	0	0	2	[2;2]	Low Convergence
	SME Cooperation	2	0	0	1	1	0	[0;1]	No Convergence
	SME Opportunities	2	0	0	0	1	2	[0;2]	No Convergence
Cooperation	Cooperation	2	3	2	5	5	5	[3;5]	Partial Convergence
	Information Sharing	5	0	0	0	0	5	[0;5]	High Divergence
	Transparency	5	3	5	0	0	5	[5;5]	Strong Convergence
	Competition Cooperation	2	1	0	0	0	0	[0;1]	No Convergence
	Digital Identities	0	0	0	0	0	0	[0;0]	No Convergence
	Government Procurement	0	0	0	1	1	0	[0;1]	No Convergence

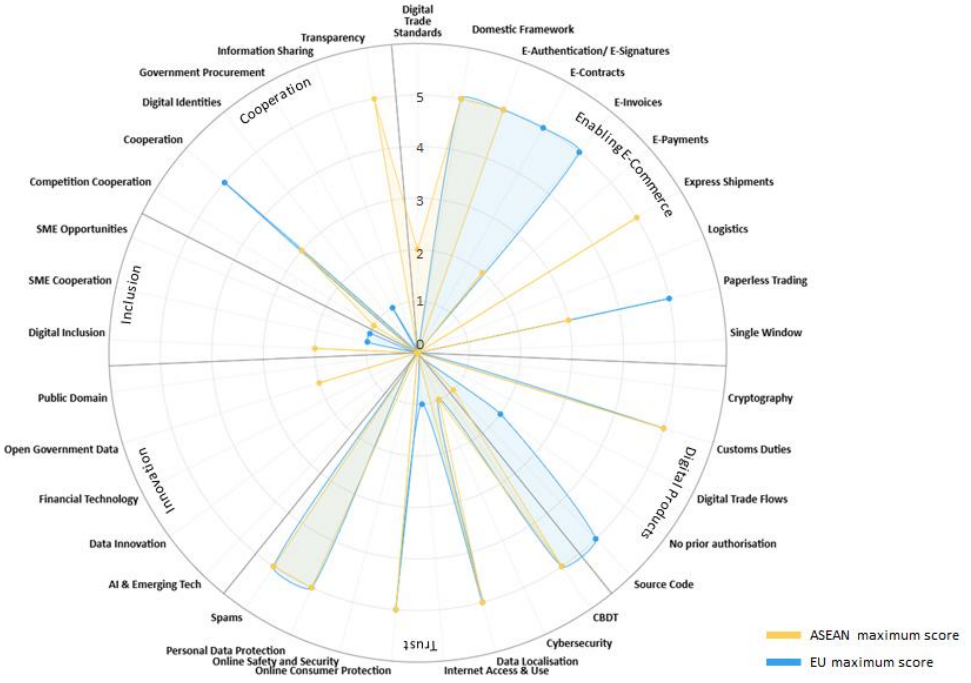
Score 0: No reference is made to the agreement
Score 1: Vague reference is made, mainly as aspiration (preamble, recognition)
Score 2: Topic addressed by the agreement, but mainly in non-binding terms
Score 3: Legally binding language, not subject to DSM
Score 4: Legally binding language, subject to DSM, but without sanction/ remedies
Score 5: Legally binding provisions, subject to DSM and sanctions/ remedies

Note. The ZOPA is made up of the range of maximum scores (i.e., level of commitments) that parties are willing to make under the examined FTAs. The level of convergence/divergence is determined by the sum of the maximum score (level of commitments) and the spread of maximum scores (differences) of each area of commitment by the EU and ASEAN, respectively. A combination of a higher sum and a lower spread indicates stronger convergence, while a lower sum and a higher spread indicates greater divergence.

Source: Authors' compilation.

Similarly, for the EU, the EU–New Zealand FTA (2023) and the EU–Japan Comprehensive Economic Partnership Agreement (with its 2024 data protocol) agreements reflect the EU's latest approach to digital trade, aligned with its digital strategy. Additionally, the EU-Singapore Digital Trade Agreement, signed on 7 May 2025, is included to showcase the common framework agreed between the EU and one of the ASEAN member states. Together, these five agreements provide a relevant basis for analysing convergence and divergence in digital trade provisions adopted by the EU and ASEAN member states, highlighting each region's priorities and providing insights into areas of alignment.

Figure 5: Indicative ZOPA of EU and ASEAN Digital Trade Provisions



Source: International Economics Consulting Ltd (2025), based on EU and ASEAN agreements.

The analysis reveals strong alignment in traditional areas but notable gaps for taking on commitments in emerging digital issues. Convergence is observed in foundational provisions such as domestic frameworks, e-authentication, and key trust-related disciplines, including cross-border data transfers, data localization, and personal data protection, where both regions have consistently made high-level commitments across agreements. In contrast, divergence is high in transactional areas such as e-contracts and express shipments, reflecting differing regulatory emphasises between the two regions in regulating these issues under regional trade frameworks. Moderate divergence is found in areas like e-invoices and source code, which may be bridged through negotiation and cooperation.

A large number of provisions, including AI, fintech, digital identities, and online safety, show little or no convergence, underscoring the early stage of policy development and/or cooperation in these areas. Innovation, inclusion, and to some extent, cooperation are covered in a limited scope in the two regional blocs' FTAs, indicating an area for strengthening cooperation. In addition to the commitments on substantive issues, both regions also often include provisions related to general and security exceptions,

indicating a shared understanding of safeguards within trade rules.

Notably, the above score is subject to some degree of generalisation, and a more detailed analysis of the text of the selected trade agreements will help reveal further points of convergence and divergence to give policymakers and trade negotiators insights. As will be observed, parties tend to reserve policy spaces in commitments, as analysed below, even in areas of high commitments.

However, for those provisions with divergent levels of commitment at the moment, parties may be able to establish common ground provided they are willing to adjust commitment in these policy areas to an acceptable level for both sides. For example, rather than pursuing binding commitments, parties may consider including the areas of divergence under a cooperation scheme to promote information exchange, best practice sharing, peer learning, etc.

One key point of convergence among digital trade provisions in both regions' trade agreements pertains to the right to regulate. Right to regulate provisions often feature in the "trade and development chapter" of EU FTAs Baker and Le, 2022) and enter the digital trade realm to affirm policy space for the state to create boundaries to protect legitimate policy objectives. In other words, the right to regulate safeguards a nation's ability to enact necessary public interest policies (such as in national security, health, environmental, or safety rules). This provision, therefore, maintains the right for legitimate digital governance while still encouraging countries to make meaningful commitments.

Under the analysed EU trade agreements, the right to regulate provision is often positioned at the beginning of the chapter,[8] emphasising the prevailing volition of the EU and its partners in affirming the principle of international law that the conclusion of the trade agreement does not affect the parties' sovereign right to regulate.

For example, under the EU-Singapore DTA, Article 3 (Right to regulate), Parties "reaffirm their right to regulate within their territories to achieve legitimate policy objectives, such as the protection of public health, social services, public education, safety, environment or public morals, social or consumer protection, privacy and data protection, and the promotion and protection of cultural diversity."

For ASEAN FTAs, while there is no dedicated right to regulate, this principle is embedded in several commitments that provide policy space. For example, under the RCEP cross-border data transfer and data localization provisions, parties emphasise that "Nothing [in this Article] shall prevent a Party from adopting or maintaining: (a) any measure inconsistent with [paragraph 2] that it considers necessary to achieve

[8] Sometimes even before definition provision, such as in the case of the EU-Singapore Digital Trade Agreement (DTA).

a legitimate public policy objective, provided that the measure is not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on trade; or (b) any measure that it considers necessary for the protection of its essential security interests." While the RCEP requires a necessity test for this exception, it can be interpreted broadly to provide sufficient space for domestic regulatory purposes.

Nonetheless, while the prohibition of imposing customs duties on electronic transmissions is unanimously incorporated in both the EU and ASEAN's trade agreements, closer examination of the text reveals a potential point of divergence. At the basic level, all analysed trade agreements provide a definite moratorium on customs duties on electronic transmissions.[9]

In the EU-New Zealand FTA, parties further clarified that the moratorium will not preclude a party from imposing internal taxes, fees, or other charges on electronic transmissions, provided that such taxes, fees, or other charges are imposed in a manner consistent with the agreement.[10] This clause is in line with Article 11.4 of the WTO Agreement on E-Commerce (stabilized text), and addresses concerns among some WTO Members about the potential loss of government tariff revenue due to the extension of the moratorium.

That said, commitments on customs duties on electronic transmissions under the analysed ASEAN FTAs appear more conservative. Specifically, the RCEP and the AANZFTA (Updates) bind the commitment to the outcome of future WTO Ministerial Decisions on customs duties on electronic transmissions and/or within the framework of the Work Programme on Electronic Commerce.[11] In other words, if the WTO e-commerce moratorium on customs duties is reversed, the commitments under the RCEP and AANZFTA may also be relinquished. This potential reversal of an important discipline may cause uncertainties for the cross-border digital trade environment, fragmentation of digital markets, and widening regulatory divergence among countries with different regimes.

Notably, none of the examined agreements of ASEAN and the EU has provisions on non-discrimination of digital products, highlighting a significant area with no convergence in approach. While other agreements concluded by individual ASEAN member states have this provision,[12] the regional bloc as a whole has not seemed

[9] Article 203, EU-UK TCA; Article 12.6, EU-NZ FTA; Article 19.7, EU-Chile ITA; Article 8.72, EU-Japan EPA; Article 8, EU-Singapore DTA.

[10] This can be interpreted to include, among others, non-discriminatory rules, for example as provided under Article 10.6 (National treatment) of the EU-NZ FTA.

[11] Article 12.11, RCEP; Article 13, Chapter 10, AANZFTA.

[12] Such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP),

to converge in this area. Similarly, none of the examined EU agreements has any provision on non-discrimination of digital products. This lack of commitment to non-discrimination in digital products may relate to difficulties in defining the scope of digital products. Under agreements signed by individual ASEAN member states, a digital product is defined as a computer programme, text, video, image, sound recording, or other product that is digitally encoded, produced for commercial sale or distribution, and that can be transmitted electronically.[13] However, parties do not always clearly define whether the digital product should be treated as a good or a service.[14]

On the other hand, the EU is of the view that electronic transmissions shall be considered as the supply of a service.[15] Under the EU-UK TCA, the EU further clarifies that computer programmes shall be considered as computer and related services, regardless of whether they are delivered via a network, including the internet. Moreover, the commitment to non-discrimination of digital products may interfere with the EU's stance on commitments on audio-visual services to protect its cultural diversity. On that basis, the divergences for provisions on the non-discrimination of digital products may be harder to reconcile than other issues. These different stances of countries on "digital products" governance are further exemplified in the lack of disciplines on "digital products" in the final text of the WTO E-commerce Agreement, despite the existence of this provision in earlier drafts.

On data governance, examination of the text shows a strong level of convergence, even though these are mostly at a high-policy level. For personal data protection, both the EU and ASEAN trade agreements contain strong commitments to adopt or maintain a domestic personal data protection legal framework.

Overall, the personal data protection commitments under EU agreements confirm the EU's strong stance on protecting personal data and privacy as fundamental rights, which, as indicated in the Communication from the Commission to the European Parliament and the Council Exchanging and Protecting Personal Data in a Globalised World (2017), is not subject to trade negotiations (European Commission, 2017). As such, EU agreements further emphasise the power of countries to determine the appropriate level of the protection of personal data and privacy within their domestic legal framework. For example, all analysed EU agreements include a provision stating that "Nothing [in this Agreement] shall affect the protection of personal data and

the Digital Economic Partnership Agreement, the KSDPA, and the UK-Singapore Digital Economy Agreement.

[13] Article 3.1, DEPA; Article 14.1, CPTPP; Article 14.1, KSDPA

[14] Footnote to Article 3.1, DEPA; Article 14.1, CPTPP; Article 14.1, KSDPA

[15] Article 203 (Customs duties on electronic transmissions), EU-UK TCA

privacy afforded by the Parties' respective measures".[16]

The EU, however, shows flexibility in considering good international principles and guidelines on personal data protection or exploring legal convergence mechanisms with partners.[17] ASEAN agreements, while sharing the same commitment to developing domestic personal data protection legal frameworks, also encourage mechanisms to promote compatibility and interoperability between different personal data protection legal frameworks for protecting personal information. Considering no ASEAN member state has received the adequacy decision under the EU General Data Protection Regulation (GDPR),[18] pathway to adequacy could be either a sticking point or leverage for either regional bloc in striving to score a deal.

For cross-border data flows and data localization, all examined agreements converge in their commitment to ensuring cross-border data flows; however, in detail, the level of commitment may differ. While all examined agreements provide legal commitments on (i) not prohibiting or restricting cross-border data flows and (ii) not requiring the location of computing facilities in a party's territory, the EU agreements reflect a similar objective but are different in their approach. In particular, the EU agreements only provide for a political commitment to cross-border data flows by stating that "Parties are committed to ensuring cross-border data flows [...]".[19] Furthermore, EU agreements provide a detailed and exhaustive list of prohibited restrictions on data flows, including data localization and the prohibition of data transfers.

The EU-Japan EPA (Data Protocol) also prohibits a party from requiring a systematic approval of that party prior to the transfer of information to the territory of another party. Notably, however, this prohibition does not prevent a party from taking specific measures, such as requirements on approval for specific transfer instruments or a particular cross-border transfer of information for protection of personal data and privacy or other measures to ensure compliance with laws and regulations on conformity assessment, intellectual property rights protection, or confidentiality

---

[16] The EU-Japan Data Protocol has a slightly softer provision expressed through recognition: "Each Party recognises the right of the other Party to determine the appropriate level of the protection of personal data and privacy, to be provided for by their respective measures."

[17] Article 6.7, EU-Singapore DTA.

[18] In total 16 adequacy decisions are in place in Andorra, Argentina, Brazil, Canada (commercial organizations), Faroe Islands, Guernsey, Israel, Isle of Man, Japan, Jersey, New Zealand, Republic of Korea, Switzerland, United Kingdom (under the GDPR and the Law Enforcement Directive), the United States (for commercial organizations certified under the EU-US Data Privacy Framework) and Uruguay. See European Commission (2025), the Adequacy decisions.

[19] As a comparison, CBDT commitments under ASEAN member state agreements more explicitly state that "Party [shall allow the cross-border transfer of information by electronic means] OR [shall not prevent cross-border transfer of information by electronic means] where such activity is for the conduct of the business of a covered person."

obligations.[20] In other words, cross-border data transfers will still be subject to regulatory scrutiny by all states.

Commonalities are also found in the affirmation of policy space to allow parties to regulate cross-border data flows for a legitimate public policy objective,[21] so long as measures based on 'legitimate public policy objective' do not comprise a form of disguised protectionism or discrimination.

Furthermore, in agreements by both the EU and ASEAN and individual member states that introduce language for a "necessity test" for the measures by parties in regulations on the location of computing facilities (data localization) and cross-border data flows.[22] To further secure public policy spaces, ASEAN's agreements (i.e., the RCEP and AANZFTA) further clarify that such measures applied to achieve "legitimate public policy objectives" shall not be subject to dispute settlement mechanisms, leaving enormous policy space for parties.

Overall, the comparison of digital trade provisions across agreements reveals a wide spectrum of divergence/convergence (Figure 6). As noted, some areas are characterised by "soft" divergence; that is, reconciliation can be achieved by finding a middle ground in cooperative terms or through non-binding commitments. Parties may also find common ground on some areas of current non-convergence when parties have developed domestic frameworks (such as in the case of the EU's inclusion of cross-border data transfer in more recent FTAs in line with the EU GDPR). Along this line, it can be expected that more trade-related issues, such as digital identities, AI, and emerging technology, may enter regional trade frameworks in the future, moving from high divergence/no convergence to a considerable convergence level. However, some countries are in a position to "wait-and-see" to peg the customs duty on e-transmission to the WTO Ministerial

Decisions on the e-commerce moratorium, which may erode the results achieved so far in this area of commitments. These differences reflect the current differences in regulatory approach, levels of digital maturity, and strategic priorities of countries

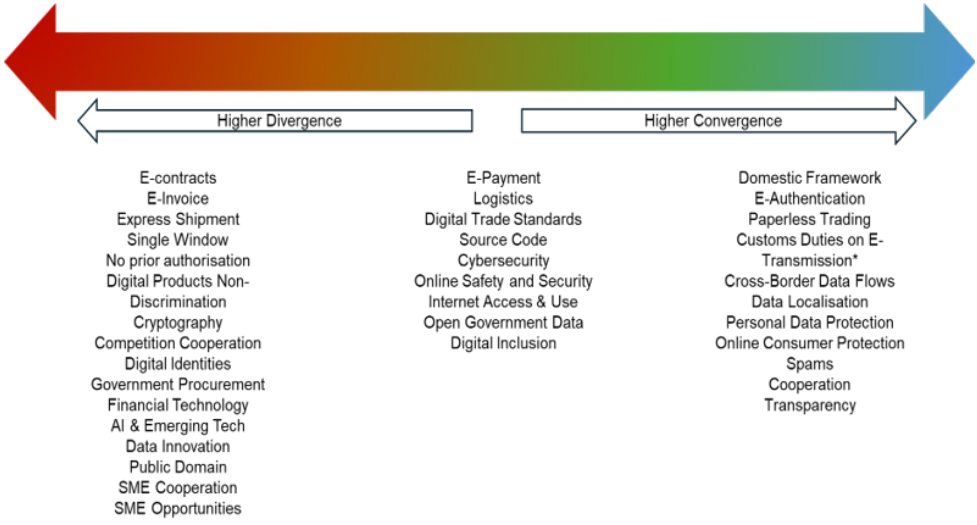
[20] Article 8.81.2.f and its footnote, EU-Japan EPA (Data Protocol)

[21] The EU-Japan Data Protocol and the EU-Singapore Digital Trade Agreement provide a definition for "legitimate public policy objective", which may encompass public security, public morals, human, animal or plant life or health, public order, other fundamental interests of society such as social cohesion, online safety, cybersecurity, safe and trustworthy artificial intelligence, protecting against the dissemination of disinformation, or other comparable objectives of public interest, taking into account the evolving nature of digital technologies and related challenges.

[22] These include the EU-Japan Data Protocol (Article 8.81(3)), the EU-Singapore DTA (Article 5.4), CPTPP (Articles 14.11.3 and 14.13.3), RCEP (Articles 12.14.3, and 12.15.3), Digital Economic Partnership Agreement (Articles 4.3.3 and 4.4.3), AANZFTA (Articles 17.3 and 18.3), KSDPA (Articles 14.14.3 and 14.15.3), and UK-Singapore Digital Economy Agreement (Articles 8.61-F(3) and 8.61-G(3).

across the regions, as will be discussed in the next section.

Figure 6: Indicative spectrum of divergence-convergence of digital trade disciplines in trade agreements



Note. Customs duties on electronic transmission are identified as an area of current convergence, but the status may change depending on future outcomes of WTO Ministerial Decisions on the e-commerce moratorium.

Source: Authors' illustration.

IV. POLITICAL ECONOMY DIMENSIONS OF DIGITAL TRADE NEGOTIATIONS

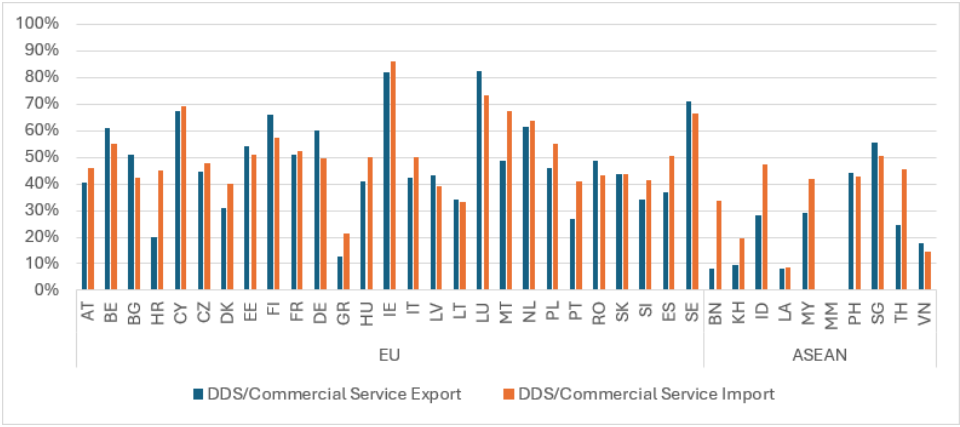
In shaping digital trade provisions, like any other state or regional bloc, the choices of commitments made by the EU and ASEAN are influenced by their digital readiness, the relative importance of digital services in the economy, and the respective institutional and legal contexts. Together, these factors create asymmetries in ambition and readiness that influence the design and negotiation outcomes of EU-ASEAN digital trade provisions.

Different relative importance of digital trade and digital readiness. The current relative importance of digital trade and the level of readiness to embrace the opportunities presented by the digital age can be indicated through the share of digitally delivered services over total commercial service trade and the Network Readiness Index, [23]respectively.

[23] The Network Readiness Index indicates the how well countries are prepared to utilise information and communication technologies (ICT). It assesses a nation's performance across four key pillars: Technology, People, Governance, and Impact. See Portulans Institute (2024).

For the countries under study, it is shown that digital trade (using digitally delivered services as a proxy) has a relatively higher share in total commercial service trade in the EU, at 58% on average, compared to 46% in ASEAN. Specifically, digitally delivered services account for more than 80% of total service trade in Ireland and Luxembourg, compared to the best performance of over 50% by Singapore in ASEAN. This trend corresponds to the digital readiness of the two regions, as indicated through the Network Readiness Index average score of 62.9 (over 100) by the EU compared to 52.7 by ASEAN. Within each regional group, the relative importance of digital trade also differs, corresponding to their level of digital readiness (Figure 6 and Figure 7).

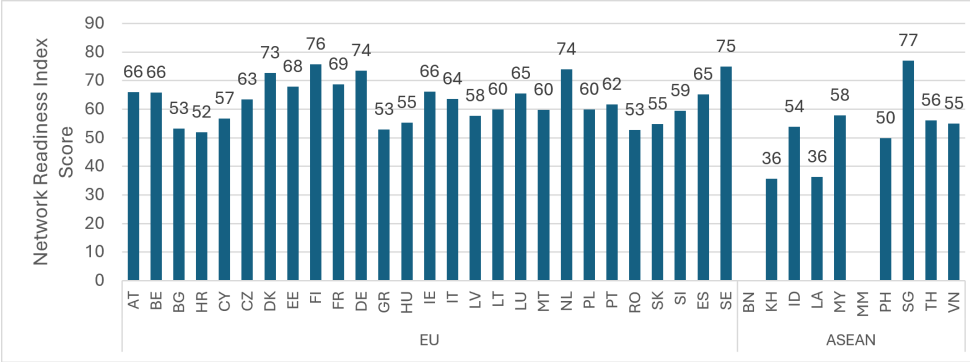
Figure 7: Digitally delivered services as a percentage of commercial service trade in 2024, EU and ASEAN member states



Note. AT = Austria; BE = Belgium;; BG = Bulgaria; HR = Croatia; CY = Cyprus; CZ = Czechia; DK = Denmark; EE = Estonia; FI = Finland; FR = France; DE = Germany; GR = Greece; HU = Hungary; IE = Ireland; IT = Italy; LV = Latvia; LT = Lithuania; LU = Luxembourg; MT = Malta; NL = Netherlands; PL = Poland; PT = Portugal; RO = Romania; SK = Slovakia; SI = Slovenia; ES = Spain; SE = Sweden; BN = Brunei Darussalam; KH = Cambodia; ID = Indonesia; LA = Laos; MY = Malaysia; MM = Myanmar; PH = Philippines; SG = Singapore; TH = Thailand; VN = Vietnam; DDS = digitally delivered services. Data for Myanmar is not available.

Source: WTO (2025).

Figure 8: Network Readiness Index 2024, EU and ASEAN member states



Note. AT = Austria; BE = Belgium;; BG = Bulgaria; HR = Croatia; CY = Cyprus; CZ = Czechia; DK = Denmark; EE = Estonia; FI = Finland; FR = France; DE = Germany; GR = Greece; HU = Hungary; IE = Ireland; IT = Italy; LV = Latvia; LT = Lithuania; LU = Luxembourg; MT = Malta; NL = Netherlands; PL = Poland; PT = Portugal; RO = Romania; SK = Slovakia; SI = Slovenia; ES = Spain; SE = Sweden; BN = Brunei Darussalam; KH = Cambodia; ID = Indonesia; LA = Laos; MY = Malaysia; MM = Myanmar; PH = Philippines; SG = Singapore; TH = Thailand; VN = Vietnam; Data for Brunei Darussalam and Myanmar is not available.

Source: Portulans Institute (2025)

As the level of digital readiness and the relative importance of digital trade increase, countries have more incentives to adopt more liberalizing measures to enable digital trade, either through unilateral (domestic regulations) or cooperative frameworks (such as under trade agreements). While there is no single comparative global dataset, the OECD Digital Services Trade Restrictiveness Index (Figure 9)[24] and the UNESCAP Regional Digital Trade Integration Index (Figure 10)[25] suggest the relative (though not directly comparable) level of openness/restrictiveness of digital trade rules.

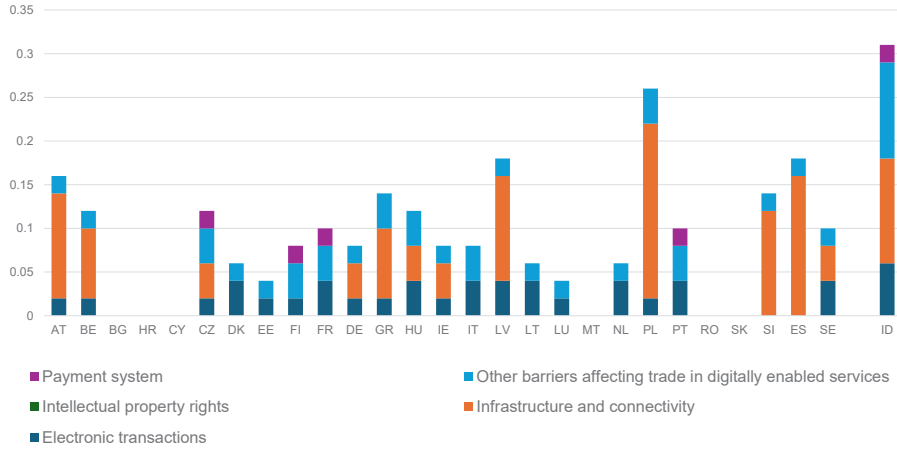
The OECD Digital Services Trade Restrictiveness Index indicates that even among

[24] The OECD Digital Services Trade Restrictiveness Index measures cross-cutting barriers that inhibit or completely prohibit firms' ability to supply services using electronic networks, regardless of the sector in which they operate. It includes five measures: infrastructure and connectivity, electronic transactions, e-payment systems, intellectual property rights and other barriers to trade in digitally enabled services. The index is a composite that takes values between 0 and 1, where 0 indicates an open regulatory environment for digitally enabled trade and 1 indicates a completely closed regime. The OECD Digital Services Trade Restrictiveness Index 2024 data set covers 43 countries, including 38 OECD members and some accession candidates.

[25] The Regional Digital Trade Integration Index indicates the regulatory costs of doing regional business digitally across 12 policy areas. The index scores, ranging from zero to one, imply how significant the regulatory environment adds to the cost of doing digital trade-related businesses. The UNESCAP Regional Digital Trade Integration Index dataset covers its 48 member countries. See United Nations Economic and Social Commission for Asia and the Pacific, Economic Commission for Africa and Economic Commission for Latin America and the Caribbean, 2024. Regional Digital Trade Integration Index 2.0: A Guide. June 2024. Bangkok: ESCAP. Available at https://hdl.handle.net/20.500.12870/6849.

the EU member states, restrictiveness differs from relatively open regimes, such as Estonia (0.04), Luxembourg (0.04), Denmark (0.06), Netherlands (0.06) and Ireland (0.08), to relatively restrictive regimes such as Poland (0.26), Latvia (0.18) and Spain (0.18). However, overall, the EU digital services trade regimes are relatively open, at 0.11 (over 1) on average, compared to the relative restrictiveness of Indonesia, at 0.31 (over 1) (Figure 8). Among ASEAN member states, the restrictiveness of digital trade regimes also differs, ranging from regimes with relatively lower regulatory costs, such as Singapore (0.28) and Thailand (0.34), to regimes with relatively higher regulatory costs, such as Vietnam (0.59) and Indonesia (0.54) (Figure 10).

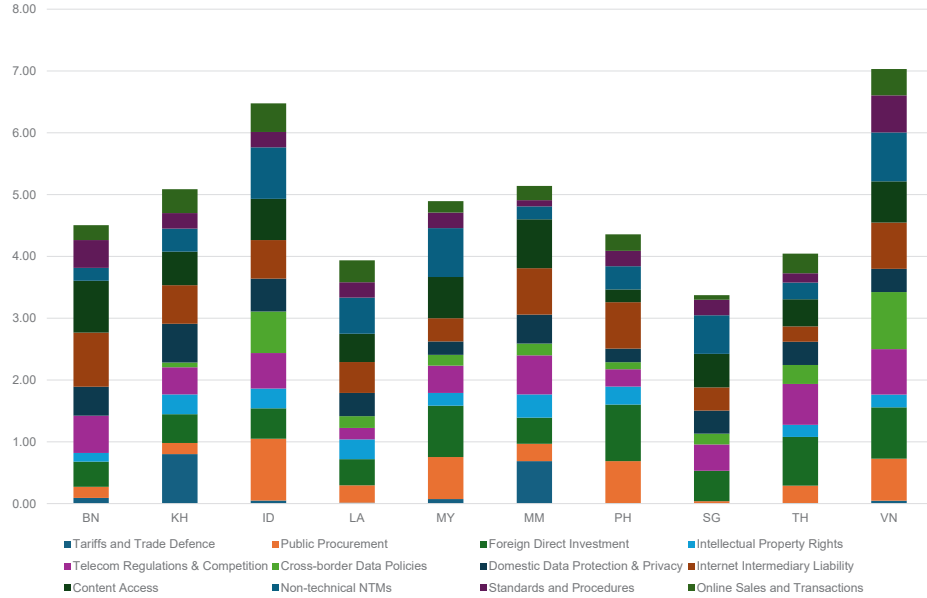
Figure 9: Digital Services Trade Restrictiveness Index



Note. AT = Austria; BE = Belgium;; BG = Bulgaria; HR = Croatia; CY = Cyprus; CZ = Czechia; DK = Denmark; EE = Estonia; FI = Finland; FR = France; DE = Germany; GR = Greece; HU = Hungary; IE = Ireland; IT = Italy; LV = Latvia; LT = Lithuania; LU = Luxembourg; MT = Malta; NL = Netherlands; PL = Poland; PT = Portugal; RO = Romania; SK = Slovakia; SI = Slovenia; ES = Spain; SE = Sweden; ID = Indonesia; Data for Bulgaria, Croatia, Cyprus, Malta, Romania, Slovakia is not available. Only data for Indonesia is available among ASEAN Member States.

Source: OECD Digital STRI (2025).

Figure 10: Digital Services Trade Restrictiveness Index



Note. BN = Brunei Darussalam; KH = Cambodia; ID = Indonesia; LA = Laos; MY = Malaysia; MM = Myanmar; PH = Philippines; SG = Singapore; TH = Thailand; VN = Vietnam

Source: UNESCAP (2024).

Overall, EU member states generally have a higher level of digitally delivered services exports and imports proportionate to service trade, which necessitates facilitating digital trade rules. This level of readiness and the relative importance of digital trade to service trade, and by extension, the national economy, clearly influence a country's approach to regulating digital trade. Furthermore, in a regional bloc, the institutional setting also has an influence on how countries reconcile an acceptable level of commitments under regional trade frameworks, as analysed below.

Regional institutional context. The EU has achieved high regional economic integration, making it one of the most advanced examples of such cooperation globally. As a result, the EU has harmonized many economic policies, including competition rules, consumer protection, and environment protection. It has thereby created a more unified economic space. In digital trade, the EU leads globally in both exports and imports of digitally delivered services (WTO, 2025) and has, for over a decade, implemented the EU Single Digital Market strategy (European Commission, 2015), the first regional economic community to conceptualize and implement such initiatives.

To address emerging issues in its digital economy, the EU has developed a comprehensive regulatory framework for it (Köhler-Suzuki, 2023), which has inspired similar rules in other countries (the so-called "Brussels Effect"). Examples include the GDPR, the Digital Services Act, the Digital Market Act, the Data Act, the Data Governance Act, the Artificial Intelligence Act, the Cyber Resilience Act, etc.

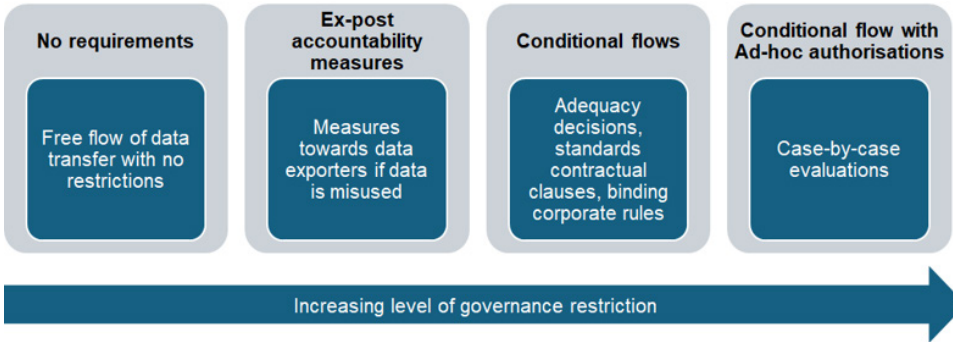
Unlike the EU, which has exclusive competence in all trade-related matters,[26] the institutional arrangement among ASEAN members largely accommodates discretionary powers to member states. In external economic integration, the "ASEAN Way" plays a central role in defining the scope of ASEAN's commitments. Under the ASEAN Way, ASEAN operates on consensus decision-making, non-interference, territorial integrity, and peaceful settlement of conflict (Yukawa, 2017). This approach often results in softer, non-binding digital trade provisions that prioritise national policy space with an incremental approach toward harmonization. Flexibility in the implementation is enabled: where there is no consensus or when the need for expedited decisions arises, ASEAN will apply the ASEAN Minus X formula [Article 21.2 of the ASEAN Charter]. Under the ASEAN Minus X formula, two or more countries may proceed with an agreed services sector liberalisation without having to extend the concessions to non-participating countries. Others may join at a later stage or whenever ready.

Consequently, ASEAN-led agreements such as RCEP and AANZFTA tend to adopt more cautious language, allow transitional periods, and reflect a diversity of domestic regulatory readiness. This inherently limits the ambition of digital trade commitments within ASEAN frameworks. Furthermore, the laxer approach in institutional arrangement, while allowing ample spaces for domestic policymaking, often results in fragmentation and divergences that are challenging to consolidate in digital regulations.

Divergences in approaches to specific digital trade issues. The divergences in approach to digital trade issues also stem from the differences in regulatory approaches by countries. In most other areas, ASEAN member states and the EU exhibit subtle differences in their respective digital trade-related regulations, **which reflect variations in legal frameworks, levels of economic integration, and policy priorities.** Take the areas of cross-border data transfer as an example. While most countries' approaches can be classified as conditional flows (Figure 11), conditions for transfer differ and result in a landscape of a high level of diversity (UNCTAD, 2023).

[26] Article 3(1)(e) and Article 207, Treaty on the Functioning of the European Union; Also see European Commission (n.d.). Areas of EU action.

Figure 11: Approaches to data flow regulations



Source: Casalini et al. (2021).

Generally, the EU adopts a harmonized rights-based approach to cross-border data flows, as prescribed under Regulation (EU) 2016/679, also known as the GDPR.[27] At the core of the EU's approach to the treatment of cross-border data transfer is the non-negotiable principle of the EU's rights-based approach to digital policy (European Commission, 2017). The EU GDPR, therefore, sets a high standard for cross-border data flows by placing personal privacy at the centre of its external digital trade negotiations. Under this regulation, personal data may only be transferred outside of the EU in compliance with the conditions for transfer laid down in Chapter V of the GDPR, namely: Adequacy Decision (Article 45),[28] Appropriate Safeguards[29] (Article 46), or Derogations for Specific Situations (Article 49). While an adequacy decision is the preferred route, only 16 decisions have been in place so far.[30]

In contrast, ASEAN member state follows a more diverse approach, as each country has its own national personal data protection laws or sectoral regulations. Four ASEAN member states (Indonesia, Lao PDR, Thailand, Viet Nam) have some form of data localization regulations that require data, whether personal or non-personal, to be processed or stored within the country of origin (Watanabe, Ogura and Oikawa, 2025).

---

[27] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

[28] In total, 16 adequacy decisions are in place: for Andorra, Argentina, Brazil, Canada (commercial organizations), Faroe Islands, Guernsey, Israel, Isle of Man, Japan, Jersey, New Zealand, Republic of Korea, Switzerland, the United Kingdom (under the GDPR and the LED), the United States (for commercial organisations certified under the EU-US Data Privacy Framework) and Uruguay. See European Commission (2025). Adequacy decisions.

[29] Such as standard contractual clauses, binding corporate rules, approved codes of conduct or certification mechanisms, or ad hoc contractual clauses.

[30] See European Commission (n.d.). Adequacy decisions.

In addition to the obligations and rights related to personal data protection, ASEAN member states' domestic personal data protection laws establish interoperability across jurisdictions to allow data transfer under specific conditions. Similar to the EU, the mechanisms include adequacy status to foreign countries or other exceptions such as model contractual clauses, standard contractual clauses, binding corporate rules, certification, approval of authority, etc.

However, each country adopts a different set of mechanisms, which leads to a fragmented landscape of requirements by individual countries (Watanabe, Ogura and Oikawa, 2025). For example, in Viet Nam, the cross-border transfers of personal data require a "Transfer Impact Assessment", which must showcase, among other things, consent of data subjects and contractual obligations on personal data processing. [31]For Malaysia, the newly introduced Personal Data Protection (Amendment) Bill 2024 removes the requirement for approval from the Malaysian Communications and Multimedia Commission for cross-border data flows (Chew, Kan and Ng, 2024).

However, Malaysia's Cross-Border Personal Data Transfer Guideline also suggests that the data controller may conduct a transfer impact assessment to ascertain if the relevant personal data protection law of the receiving country/jurisdiction is equivalent to that of Malaysia (Malaysian Personal Data Protection Commissioner, 2025). Such differences in the domestic approaches have been reflected in the varied depth of provisions on cross-border data flows in trade agreements, which is less robust than that of personal data protection due to the need to reconcile the differentiated approaches to cross-border data flows.

Similarly, in e-authentication, while most FTAs now have strong commitments to recognise the legal validity of e-signatures, different implementation approaches under the domestic regulatory framework may cause further friction for businesses engaging in cross-border digital trade. Currently, regulatory approaches to e-authentication and e-signatures can be divided into three distinct models: prescriptive, minimalist, and tiered (Figure 12) (Isono, Prilliadi and Mahusin, 2025).

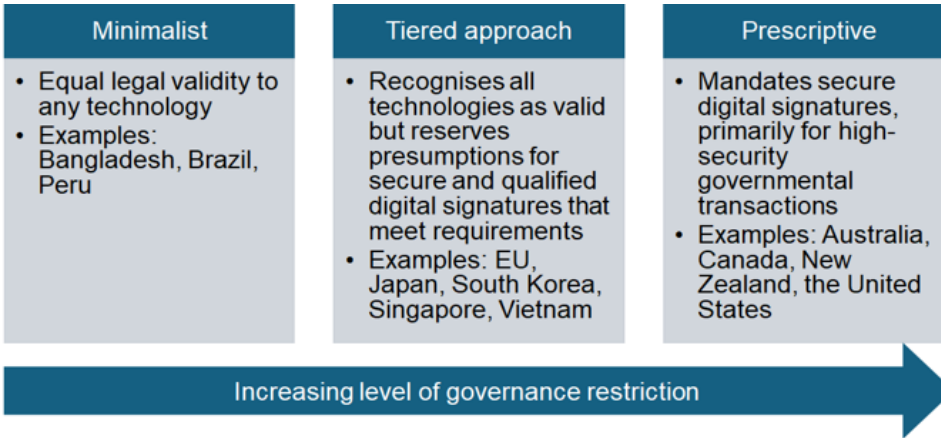
However, even within countries adopting a tiered approach, the classification of services also shows divergence. For example, the EU eIDAS 2.0 provides a wide range of trust service solutions, including certificates for the provision of trust services, e-signatures, e-seals, e-timestamps, electronic registered delivery service, website authentication certificates, e-attestations of attributes, e-archiving, signature/seal creation devices, and e-ledgers.

Most trust services comprise qualified and non-qualified services, with qualified trust

[31] Article 25.2, Decree 13/2023/ND-CP on Personal Data Protection (Viet Nam). See Le, L; Baker, P. (2023). The New Personal Data Protection Decree of Viet Nam has Far Reaching Implications for Businesses.

services offering higher legal certainty and higher security of electronic transactions (European Commission, 2025). In ASEAN, e-authentication currently still mostly focuses on e-signatures, which are often covered under domestic electronic transaction laws. Most ASEAN member states also adopt a tiered approach,[32] but classification differs. For instance, Singapore applies a tiered model which recognises all e-signature technologies but accords secure trust services with presumptive legal validity.[33] In Vietnam, the Viet Nam Law on E-Transactions 2023 classifies electronic signatures into three categories (specialised, public, official), each with increasing certification requirements and legal presumptions. In this context, achieving regional e-signature interoperability, particularly in countries with the tiered approach, is essential for facilitating regional digital transactions and economic integration (Isono, Prilliadi and Mahusin, 2025).

Figure 12: Regulatory approach to e-authentication



Source: Author's compilation based on Isono, Prilliadi and Mahusin (2025).

It is worth recognizing the challenges to achieving a single approach to digital governance, as it touches upon several important areas of the modern economy. While the new information and telecommunication technology (ICT) innovations have enabled global connections and economic growth, data-driven technologies such as facial recognition or targeted advertising may also contribute to undesired consequences of discrimination, profiling, or even misinformation (Confessore, 2018). Digital governance frameworks, therefore, have been driven by the need to balance

[32] Cambodia and Myanmar both show a minimalist approach, with no specific requirements for advanced/secure/certified e-signatures, and broad legal validity is assumed to any technology used for electronic signatures

[33] Section 19, Part 2, Presumptions relating to secure electronic records and signatures. Singapore Electronic Transactions Act 2010 (amended 2020).

the increasing importance of data as an asset and the need to protect individuals' privacy rights.

This gives rise to diverse approaches of different jurisdictions in regulating digital-related issues, depending on the states' approaches to digital sovereignty (Gao, 2021; UNCTAD, 2021). Furthermore, as in other policy areas, digital governance is subject to jurisdictional conflicts due to its extraterritoriality. As a result, the fragmentation of domestic regulations with duplicated requirements may incur burdens for businesses. Similar to non-tariff measures for trade in goods, these burdens comprise costs to identify and process the information on relevant requirements in the target market (information costs), costs to adjust the product or production process to the requirements of the importing country (specification costs), or costs to verify and prove compliance (conformity assessment costs), or a combination of the three (Gourdon, Cadot, and von Tongeren, 2018; OECD, 2017; von Lampe, Deconinck and Bastien, 2016). These costs may disproportionately affect cross-border service providers, SMEs, and data-driven firms. Therefore, trying to resolve the fragmentation will have important consequences for the transmission of the benefits of digitalization to all.

Consequently, while there is no simple solution to resolve political economy aspects of digital trade negotiation, this section suggests a high-level framework for negotiating parties to find convergence through cooperation. In digital policy areas, countries with clearly divergent approaches to digital governance are more likely to omit the controversial issue from the negotiating table. By contrast, countries with similarly not-so-restrictive approaches may have more room to achieve mutual recognition and interoperability.

That said, where there are divergences, negotiating parties may still be able to strengthen dialogue to foster understanding and find a bridge through softer cooperation mechanisms. Existing digital trade agreements provide several examples of cooperation mechanisms which can facilitate convergence, such as joint initiatives in the field of standards, technical regulations and conformity assessment procedures; sharing of experiences and best practices; exchange of information; joint committees; dedicated expert workshops; R&D pilots; authority cooperation in cross-border cases (e.g., in consumer protection, competition); mutual recognition arrangements, etc. [34]

[34] See, for example, cooperation areas and mechanisms provided under the EU-Singapore Digital Partnership.

Figure 13: Possible cooperation based on the compatibility of governance models

Party A Governance restrictions	High	Cooperative mechanisms to foster mutual understanding and possible common ground	Cooperative mechanisms to foster mutual understanding and possible common ground	Issue unlikely to enter FTA; if yes, only through best endeavour cooperative or information exchange mechanisms
	Medium	Cooperative mechanisms to foster mutual understanding and possible common ground	Find convergence through mutual recognition	Cooperative mechanisms to foster mutual understanding and possible common ground
	Low	Promote private governance through standards	Cooperative mechanisms to foster mutual understanding and possible common ground	Cooperative mechanisms to foster mutual understanding and possible common ground
		Low	Medium	High
	Party B - Governance restrictions			

Source: Authors' compilation.

V. CONCLUSION

While digital trade-related issues have entered free trade agreement frameworks for decades, with increasingly expanding scope, parties clearly diverge on the scope and depth of commitments rooted in countries' different institutional and legal contexts and embedded interests in relevant issues. Considering the different levels of readiness of the parties in negotiating digital trade-related issues, the existing agreements already provide suggestions on the depth and scope that parties have been willing to commit to in the past. They offer insights into the potential areas of convergence and divergence between parties, with a view to building a zone of possible agreement for achieving a digital trade agreement in some areas. As such, the paper highlights what may be easier-to-negotiate areas.

In a negotiation involving parties at different stages of digital governance and varying legal readiness, uneven digital maturity will shape parties' commitment preferences towards capacity-building provisions and cooperation-based commitments rather than binding rules. Furthermore, stronger commitments could be made with embedded transitional periods or party-specific carve-outs for implementation and enforcement of commitments. For example, the AANZFTA (Updates) provides carve-outs to delay

the application of the dispute settlement mechanisms (i.e., enforcement) until three years after the date of entry into force of the Second Protocol for the data localization and cross-border data transfer provisions. In addition, dispute settlement mechanisms (i.e., enforcement) will also not apply to Cambodia, Lao PDR, and Myanmar, unless otherwise amended following further review and agreement.[35]

Similarly, the CPTPP also provides for a transitional period for parties, often in three to five years, to proceed with the necessary domestic legal reforms before being bound by the commitments under the agreement.[36] These mechanisms can be adapted to a future framework to ensure that parties are allowed sufficient time and space to foster domestic reform in line with international commitments. These flexibilities may also enhance the developmental value of digital trade agreements by allowing regional and international partnerships to promote more inclusive participation in the digital economy across economies with differing levels of readiness, thereby contributing to broader sustainable development outcomes.

When commitments converge in FTAs (high convergence in ZOPA), the nuances of implementation requirements under domestic regulatory frameworks may still greatly differ. This can be observed under EU and ASEAN agreements, such as in customs duties on electronic transmission, cross-border data transfer, and location of computing facilities (i.e., data localization). Such intricacies cause operational and compliance burdens for businesses operating across borders. In areas of great divergence (i.e., no or little ZOPA), such as in the treatment of digital products. Parties can still engage in collaborative dialogues to find common ground and promote collaborative solutions through flexible, pragmatic, and capacity-oriented initiatives to deepen mutual understanding and promote interoperability across digital economies.

The ZOPA analytical framework (see section 3) can be applied to most emerging issues, such as environment, labour, emerging technology, etc., with adaptation to the provision mapping. However, this paper's approach is limited in that the framework does not cover regulatory maturity or governance and political economy considerations, which will still need to be based on qualitative, case-by-case analysis. As the analysis shows, the political economy dimension, which is more difficult to

---

[35] Article 20 (Dispute Settlement), Chapter 10 (Electronic Commerce),

[36] For example, Article 14.18 (Dispute Settlement) of the CPTPP provides that Malaysia shall not be subject to dispute settlement under Chapter 28 (Dispute Settlement) regarding its obligations under Article 14.4 (Non-Discriminatory Treatment of Digital Products) and Article 14.11 (Cross-Border Transfer of Information by Electronic Means) for a period of two years after the date of entry into force of this Agreement for Malaysia. Similarly, Viet Nam shall not be subject to dispute settlement under Chapter 28 (Dispute Settlement) regarding its obligations under Article 14.4 (Non-Discriminatory Treatment of Digital Products), Article 14.11 (Cross-Border Transfer of Information by Electronic Means) and Article 14.13 (Location of Computing Facilities) for a period of two years after the date of entry into force of the CPTPP for Viet Nam.

quantify, sets redline for negotiations, as indicated in the EU's rights-based approach in matters related to personal privacy.

While it is challenging to put a numerical value, the governance approach can still be categorised to provide negotiators with information on the potential areas and mechanisms for further collaboration with a partner state, through fostering mutual recognition, cooperation and dialogue. As digital governance is still evolving, countries may migrate to existing governance models (such as in Malaysia, from ad-hoc to a conditional flow data governance model) or take up new models (such as in newer policy areas, such as AI governance). The existing body of research on commitments made by countries under regional trade partnership frameworks thus needs to keep developing, and domestic governance approaches to keep evolving.

The dynamics of commitments analysed in this paper also imply the possible contribution to the future expansion of the plurilateral work on e-commerce. The current lack of disciplines on policy areas such as cross-border data flows and data localization under the WTO plurilateral digital trade framework suggests the difficulties in achieving consensus among the global trade forum's diverse membership.

Meanwhile, the inclusion of these disciplines in agreements by regional blocs like the EU and ASEAN suggests that meaningful progress in digital trade governance is currently more feasible in regional or bilateral forums than in the multilateral WTO system. This again emphasises the role of regional blocs as "laboratories" and stepping stones for new rules by setting practical and enforceable digital trade disciplines based on the level of readiness for commitments by members and the interest attached to specific trade partners.

This paper recognizes the challenges of incorporating the non-quantifiable dimensions of regulatory maturity, preparedness, political economy and governance to decode their impacts on economic outcomes. This paper has thus aimed to open discussion on different future research based on our methodological framework and initial findings. For example, an index of implementation history of FTAs, or political economy stance -restricted or open digital trade—can be developed, using proxies for outcome indicators like trade to GDP or level of restriction metrics, similar to the OECD Digital Services Trade Restrictiveness Index.

NOTE ON AUTHORS

Paul Baker is the Founder and Chairman of the International Economics Consulting Group, Chairman of the Africa Trade Foundation, and a Visiting Professor at the College of Europe. He has over 30 years of experience advising governments and international organizations on trade policy and negotiations. He recently advised the ASEAN Secretariat and the European Commission on digital trade.

Email: baker@tradeeconomics.com

Loan Le is Director at International Economics Consulting (Viet Nam), where she leads trade strategy and advisory work in East Asia. Her expertise covers trade agreements, digital trade, value chain analysis, and economic integration. She has extensive experience delivering trade negotiation training and capacity-building programmes across the Asia Pacific, Africa, and other emerging economies.

Email: le@tradeeconomics.com

REFERENCES

Abidi, N., M. E. Herradi and S. Sakha (2022). Digitalisation and resilience: firm-level evidence during the COVID-19 pandemic. IMF Working Papers, 2022(034). International Monetary Fund.

Andrenelli, A. and J. Lopez-Gonzalez (2023). Understanding the potential scope, definition, and impact of the WTO e-commerce moratorium. OECD.

ASEAN (2021). The Bandar Seri Begawan roadmap: an ASEAN digital transformation agenda to accelerate ASEAN's economic recovery and digital economy integration.

ASEAN (2022). Joint media statement of the eighteenth AEM–EU Trade Commissioner consultation. 18 September 2022.

ASEAN (2023). Joint media statement of the nineteenth AEM-EU Trade Commissioner consultation. 20 August 2023.

ASEAN (2024). Joint media statement of the twentieth AEM–EU Trade Commissioner consultation. 19 September 2024.

Baker, P. R. (2021). Handbook on negotiating sustainable development provisions in preferential trade agreements. United Nations Economic and Social Commission for Asia and the Pacific, as detailed in Baker, P. R. and L. Le (2022). Trade and sustainable development in new generation FTAs: depth, scope, and implications. In International economic integration: a journey to the new generation FTAs. Hanoi: Viet Nam National University Press.

Baker, P.; Le, L. (2023). Promoting Sustainable Development Through Digital Trade and Digital Trade Policies, ARTNeT Working Paper Series No. 229, December 2023, Bangkok, UN ESCAP.

Burri, M., Maria Vasquez Callo-Müller and K. Kugler (2024). TAPED: trade agreement provisions on electronic commerce and data. Available at https://unilu.ch/tapedl.

Casalini, F., J. López-González and T. Nemoto (2021). Mapping commonalities in regulatory approaches to cross-border data transfers. OECD Trade Policy Paper No. 248.

Chew, K. Y.; Kan, S.; Ng, C.H. (2024). Malaysia: personal data protection (amendment) bill 2024. Baker McKenzie.

Clarke, G. (2008). Has the internet increased exports for firms from low and middle-income countries? Information Economics and Policy, vol. 20, pp. 16–37.

Confessore, N. (2018). Cambridge Analytica and Facebook: the scandal and the fallout so far. The New York Times.

Dür, A., Leonardo Baccini and Manfred Elsig (2023). The design of international trade agreements: introducing a new database. The Review of International Organisations, vol. 9, No. 3, pp. 353–375.

European Commission (2015). A digital single market strategy for Europe. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels: European Commission.

European Commission (2016). Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

European Commission (2017). Communication on exchanging and protecting personal data in a globalised world. COM(2017). 10 January 2017.

European Commission (2021). Trade policy review – an open, sustainable and assertive trade policy. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels: European Commission.

European Commission (2025). Adequacy decisions.

European Commission (2025). Digital trade agreements.

European Commission (2025). Digital trade in EU trade agreements. Access2Markets.

European Commission (2025). Questions and answers on trust services under the European Digital Identity Regulation.

European Commission (n.d.). Areas of EU action.

European Parliamentary Research Service (2024). The EU's digital trade policy.

Fisher, R., William Ury and Bruce Patton (2011). Getting to yes: negotiating agreement without giving in, 3rd ed. New York: Penguin Books.

Gao, H. S. (2021). Data sovereignty and trade agreements: three digital kingdoms. In Anupam Chander and Haochen Sun, eds., Data sovereignty: from the digital Silk Road to the return of the state, pp. 213–239. Oxford: Oxford University Press.

Gourdon, J., C. Cadot and F. von Tongeren (2018). Estimating ad valorem equivalent of non-tariff measures: combining price-based and quantity-based approaches. TA/TC/WP(2017)/12/Final. Paris: OECD.

Hofmann, C., Alberto Osnago and Michele Ruta (2017). Horizontal depth: a new database on the content of preferential trade agreements. Policy Research Working Paper No. WPS 7981. Washington, D.C.: World Bank Group.

IIDS (2020). WTO members highlight the benefits and drawbacks of the e-commerce moratorium.

Isono, I., Hilmy Prilliadi and Mahirah Mahusin (2025). Enhancing e-authentication and e-signature across ASEAN: building interoperable frameworks for seamless digital transactions. Policy Brief No. 2024-14. Jakarta: Economic Research Institute for ASEAN and East Asia.

Kanth, R. (2023). WTO: India, South Africa push back against proponents of e-commerce moratorium. Third World Network.

Köhler-Suzuki, N. (2023). Mapping the EU's digital trade: a global leader hidden in plain sight? Notre Europe.

Le, L. and Peter P. R. Baker (2023). The new personal data protection decree of Viet Nam has far-reaching implications for businesses.

López-González, J. and J. Ferencz (2018). Digital trade and market openness. OECD Trade Policy Papers No. 217. Paris: OECD Publishing. https://doi.org/10.1787/1bd89c9a-en.

Malaysian Personal Data Protection Commissioner (2025). Personal data protection guideline on cross-border personal data transfer.

Merino, M. (2017). Understanding ZOPA: the zone of possible agreement. Harvard Business School. 14 September.

OECD (2017). International regulatory co-operation and trade: understanding the trade costs of regulatory divergence and the remedies. Paris: OECD.

OECD (2023). The digital trade review 2023. October 2023. Paris: OECD.

Portulans Institute (2024). Network readiness index 2024: building a digital tomorrow: public-private partnerships for digital readiness.

Sánchez, A. (2018). Is the WTO Trade Facilitation Agreement an enabler of e-commerce? UNCTAD Transport and Trade Facilitation Newsletter, No. 80, fourth quarter 2018. Geneva: UNCTAD.

Sävenborg, E. (2022). The digital-only trade agreements – what is new? Stockholm: National Board of Trade, Sweden.

Shonk, K. (2025). How to find the ZOPA in business negotiations. Harvard Law School. 19 June.

Taheri, R., O. Adams and P. Stern (2021). DEPA: the world's first digital-only trade agreement. Asia-Pacific Foundation of Canada.

UNCTAD (2021). Digital economy report 2021: cross-border data flows and development: for whom the data flow. Geneva: United Nations.

UNCTAD (2023). G20 members' regulations on cross-border data flows. Geneva: United Nations.

Ungphakorn, P. (2024). Getting to yes: what's behind the e-commerce standoff at the WTO? Hinrich Foundation.

von Lampe, M., K. Deconinck and V. Bastien (2016). Trade-related international regulatory co-operation: a theoretical framework. OECD Trade Policy Papers, No. 195. Paris: OECD.

Watanabe, S., Ema Ogura and Keita Oikawa (2025). Current status of ASEAN data governance and its implications for the Digital Economy Framework Agreement. ERIA Discussion Paper Series No. 539. Jakarta: Economic Research Institute for ASEAN and East Asia.

Wirjo, A., T. Q. Nguyen and S. Calizo (2022). Resiliency in a post-pandemic APEC: approaches to driving growth in digital services. Policy Brief No. 47, August 2022.

WTO (2024). Global trade outlook and statistics, April update. Geneva: World Trade Organization.

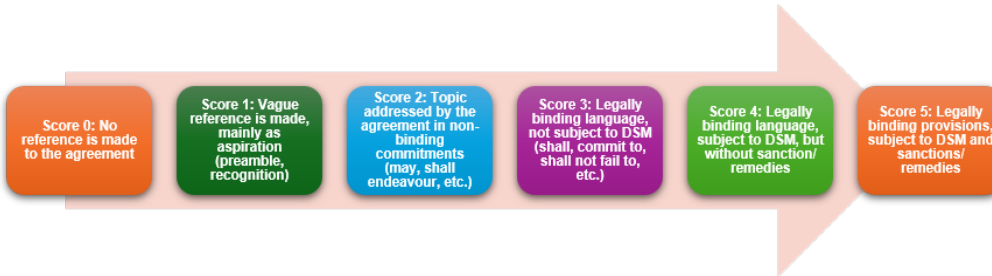
WTO (2024). Joint statement initiative on electronic commerce. INF/ECOM/87. Geneva: World Trade Organization.

WTO (2025). Digitally delivered services trade dataset. Geneva: World Trade Organization.

Yukawa, T. (2017). The ASEAN Way as a symbol: an analysis of discourses on the ASEAN norms. The Pacific Review, pp. 1–17.

TECHNICAL ANNEX

This annex assesses the depth (i.e., level of commitments) of provisions from the selected trade agreements, using the methodology developed by Baker (2021) to assign scores and arrive at the convergence/divergence degree. For illustrative purposes, examples from the examined Agreements are provided; where examples are not available, a suggestive text is provided.



Note. Where an article covers multiple commitments on the same policy areas, the enforceability of the most strongly worded commitment is taken.
Source: Baker (2021).

Score 0: No reference is made to the agreement. No reference in the text of the agreement.

Score 1: A Vague reference is made, mainly as an aspiration (preamble, recognition). Article 8.78 (Consumer protection) of the EU-Japan EPA only goes as far as "recognising the importance" of adopting and maintaining consumer protection measures and cooperation in this area. No definite commitments are made to ensure that Parties shall adopt and enforce such measures. Therefore, a score of 1 is assigned to this article.

EU-Japan EPA, Article 8.78 (Consumer protection)

The Parties recognise the importance of adopting and maintaining transparent and effective consumer protection measures applicable to electronic commerce, as well as measures conducive to the development of consumer confidence in electronic commerce.

The Parties recognise the importance of cooperation between their respective competent authorities in charge of consumer protection on activities related to electronic commerce in order to enhance consumer protection.

The Parties recognise the importance of adopting or maintaining measures, in accordance with their respective laws and regulations, to protect the personal data of electronic commerce users.

Score 2: Topic addressed by the agreement, but mainly in non-binding terms (may, shall endeavour). Article 8 (Digital Trade Standards and Conformity Assessment), AANZFTA (Update), has a combination of score-1 ("Parties recognise the important role […]") and score-2 ("Parties shall endeavour to […] and "Party shall, where appropriate, encourage [..]". Where an article has more than one provision with a different score for the level of commitment, the higher score will be assigned. Therefore, in this case, score-2 is assigned to the article.

AANZFTA (Update), Article 8 (Digital Trade Standards and Conformity Assessment)

The Parties recognise the important role of relevant international standards in reducing barriers to trade and fostering a well-functioning digital economy, including their potential to decrease trade compliance costs and increase interoperability, reliability, and efficiency.

Each Party shall, where appropriate, encourage the adoption of international standards that support digital trade.

The Parties shall endeavour to explore collaborative initiatives, share best practices, and exchange information on standards, technical regulations, and conformity assessment procedures in areas of mutual interest with a view to facilitating electronic commerce and digital trade.

Score 3: Legally binding language, not subject to DSM. Article 12.8 (Online Personal Information Protection) has a combination of weakly binding commitments (score-2) ("shall encourage", "shall take into account") and binding commitments ("shall adopt or maintain", "shall publish"). Therefore, a preliminary score of 3 is assigned for the whole article. Article 12.8, reading in combination with Article 12.17 (Settlement of Disputes), indicates that the Article is not subject to a dispute settlement mechanism (DSM). Therefore, a final score of 3 is assigned to the article.

RCEP Article 12.8: Online Personal Information Protection

Each Party shall adopt or maintain a legal framework that ensures the protection of personal information of the users of electronic commerce.

In the development of its legal framework for the protection of personal information, each Party shall take into account international standards, principles, guidelines, and criteria of relevant international organisations or bodies.

Each Party shall publish information on the personal information protection it provides to users of electronic commerce, including how: (a) individuals can pursue remedies; and (b) businesses can comply with any legal requirements.

The Parties shall encourage juridical persons to publish, including on the internet, their policies and procedures related to the protection of personal information.

The Parties shall cooperate, to the extent possible, for the protection of personal information transferred from a Party.

RCEP, Article 12.17: Settlement of Disputes

[…] 3. No Party shall have recourse to dispute settlement under Chapter 19 (Dispute Settlement) for any matter arising under this Chapter. […]

Score 4: Legally binding language, subject to DSM, but without sanction/ remedies. None of the analysed agreements has a score-4 provision, as the DSM in all analysed agreements leads to the suspension of concessions or other obligations in case of violation and non-compliance with the obligations made. Below provides an example of how different articles can be read together to qualify a commitment of score 4 - legally binding language for a specific policy area (Article 1), which is subject to DSM (Article 2), but the DSM process will only end up in the Panel's report being circulated, with no sanctions/ remedies will be available for Parties in case a violating party does not comply with the rulings made in the Panel's report.

Article [1] Cross-border Transfer of Information by Electronic Means

[…] A Party shall not prevent cross-border transfer of information by electronic means where such activity is for the conduct of the business of a covered person.

3. Nothing in this Article shall prevent a Party from adopting or maintaining: (a) any measure inconsistent with Paragraph 2 that it considers necessary to achieve a legitimate public policy objective, provided that the measure is not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on trade; or (b) any measure that it considers necessary for the protection of its essential security interests. Such measures shall not be disputed by other Parties.

Article [2] Dispute settlement

The provisions of Chapter [XX] (Dispute Settlement) of this Agreement shall apply mutatis mutandis to any dispute that arises between the Parties concerning the

interpretation and application of this Agreement.

Article [3] Panel of Experts

[…] The Panel of Experts shall issue the final report no later than 180 days after the date of its establishment, unless the Parties agree otherwise. This final report shall be made publicly available unless otherwise mutually decided. […]

Score 5: Legally binding provisions, subject to DSM and sanctions/ remedies. Below is an example of the combination of provisions that qualifies in a score-5 provision: legally binding commitment in a specific policy area (Article 11 FTA), combining with the adoption of DSM for dispute (Article 33 DTA, which link to Chapter 14 of the EU-Singapore FTA), which can lead up to suspension of concessions or other obligations as sanctions/ remedies in case the violating party fails to comply with arbitration ruling (Article 14.12 EU-Singapore FTA).

EU-Singapore DTA, Article 11 - Source code

1. Neither Party shall require the transfer of, or access to, the source code of software owned by a natural or juridical person of the other Party as a condition for the import, export, distribution, sale, or use of such software, or of products containing such software, in or from its territory.

EU-Singapore DTA, Article 33 – Dispute settlement

The provisions of Chapter Fourteen (Dispute Settlement) of the Free Trade Agreement shall apply mutatis mutandis to any dispute that arises between the Parties concerning the interpretation and application of this Agreement.

EU-Singapore FTA, Article 14.12 Temporary Remedies in Case of Non-compliance

[…] 2. If no agreement on compensation is reached within 30 days of the end of the reasonable period of time or within 30 days of the issuance of the ruling of the arbitration panel under Article 14.11 (Review of Any Measure Taken to Comply with the Arbitration Panel Ruling) that no measures were taken to comply with the ruling of the arbitration panel or that a measure taken to comply with that ruling is inconsistent with the provisions referred to in Article 14.2 (Scope), the complaining Party shall be entitled, upon notification to the other Party and to the Trade Committee, to suspend obligations arising from any provision referred to in Article 14.2 (Scope) at a level equivalent to the nullification or impairment caused by the violation. The notification shall specify the level of obligations that the complaining Party intends to suspend. The complaining Party may implement the suspension at any moment after the expiry of ten days after the date of receipt of the notification by the Party complained against, unless the Party complained against has requested arbitration under paragraph 3.

Finally, to arrive at the convergence/divergence degree, the following steps were adopted:

Step 1: Max score was assigned for each policy area (provision) in the analysed agreements by the EU and ASEAN, respectively. For example, for the Domestic Framework for Digital Trade, RCEP scores 3, and AANZFTA (Update) scores 5. The assigned score for ASEAN in the Domestic Framework is therefore 5.

Step 2: Use a combination of the sum and the spread (difference between the highest and the lowest scores) to assess the level of convergence or divergence in the analysed digital trade provisions. For each provision, we calculate (i) Total Score (Sum) to indicate overall commitment to the provision and (ii) Score Spread (Max minus Min) to reflect the gap between the two regional blocs in each policy area (provision).

The preliminary level of convergence/divergence is then assigned to each policy area (provision), using a simple logic to reward higher Total Score and lower Score Spread to indicate Higher Convergence.

Total Score (Sum) <=2: “No Convergence”

Total Score (Sum) <=5, Score Spread <=2: “Low Convergence”; else, “High Divergence”

Total Score (Sum) <=8, Score Spread <=2: “Partial Convergence”; else “Moderate Divergence”

Total Score (Sum) <=10, Score Spread <=2, “Strong Convergence”; else “Moderate Divergence”)

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

TRADE AGREEMENTS AND DIGITALLY DELIVERED SERVICES: THE VARIED EVIDENCE FROM EMERGING ASIA

Dr. Avik Ghosh

Email: avikghosh@rbi.org.in or avikghosh20@iitk.ac.in

This paper examines whether regional trade agreements with digital provisions accelerate digitally delivered service exports in emerging Asia. The study finds that such agreements significantly boost digitally delivered service exports, particularly in financial services, computer services, and intellectual property. However, these effects are highly conditional and concentrated in economies with stronger trade integration, sound external balance, and greater export dynamism. Results suggest that regional trade agreements act as accelerators rather than automatic drivers of digital trade. To enable broader participation in the digital economy, trade liberalization must be complemented by domestic regulatory alignment, digital infrastructure investment, and targeted capacity building.

Keywords: digitally delivered services, regional trade agreements, macroeconomic trade moderators, emerging Asian economies, staggered difference-in-differences

JEL classification: F13, F14, F63, C21, C23

I. INTRODUCTION

The proliferation of digital technologies has fundamentally transformed global trade, redefining how services are produced, delivered, and consumed. Digitally delivered services (DDS)—telecommunications, financial services, and computer services—are a critical component of international commerce, particularly in emerging and developing economies (López González and Jouanjean, 2020). Unlike traditional trade in goods, DDS bypasses many physical barriers, enabling countries to export services through cross-border data flows, cloud infrastructure, and online platforms. This digital shift has created new avenues for economic growth and structural transformation, particularly for emerging Asian economies seeking to diversify beyond manufacturing. The COVID-19 pandemic has accelerated the shift toward digital service delivery, intensifying the Baldwin need for modernized trade governance to facilitate cross-border digital transactions (Baldwin and Evenett, 2020).

In parallel, regional trade agreements (RTAs) have evolved to address the demands of a digitalizing global economy. Increasingly, RTAs incorporate explicit digital trade provisions that go beyond tariff reduction to include regulations on cross-border data flows, e-commerce facilitation, digital taxation, e-signatures, and fintech interoperability (Burri, 2021). Agreements like the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), the Regional Comprehensive Economic Partnership, and numerous bilateral RTAs now embed digital chapters aimed at creating common frameworks for digital transactions. Countries across Asia are actively aligning their trade policies with digital economy considerations, recognizing that RTAs can serve as both market access instruments and regulatory benchmarks for digital trade governance (Bacchetta, Beverelli and Cadot, 2022). This shift has profound implications for emerging economies that are integrating digital trade clauses into regional and bilateral trade agreements to accelerate their entry into global digital value chains.

Despite this policy momentum, empirical research on the actual impact of RTAs on digitally delivered services remains limited. Most existing studies focus on aggregate trade effects or e-commerce outcomes, often neglecting the component-level dynamics of DDS, such as the differential impacts on financial services, intellectual property, or telecommunications (Monteiro and Teh, 2017). Moreover, the literature has yet to systematically explore how macro-trade fundamentals, such as services trade integration, export and import capabilities, and external balances, condition the effectiveness of RTAs in promoting DDS growth. Without this understanding, policymakers risk overestimating the uniform benefits of digital RTAs, potentially overlooking the role of domestic readiness and trade structure in shaping outcomes.

This paper addresses this gap by framing the analysis around two theoretical pillars. First, the Institutional Complementarity Framework (Aghion, Antonin and Bunel, 2019)

suggests that trade agreements act as catalysts for growth only when aligned with complementary domestic institutions. In DDS context, RTAs provide the legal and regulatory infrastructure for digital trade, but their effectiveness depends on alignment with domestic capabilities, including digital infrastructure, regulatory readiness, and trade openness. Without this alignment, RTAs may fail to deliver their intended benefits, particularly in service sectors that are sensitive to cross-border standards and data governance (Heuser and Mattoo, 2017). Second, the paper draws from the New Trade Theory with Network Goods (Melitz and Redding, 2014), where digital services, characterized by high scalability and low marginal costs, exhibit network effects that amplify trade gains when economies achieve scale and integration. This framework implies that countries with higher services trade volumes, better export capacities, and open import regimes are structurally better positioned to convert RTA commitments into DDS growth. It also explains why countries with limited trade integration may see muted impacts from digital RTAs, even when legal commitments are in place (Chen and Nordås, 2021).

By examining how digital trade provisions in RTAs accelerate digitally delivered services, the paper addresses emerging Asia's urgent challenge to achieve inclusive, technology-enabled economic diversification. The paper thus contributes directly to the to the attainment of Sustainable Development Goal (SDG) 8 (decent work and economic growth) and SDG 9 (industry, innovation, and infrastructure). DDS exports offer a scalable pathway for countries to participate in global value chains without heavy capital infrastructure, creating employment in high-skill sectors and enabling structural transformation.

However, conditional findings reveal that digital RTAs alone are insufficient—they must be paired with investments in digital infrastructure, skills development, and institutional capacity to broaden participation beyond coastal hubs and large exporters. By identifying these enabling conditions, the study emphasizes that accelerating digital trade must be aligned with domestic capability building to ensure equitable access to opportunities. This framing situates digital trade not merely as a driver of export growth, but also as a policy instrument for inclusive development, ensuring digital trade integration translates into broad-based prosperity and reduced regional inequality, as well as resilient diversification within and across emerging Asian economies. This is the core objective underpinning the SDG agenda.

Building on these theoretical foundations, the paper empirically investigates the role of RTAs in promoting DDS across 15 emerging Asian economies from 2005 to 2024. The research advances the literature in four significant ways. First, it disaggregates DDS into nine EBOPS-based subcomponents,[1] allowing for sector-specific analysis

[1] EBOPS refers to Extended Balance of Payments Services Classification, an international statistical framework of detailed categories for recording trade in services within the balance of payments.

of how RTAs influence financial services, intellectual property, computer services, and other digitally traded sectors (Miroudot, 2019). This sectoral focus captures the differentiated channels through which digital trade provisions impact service exports.

Second, the study integrates macro-trade moderators into the analysis, including trade in services, export volume index, import volume index, and external balances. This framework allows testing of the conditional effectiveness of RTAs, recognizing that their impact is amplified when broader trade conditions are favourable (Antràs and Staiger, 2012). By embedding DDS in a wider macro-trade context, the paper identifies the enabling conditions that determine whether RTAs serve as accelerators or remain dormant legal instruments. Third, the paper conducts an in-depth heterogeneity analysis across country groups and trade conditions. By comparing the Association of Southeast Asian Nations (ASEAN), South Asian Association for Regional Cooperation (SAARC), and other regional clusters, the study reveals distributive disparities in DDS gains from RTAs. Economies like the People's Republic of China, Malaysia, and Viet Nam—characterized by higher trade openness and digital capacity—derive significant benefits from RTAs, while Nepal, Myanmar, and Bangladesh experience limited gains due to structural bottlenecks. This cross-country perspective aligns with recent calls in the literature for context-sensitive trade policy analysis (Fernandes et al., 2020). Fourth, the empirical strategy employs a robust suite of methods, including fixed effects models, instrumental variables, interaction analysis, quantile regressions, and the Callaway and Sant'Anna (2021) difference-in-differences estimator. These approaches account for treatment timing heterogeneity and enable causal inference, providing a comprehensive picture of how RTAs affect DDS in varied trade and policy contexts.

The results confirm that RTAs with digital provisions substantially enhance DDS exports, especially in high-value sectors like financial services, computer services, and intellectual property. However, the effect is conditional, not uniform, across economies, sectors, and trade environments. Economies with robust trade integration and supportive macroeconomic conditions realize greater DDS gains, while those with structural weaknesses experience attenuated impacts. This research bridges theoretical frameworks and empirical analysis, linking the institutional and network-based drivers of digital trade with actionable policy insights. It provides policymakers with evidence-based guidance on how to design RTAs, align domestic policies, and build digital capacities to maximize the benefits of digital trade integration in Asia and the Pacific.

II. LITERATURE REVIEW

This literature review frames the research motivation in three interlinked themes: (a) empirical findings on the rise of digitally delivered services (DDS) in trade; (b) the role of RTA in shaping digital trade flows; and (c) the conditional, moderated, and

heterogeneous effects of RTAs on DDS, particularly in emerging Asia. This structure supports a clear progression from global evidence to the specific research gaps the paper addresses.

Empirical Evidence on the Rise of Digitally Delivered Services. A growing empirical literature highlights the expansion of DDS globally but underscores substantial asymmetries in participation and outcomes. According to the World Trade Organization (WTO, 2024), DDS now accounts for over 50% of global services trade, but developed economies dominate high-value segments such as intellectual property licensing, financial services, and IT-based exports. This pattern reflects what Baldwin (2016) calls the third unbundling, the real-time separation of services production and delivery via digital platforms, reducing the need for geographic proximity. The Knowledge-Capital Model of Trade in Services (Markusen, 2005) provides a theoretical lens to understand this asymmetry.[2] It emphasizes that countries exporting services require both knowledge assets (e.g., human capital, intellectual property) and digital infrastructure. Empirically, Freund and Weinhold (2004) show that a 10% increase in internet penetration boosts service exports by about 1%, but this relationship is strongest in economies already embedded in global services trade.

Avdjiev et al. (2020) introduce a cross-border services trade dataset that confirms these patterns: developed countries have leveraged DDS to expand their share in global services trade, while many developing countries remain marginal players. For Asia, Fernandes et al. (2020) identify significant heterogeneity: India and the Philippines are global leaders in IT-enabled services, but other Asian economies lag due to weak regulatory capacity, limited digital infrastructure, and gaps in digital skills. At the sectoral level, Borchert, Gootiiz and Mattoo (2014) find high policy barriers in services sectors such as finance and telecommunications, reinforcing the notion that digital connectivity alone is insufficient. Lanz and Maurer (2015) further argue that prior global value chain participation and trade openness amplify the benefits of digital services expansion. This aligns with the Global Value Chain Integration Theory, where firms in digitally intensive sectors benefit more from trade liberisation due to scalability and network effects (Taglioni and Winkler, 2016). However, much of the DDS literature aggregates digital services into a single category, overlooking intra-sectoral variations. The lack of component-level analysis restricts policy insights, especially for countries seeking to diversify beyond traditional outsourcing into higher-value digital services.

Regional Trade Agreements and Digital Trade Provisions. A parallel strand of literature focuses on how RTAs increasingly govern digital trade. Monteiro and Teh

[2] It explains trade and investment patterns by combining firm-level knowledge assets with capital-intensive production, allowing multinational firms to serve foreign markets via both exports and local subsidiaries.

(2017) document that, since the early 2000s, RTAs have incorporated digital chapters addressing e-commerce facilitation, cross-border data transfers, cybersecurity, and digital payments. Their analysis shows that RTAs with digital provisions correlate with higher digital services trade, but sector-specific impacts remain unexamined. The theoretical underpinning here is the Deep Integration Theory of Trade Agreements (Lawrence 1996), which posits that modern trade agreements extend beyond tariffs to address behind-the-border issues like standards, regulations, and digital protocols. Heuser and Mattoo (2017) argue that digital RTAs reduce regulatory uncertainty, fostering investment and trade in intangible assets. Ferracane and van der Marel (2020) provide empirical evidence that restrictive data policies suppress digital trade, while liberal RTAs that prohibit data localization facilitate cross-border services exports. This is consistent with Transaction Cost Economics[3] (Williamson, 1985), where reducing informational friction and regulatory barriers lowers cost-of-service provision across borders.

Globally, agreements such as the CPTPP and United States-Mexico-Canada Agreement have set new standards for digital trade governance (Burri, 2021). However, Liu and Woo (2018) note that emerging economies often face challenges in implementing digital RTAs due to weak regulatory infrastructure, leading to incomplete realization of potential gains. In Asia, Chen and Nordås (2021) find that ASEAN and the Regional Comprehensive Economic Partnership include digital trade provisions but with weaker enforcement mechanisms compared to Western RTAs. While the ASEAN Digital Integration Framework exists,[4] institutional bottlenecks slow actual harmonization of rules. Moreover, most studies evaluate digital trade in aggregate, ignoring sector-specific effects, which is problematic given the unique regulatory environments of services like finance, telecom, and intellectual property (Miroudot, 2019).

Moderated and Heterogeneous Effects of RTAs on DDS Expansion. While RTAs are expanding globally, their impact on DDS is not uniform and depends heavily on a country's structural readiness. The Institutional Complementarity Hypothesis (Aghion Antonin and Bunel, 2019) suggests that the gains from trade agreements materialize only when supported by complementary domestic institutions, such as robust data governance, skilled labour, and trade infrastructure. Rodrik (2018) cautions that without such alignment, trade liberisation may exacerbate inequalities rather than promote broad-based growth. Freund et al. (2021) empirically show that "deep" RTAs enhance services trade, but the magnitude of gains is conditional on initial services

[3] Transaction cost economics posits that firms organize transactions internally or via markets based on minimizing the costs of exchange, including search, negotiation, and enforcement (Williamson, 1985).

[4] A strategic regional blueprint guiding ASEAN member states to coordinate on digital infrastructure; data governance; seamless trade; payments; talent; micro, small, and medium-sized business inclusion; and institutional collaboration to achieve a cohesive and competitive digital economy.

trade integration and domestic regulation. Beverelli, Neumueller, and Teh (2015) extend this by demonstrating that services trade liberisation has stronger effects in countries with competitive domestic services markets and high trade openness.

The New Economic Geography of Digital Trade (Duranton and Puga, 2004) suggests that digital services are subject to agglomeration effects, where benefits concentrate in countries with pre-existing advantages in infrastructure and skills.[5] Melitz and Redding (2014) further argue that heterogeneity in firm and country capabilities leads to varied trade responses to liberisation, especially in network-based goods and services. For emerging Asia, Ahmed and Zlate (2014) show that external imbalances and financial volatility can hinder trade integration, limiting the gains from RTAs. Mulabdic, Ruta and Osnago (2017) find that the effectiveness of RTAs varies based on a country's export competitiveness and macroeconomic conditions, but this has not been tested explicitly for digital trade or DDS.

Moreover, traditional evaluations focus on average treatment effects, ignoring distributional dynamics. Recent methodological advances in heterogeneous treatment effects estimation (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021) highlight the importance of analysing how policy interventions like RTAs produce varied effects across sectors, countries, and time periods. Yet, few studies apply this approach to digital trade, leaving a significant empirical gap. Most studies treat digital trade as a single aggregate category, failing to account for sectoral variation in response to RTAs. Additionally, little empirical work looks at how macroeconomic trade conditions shape the effectiveness of RTAs in promoting DDS growth, particularly in emerging Asia. Heterogeneous impacts across economies and DDS sub-sectors remain underexplored, leaving policymakers with an incomplete understanding of when and how RTAs translate into digital trade expansion. This paper addresses these gaps by explicitly modelling DDS at the component level, integrating broader trade moderators, and applying heterogeneous treatment effect analysis. It seeks to answer four research questions:

i. Do RTAs with digital provisions significantly influence the growth of DDS in emerging Asian economies?

ii. How do the effects of RTAs vary across DDS subcomponents?

iii. What role do trade-related moderators play in conditioning RTA impacts?

iv. How do these effects differ across regional groups, reflecting varying levels of digital and trade readiness?

[5] It examines how digital technologies reshape trade patterns by reducing distance-related costs, enabling market concentration in digital hubs while expanding remote service delivery.

III. DATA AND VARIABLES

This study investigates the impact of RTAs with digital trade provisions on the growth and composition of DDS across 15 major emerging Asian economies during 2005–2024. The countries are selected based on their trade volume rankings in Asia and include India, China, Viet Nam, Malaysia, Thailand, Indonesia, Philippines, Myanmar, Cambodia, Kazakhstan, Pakistan, Bangladesh, Sri Lanka, Nepal, and Uzbekistan.[6] The selection reflects geographic and economic diversity, representing ASEAN, SAARC, and Eurasian blocs.

The primary outcome variable, DDS, is obtained from the WTO Trade in Services Database. DDS represents service exports delivered over ICT networks and includes a spectrum of digitally traded services such as business, financial, telecommunications, and computer services.[7] Total DDS data (in US dollar millions) are disaggregated into nine key subcategories aligned with the Extended Balance of Payments Services (EBOPS 2010) classification.[8] These include insurance and pension services, financial services, charges for the use of intellectual property, telecommunications services, computer services, information services, other business services, and personal, cultural, and recreational services.

To operationalize the policy intervention, a country-level indicator of RTA implementation was constructed. The RTA dummy variable takes the value 0 for all years prior to the watershed moment of RTA implementation and 1 thereafter.

These watershed years, in Table 1, are derived through manual review of bilateral and regional trade agreements, WTO notifications, national trade ministry archives, and digital trade policy briefs. Each RTA selected for this study contains explicit provisions on digital trade, e-commerce facilitation, cybersecurity, fintech, data governance, or digital payments, making them relevant to the core research question. The key explanatory variable in the baseline analysis is thus the RTA dummy, representing the onset of enforceable digital trade architecture. Not all countries in the sample implemented such RTAs during the period—Bangladesh, Sri Lanka, Nepal, and Uzbekistan— had no binding RTAs with digital clauses during this timeframe, thus serving as never-treated comparators in the empirical strategy. Appendix Table A.1

---

[6] Trade volume rankings refer to the comparative measurement of countries' total exports and imports of goods and services, used to assess their relative position in global trade flows.

[7] The WTO Trade in Services Database reports DDS at the reporting-economy level (aggregate exports by country-year) and does not provide partner-country dyads for DDS. Consequently, the empirical design is not a bilateral gravity specification; instead, identification exploits within-country time variation in DDS around the adoption of RTAs with digital provisions, supported by country and year fixed effects and complementary robustness strategies.

[8] For information, see https://unstats.un.org/unsd/tradeserv/TFSITS/msits2010/docs/MSITS%202010%20M86_web.pdf.

shows each country's mean DDS and top global DDS partner, linking these to the main trade agreements and events with key digital trade provisions.

Table 1. Classification of Digital Trade Provisions in RTAs, by Country

Country and Watershed Year	Trade Agreement/Event	Key Digital Trade Provisions/Significance
India 2015	a) U.S.-India Joint Statement: launch of ICT Working Group and Digital India cooperation (Jan 2015) b) U.S.-India Cyber Dialogue (Aug 2015) c) India-ASEAN Services Agreement, India–Singapore CECA	US-India track created a standing channel on e-commerce, data security, cyber norms, incident response, and digital-economy facilitation for IT/ITES exports; paved the way for mutual recognition of e-authentication, privacy and law-enforcement cooperation.
China, People's Rep. of 2015	a) U.S.-China Cyber Commitments (Sept 2015) b) Digital Silk Road - Belt and Road Digital MOUs	Government-level pledge against cyber-enabled IP theft; launches a working mechanism on cybercrime cooperation- foundational to digital-trade trust signals with China's top DDS market.
Malaysia 2018	a) MAS–Bank Negara Malaysia MoU/cooperation (2018) incl. payments innovation and cyber resilience. b) SG–MY real-time/QR payment linkages c) CPTPP	With Singapore (top DDS partner): regulatory/FinTech cooperation, e-payments interoperability, and live cross-border QR/instant payments that reduce frictions for services trade. (Monetary Authority of Singapore, ACI Worldwide, Bank Negara Malaysia)
Viet Nam 2018	a) ACFTA Upgrade (signed 2015; in force for all by 2018) incl. consumer protection and trade facilitation affecting e-commerce with China b) DSR/E-commerce cooperation MOUs referencing VN participation c) CPTPP	With China, stronger consumer-protection rules and facilitation under ACFTA; bilateral e-commerce/DSR cooperation channels support platform trade and digital connectivity. (ASEAN Main Portal, Ewa Direct)
Kazakhstan 2018	EAEU Digital Agenda to 2025 (2018, with Russia) - SEEC Decision No. 12 (2018) and subsequent roll-out	With Russia, union-wide digital customs/transit, electronic document flows, and platform projects supporting cross-border services.
Philippines 2019	a) U.S.-Philippines Trade and Investment Framework Agreement (TIFA) mechanism (2018–19) b) Regular TIFA workplans/meetings on IP, digital policy, and trade facilitation c) ASEAN E-commerce Agreement	TIFA is the formal U.S.-PH platform that advances IP, digital-economy, and standards issues; used to clear bilateral barriers that directly affect DDS. (philippineembassy-dc.org, United States Trade Representative)

Country and Watershed Year	Trade Agreement/Event	Key Digital Trade Provisions/Significance
Thailand 2019	a) Thailand "Smart Digital Hub" and e-trade enablement in the EEC (2018–2019) b) Digital trade hub rollout c) ASEAN E-commerce Agreement	With China, logistics digitisation, SME e-commerce onboarding, paperless fulfilment, and cross-border platform integration supporting Thai DDS exporters into China.
Indonesia 2019	a) BI–MAS expanded cooperation on regulation and payments innovation (2019) b) SG-ID MOUs on Digital Economy/Digital Transformation (2018–19) c) ASEAN E-commerce Agreement	With Singapore, central-bank and government-level frameworks enabling cross-border payments, data-governance cooperation, and digital-talent/startup collaboration that underpin DDS growth. (Monetary Authority of Singapore)
Pakistan 2019	a) U.S.-Pakistan TIFA Council (2019 adoption) b) Pakistan E-commerce Policy (2019). 2) Pakistan–China FTA Phase II	With United States, TIFA workplans on IP and entrepreneurship; national e-commerce policy modernises payments, consumer protection and logistics- enabling exportable digital services (United States Trade Representative, ESCAP)
Myanmar 2019	a) China–Myanmar Economic Corridor (CMEC) MOU (2018–19) b) 33 China-Myanmar agreements incl. infrastructure and cooperation (Jan 2020) c) ASEAN E-commerce Agreement	With China, CMEC/BRI program includes "digital silk road" cooperation, cross-border e-commerce facilitation, and connectivity that underpin DDS.
Cambodia 2019	a) China-Cambodia FTA negotiations launched (Dec 2019 feasibility; Jan 2020 Round 1) with e-commerce chapter. b) ASEAN E-commerce Agreement	With China, bilateral FTA includes an e-commerce chapter; establishes rules and cooperation that facilitate digital trade and services.
Bangladesh	None	No binding RTA or protocol covering digital trade during the period.
Sri Lanka	None	No major RTA with digital chapters in this period.
Nepal	None	Digital trade not covered in bilateral/regional agreements.
Uzbekistan	None (joined EAEU dialogue post-2019)	No binding RTA or protocol covering digital trade during the period.

Source: Author's compilation.

The control variables used in the empirical models include gross domestic product (GDP) growth (per cent annual), foreign direct investment inflows (as per cent of GDP), employment in services (as a per cent of total employment), and gross savings (as a per cent of GNI), all sourced from the World Bank's World Development Indicators database (World Bank, 2024). GDP growth is included to capture the cyclical and structural drivers of macroeconomic performance influencing digital investment behaviour (Rodrik, 2013). Foreign direct investment inflows are considered to represent external investment in digital infrastructure and services (Alfaro et al. 2004). Employment in services is a critical labour market determinant of a country's digital absorptive capacity (Eichengreen and Gupta, 2013). Gross savings is included to control for the internal capacity of economies to finance transitions towards a service-based or digital-oriented trade structure (Aghion et al., 2005).

To explore whether the effectiveness of RTAs in promoting DDS depends on existing trade fundamentals, four trade-related variables are included as moderators and interaction terms. First, trade in services (per cent of GDP) captures the baseline integration of economies into global service markets, which facilitates quicker uptake of digital exports under favourable policy regimes (López González and Jouanjean, 2017). Second, the Export Volume Index reflects the dynamism and competitiveness of outbound trade, which correlates with higher DDS potential due to scale economies in digital services (Freund and Weinhold, 2004). Third, the Import Volume Index serves as a proxy for external digital demand and trade openness- countries more open to imports tend to exhibit greater reciprocal flows in digitally deliverable sectors (Baldwin, 2016). Finally, the external balance of goods and services (current account balance, per cent of GDP) captures macroeconomic space available to fund digital infrastructure, innovation, and service trade expansion, as established in the trade-development literature (Rodrik, 2006; Aizenman, Jinjarak and Park, 2011). Each of these interaction variables is collected from the World Development Indicators database.

To estimate the change in DDS before and after RTA implementation, this study deploys a standardized within-country transformation[9] of DDS values. For each country, values are normalized over time using the formula $Z_{it}=(DDS_{it} - \mu_i)/\sigma_i$, where Z_{it} is the standardized value of DDS in year t for country i, μ_i is the country-specific mean of DDS, and σ_i is the standard deviation.

This z-score transformation enables comparison across countries with varying economic sizes and service export bases by creating a time-adjusted trajectory of DDS growth. Subsequently, the time-adjusted mean was computed for both pre- and post-RTA periods and a paired t-test done to check the statistical significance of the

[9] It adjusts variables by removing country-specific means and scaling by country-specific standard deviations. This method controls for cross-country heterogeneity, allowing meaningful comparison of variable dynamics within panel data.

difference. The results, in Table 2, reveal a substantial and statistically significant increase in DDS following RTA implementation. The time-adjusted mean for total DDS post-RTA is 0.975 compared to -0.337 pre-RTA, with a t-statistic of 11.261 and a p-value < 0.001.

A similar trend is observed across all subcomponents, with computer services, other business services, and intellectual property charges displaying the highest gains. These statistical results are consistent with the visual patterns observed in Figure A.1 (Appendix), which shows clear upward shifts in DDS trajectories around the time of RTA adoption for several countries. Figure A.2 (Appendix) illustrates the distribution of key DDS across the countries, comparing periods with and without RTAs containing digital provisions, and interprets that in most cases, countries with digital-focused RTAs exhibit higher median values and wider dispersion in digital service trade, suggesting a potential positive association between RTAs and digital trade expansion.

Table 2. Paired t-Test Results for DDS Before and After RTA Implementation

Variable	Time-adjusted Mean after RTA	Time-adjusted Mean before RTA	T-Statistic	P-Value
Total DDS	0.975	-0.337	11.261	4.28E-20
Insurance and pension services	0.650	-0.224	7.450	9.89E-12
Financial services	0.604	-0.209	6.741	4.46E-10
Charges for the use of intellectual property	0.645	-0.223	7.064	9.84E-11
Telecommunications services	0.459	-0.159	4.754	5.50E-06
Computer services	0.960	-0.332	10.567	3.08E-18
Information services	0.462	-0.172	3.974	1.44E-04
Other business services	0.935	-0.323	11.659	6.20E-22
Personal, cultural, and recreational services	0.739	-0.255	8.100	5.23E-13

Source: Author's calculation.

IV. EMPIRICAL STRATEGY

This section outlines the econometric approaches adopted to estimate the effects of RTAs with digital trade provisions on DDS across emerging Asian economies. This was conducted in four stages: (a) estimating a baseline fixed effects model with

instrumental variable (IV) technique for robustness check; (b) examining interaction effects with trade-related moderators; (c) applying a flexible difference-in-differences approach using the group-time average treatment effect estimator; and (d) conducting quantile regression to assess distributional heterogeneity.

Baseline Estimation and Instrumental Variable Strategy. The econometric strategy begins with a two-way fixed effects model to estimate the average treatment effect of RTAs on DDS while controlling for time-invariant country characteristics and global year shocks:

$$DDS_{it} = \theta + \beta RTA_{it} + \varphi X_{it} + \alpha_i + \mu_t + \varepsilon_{it} \quad (1)$$

Where DDS_{it} denotes total digitally delivered services for country i in year t. RTA_{it} is the RTA treatment dummy; X_{it} includes time-varying controls such as GDP growth, foreign direct investment inflows, employment in services, and gross savings. α_i and μ_t capture country and time fixed effects, and ε_{it} is the error term. Similar equations were employed for all the subcomponents of DDS to ascertain component-level heterogeneity at the granular level.

A central empirical concern is omitted-variable bias from time-varying determinants of DDS that may coincide with RTA adoption (e.g., domestic digital-infrastructure upgrades, regulatory reforms, platform diffusion, and changes in services-sector capabilities). The baseline specification mitigates these concerns by absorbing time-invariant cross-country differences through country fixed effects, common global shocks through year fixed effects, and key macro-structural drivers via time-varying controls. The instrumental-variable strategy further treats RTA adoption as endogenous to unobserved digital readiness, strengthening causal interpretation by purging residual simultaneity.

To address potential endogeneity of RTA implementation (e.g., countries with stronger digital trade readiness may self-select into RTAs), an instrumental variable approach was applied using two-stage least squares. Following Baier and Bergstrand (2007), it instruments RTA_{it} using trade as a percentage of GDP (TRD), Export Value Index (EXPVI), Import Value Index (IMPVI), and current account balance (CAB):

$$\text{First-stage: } RTA_{it} = \theta + \beta_1 TRD_{it} + \beta_2 EXPVI_{it} + \beta_3 IMPVI_{it} + \beta_4 CAB_{it} + \varphi X_{it} + \varepsilon_{it} \quad (2)$$

$$\text{Second Stage: } DDS_{it} = \theta + \psi RTA_{it} + \varphi X_{it} + \alpha_i + \mu_t + \varepsilon_{it} \quad (3)$$

This strategy mitigates simultaneity and omits variable bias, enhancing the causal interpretation of ψ.

Interaction with Trade-Related Moderators. To explore heterogeneous effects of RTAs conditional on trade fundamentals, it incorporates four moderators: trade in services (TRDS), Export Volume Index (EXPVI), Import Volume Index (IMPVI), and external balance on goods and services (CAB):

$$DDS_{it} = \theta + \beta_1 RTA_{it} + \beta_2 RTA_{it} * M_{it} + \varphi X_{it} + \alpha_i + \mu_t + \varepsilon_{it} \quad (4)$$

Where M_{it} denotes each moderator in separate specifications. The coefficient captures the marginal effect of RTA contingent upon the level of trade integration or macroeconomic space. This aligns with the theoretical premise that digitally inclined RTAs translate more effectively into DDS expansion when countries are structurally predisposed to service-led trade (Freund and Weinhold, 2004; Lopez Gonzalez and Jouanjean, 2017).

Robustness Using Group-Time Average Treatment Effects. Given staggered adoption of RTAs across countries, the standard two-way fixed effects estimator may suffer from treatment effect heterogeneity bias (Goodman-Bacon, 2021). This study therefore employs the group-time average treatment effect (ATT) estimator developed by Callaway and Sant'Anna (2021):

$$ATT(g,T) = E[Y_t(1) - Y_t(0) \mid G=g] \quad (5)$$

Here, g denotes the group of countries treated in year g, and t is the year of observation. This estimator allows for dynamic effects, multiple treatment periods, and controls for anticipatory behavior by using not-yet-treated or never-treated units as valid controls. The estimator is implemented using inverse probability weighting and regression adjustment, enhancing the credibility of causal inference when comparing treatment and control groups with varying treatment timing.

A related concern is anticipatory policy selection: economies may enter digitally oriented RTAs when DDS is already on an upward trajectory. The group-time ATT framework is particularly useful in this setting because it accommodates staggered adoption and enables diagnostic checks based on event-time dynamics (e.g., treatment leads) to assess whether DDS systematically rises prior to the watershed year.

Quantile Regression for Distributional Heterogeneity. To assess whether the impact of RTAs varies across the DDS distribution, quantile regression models was applied of the form:

$$DDS_{it} = \alpha + \beta_1 RTA_{it} + \gamma^{\tau} X_{it} + \varepsilon_{it}^{\tau} \quad (6)$$

DDS_{it} is the τ^{th} conditional quantile of the DDS. β_1 are estimated for each decile and are the coefficients of interest. This approach captures non-uniform effects along the distribution, revealing whether countries at higher or lower levels of digital services trade benefit differently. Furthermore, this study repeats the quantile regressions by splitting the sample based on moderator thresholds (e.g., TRDS above vs. below mean) to investigate conditional heterogeneity. This enables us to understand not only "whether" but also "where" policy effectiveness materializes, adding granular nuance to our findings.

Together, these complementary empirical strategies provide a rigorous identification framework to evaluate the digital trade-enhancing effects of RTAs across heterogeneous policy and structural environments in Asia's emerging economies.

V. RESULTS AND DISCUSSION

The results are presented in four analytically structured sub-sections: the first assesses the overall impact of RTAs with digital provisions on total DDS; the second investigates the effects of RTAs on individual DDS subcomponents; the third evaluates how trade-related fundamentals condition the RTA-DDS relationship; and the fourth examines distributional heterogeneity across countries and moderator thresholds.

Impact of RTAs on Total Digitally Delivered Services. The estimation results, in Table 3, reveal a consistently strong and statistically significant positive relationship between RTAs with digital trade provisions and the growth of total DDS. Across all four specifications, the RTA coefficient remains positive and significant at the 1% level, affirming the central hypothesis of the study. In the baseline fixed effects model without any controls (model 1), the RTA coefficient is 0.9540 ($p < 0.01$), suggesting a near one standard deviation increase in standardized DDS following RTA implementation. This effect size, although reduced with the inclusion of control variables, remains robust in magnitude and statistical significance in model 2 (0.4545), model 3 (0.2547), and the instrumental variable specification in model 4 (0.6143).

The consistent statistical strength and directional stability of the RTA coefficient across these model variants support a causal interpretation: digitally focused RTAs act as institutional catalysts for expanding digitally delivered services exports. The persistence of effect after controlling for time-invariant country heterogeneity and global shocks indicates that RTAs offer more than symbolic commitments—they operationalize trade-facilitating norms that reduce information frictions, harmonize digital standards, and enhance mutual regulatory recognition (Ferencz, 2019). These institutional mechanisms are particularly salient for services trade, where regulatory opacity and cross-border compatibility often constitute greater barriers than tariffs or logistics (Mattoo, Rocha and Ruta, 2020).

The instrumental variable approach in model 4 strengthens this interpretation. The RTA coefficient, estimated at 0.6143, remains significant despite the attenuation bias common in IV regressions, and the associated diagnostics (Wu-Hausman F = 14.03, First-stage F = 8.196) confirm the validity and strength of the instruments. These findings align with theoretical expectations from the literature on rule-based liberisation, which emphasizes that enforceable and targeted trade commitments, such as digital chapters in RTAs, reduce uncertainty and thereby stimulate private sector response in intangible trade sectors (Hoekman and Mattoo, 2011; Baldwin, 2016). Notably, these effects are observed in a group of emerging economies with varying degrees of digital readiness, suggesting that the introduction of digital clauses in RTAs

may serve as a levelling mechanism for smaller or less advanced service exporters. This also resonates with the argument that legal-institutional quality embedded in international agreements can offset domestic institutional deficiencies, especially in the domain of complex service transactions (Rodrik, 2018a; Horn, Mavroidis and Sapir, 2010).

Table 3. Regression Results for the Impact of RTAs on Total DDS

	Model 1 Total DDS	Model 2 Total DDS	Model 3 Total DDS	Model 4 Total DDS
Regional trade agreement	0.9540***	0.4545***	0.2547***	0.6143***
	(0.083)	(0.106)	(0.096)	(0.230)
GDP (annual % growth)		-0.0043	0.0007	0.0046
		(0.012)	(0.011)	(0.011)
Foreign direct investment, net inflows (% of GDP)		0.0036	0.0312	0.0342*
		(0.023)	(0.020)	(0.020)
Employment in services (% of total employment)		0.0682***	0.1016***	0.0761***
		(0.011)	(0.011)	(0.019)
Gross savings (% of GNI)		0.0018	-0.0068	-0.0035
		(0.008)	(0.007)	(0.007)
constant	7.3714***	4.7190***	3.5502***	3.8343***
	(0.040)	(0.571)	(0.513)	(0.689)
Estimation Method	Fixed Effect	Pooled OLS	Fixed Effect	Instrumental Variable
Control Variables	NO	YES	YES	YES
Instrumented Variable	NA	NA	NA	RTA
Time Fixed Effect	NO	NO	YES	YES
Wu-Hausman F				14.03***
First-stage regression F				8.196***
Hausman test	99.01***		88.761***	
Modified wald test for heteroskedasticity (χ-sq)	101.75***		91.01***	
R-sqr	0.317	0.470	0.490	
Obs	300	300	300	300
				* p<0.10, ** p<0.05, *** p<0.010
Model 1 is the baseline two-way fixed effects strategy without control variables, model 2 is pooled OLS with control variables, model 3 is two-way fixed effects with control variables, and model 4 is the instrumental variable technique.				

Source: Author's calculation.

Impact of RTAs on Various Components of Digitally Delivered Services. Table 4 presents the disaggregated fixed effects estimation results for the impact of RTAs across eight subcomponents of DDS, and the results highlight considerable heterogeneity in the strength and significance of the RTA effects.

Table 4. Sectoral Analysis of RTA Impact on DDS Subcategories

	Insurance and Pension	Use of Intellectual Property	Financial Services	Telecom Services	Computer Services	Info Services	Other Services	Personal / Cultural/ Recreational Services
Regional trade agreement	0.305*	0.639***	0.975***	0.308**	0.572***	0.260***	0.409***	0.850***
	(0.158)	(0.239)	(0.210)	(0.134)	(0.191)	(0.042)	(0.119)	(0.220)
GDP (annual % of growth)	-0.010	0.001	-0.024	0.004	-0.017	0.017	0.027**	0.034
	(0.018)	(0.030)	(0.029)	(0.017)	(0.022)	(0.029)	(0.013)	(0.027)
Foreign direct investment, net inflows (% of GDP)	0.046	0.007	-0.099**	-0.038	-0.009	0.096*	0.047*	-0.035
	(0.033)	(0.059)	(0.045)	(0.029)	(0.043)	(0.051)	(0.025)	(0.046)
Employment in services (% of total employment)	0.085***	0.122***	-0.002	0.007	0.230***	0.105***	0.078***	0.075***
	(0.019)	(0.027)	(0.015)	(0.010)	(0.023)	(0.033)	(0.014)	(0.027)
Gross savings (% of GNI)	0.022**	0.020	0.059***	0.008	0.048***	0.019	-0.029***	0.005
	(0.011)	(0.018)	(0.016)	(0.010)	(0.014)	(0.027)	(0.008)	(0.017)
Constant	-0.368	-3.444**	3.558***	5.012***	-6.243***	-4.400*	4.159***	-1.050
	(0.844)	(1.436)	(0.861)	(0.564)	(1.110)	(2.444)	(0.636)	(1.310)
Estimation method	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect
Hausman test	71.03***	101.65***	89.21***	90.97***	101.02***	100.09**	76.73***	87.54***
Modified wald test for heteroskedasticity (χ-sq)	100.98***	131.08***	99.00***	115.6***	87.09***	96.55***	101.4***	88.49***
R-sqr	0.237	0.312	0.111	0.032	0.604	0.164	0.347	0.266
Obs	300	300	300	300	300	300	300	300

** p<0.10, ** p<0.05, *** p<0.010*

Source: Author's calculation.

The coefficient on the RTA dummy is statistically significant and positive across all service categories, though the magnitude varies notably, suggesting that digital

trade provisions in RTAs disproportionately benefit certain digital service domains over others.

The largest impacts are observed in financial services (0.9757, $p < 0.01$), personal/cultural/recreational services (0.8504, $p < 0.01$), and computer services (0.5727, $p < 0.01$). These sectors are particularly sensitive to cross-border digital infrastructure, regulatory alignment, and data mobility, which are often core elements of modern RTAs. These findings align with theoretical perspectives emphasizing the importance of institutional depth in liberalizing high-skill, knowledge-intensive services (Borchert, Gootiiz and Mattoo, 2014; Heuser 2019). Financial and computer services, for instance, rely on interoperable data governance, cyber standards, and digital identity protocols- all of which are increasingly embedded in trade agreements (Casalini and López González, 2019).

Moderate but significant effects are observed in use of intellectual property (0.6392, $p < 0.01$) and other business services (0.4093, $p < 0.01$). These sectors benefit from harmonization in legal enforcement and cross-border licensing, which RTAs often strengthen. The relatively smaller yet positive effects in telecommunications (0.3087, $p < 0.05$) and insurance and pension services (0.3051, $p < 0.10$) may reflect continued regulatory protection or less direct exposure to digital clauses (van der Marel and Shepherd, 2013). The comparatively lower R-squared values in these categories further suggest that factors beyond trade policy, such as domestic market structures, may play a larger role. Overall, these patterns affirm that RTAs do not uniformly benefit all digital service sectors. Rather, their impact is shaped by the compatibility of sectoral characteristics with digital governance disciplines embedded in modern trade architecture (Findlay and Hoekman, 2021).

The heterogeneous responses across DDS subcomponents (see Table 4) reflect not just variation in RTA coverage but differences in sectoral regulatory architecture and the bindingness of digital provisions. Financial services and computer services—our highest-coefficient sectors (0.975 and 0.573, respectively)—are prominently featured in modern RTAs with explicit disciplines in cross-border data flows, digital payments interoperability, and cybersecurity. These provisions are enforceable under dispute settlement mechanisms (e.g., CPTPP's investor-state clauses, the Regional Comprehensive Economic Partnership's consultation protocols), creating credible commitment devices. Conversely, telecommunications and insurance, while mentioned in RTAs, often retain carve-outs for "measures necessary for prudential reasons" or "national security", rendering commitments less binding (van der Marel and Shepherd, 2013). This paper's approach captures effective bindingness through the watershed-year methodology: RTAs are coded as active only when enforceable digital provisions come into force, not merely when the agreement is signed. However, it is acknowledged that depth of enforcement and compliance monitoring vary and are not directly observable in this data. Future research using hand-coded

sectoral RTA provisions and dispute settlement records would provide more granular enforcement variation. The low R-squared values in telecom and insurance further suggest that sectoral domestic barriers—licensing caps, foreign ownership limits, prudential requirements—remain binding constraints even post-RTA, explaining the muted policy response.

The Role of Trade Variables as Moderators. The interaction models reported in Table 5 provide compelling evidence that the impact of RTAs on DDS is significantly conditioned by underlying trade fundamentals. The interaction terms, capturing how RTAs interact with structural trade variables, act as amplifiers that unlock the potential of digital trade architecture only when supported by conducive economic environments.

Table 5. Moderating Role of Trade Fundamentals in the RTA-DDS Relationship

	Total DDS	Total DDS	Total DDS	Total DDS
Regional Trade Agreement	0.3345**	0.7610**	1.3864***	0.0632
	(0.146)	(0.311)	(0.354)	(0.082)
Regional Trade Agreement # Trade in services	0.0220**			
	(0.009)			
Regional Trade Agreement # Export volume index		0.0073***		
		(0.002)		
Regional Trade Agreement # Import volume index			0.0119***	
			(0.002)	
Regional Trade Agreement # External balance on goods and services				0.0234**
				(0.010)
GDP (annual % growth)	0.0183	0.0024	-0.0062	0.0129
	(0.012)	(0.011)	(0.010)	(0.010)
Foreign direct investment, net inflows (% of GDP)	0.0019	0.0210	0.0219	0.0032
	(0.017)	(0.020)	(0.020)	(0.015)
Employment in services (% of total employment)	-0.0178*	0.1041***	0.1041***	-0.0221**

	Total DDS	Total DDS	Total DDS	Total DDS
	(0.010)	(0.011)	(0.011)	(0.010)
Gross savings (% of GNI)	0.0028	-0.0197**	-0.0127*	0.0037
	(0.006)	(0.008)	(0.007)	(0.005)
constant	7.1359***	3.8827***	3.7119***	7.3063***
	(0.478)	(0.512)	(0.493)	(0.493)
Estimation Method	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect
Control Variables	YES	YES	YES	YES
Time Fixed Effect	YES	YES	YES	YES
Hausman test	595.98***	717.81***	311.54***	454.39***
Modified wald test for heteroskedasticity (χ-sq)	690.60***	1511.61***	1151.21***	1387.29**
R-sqr	0.834	0.514	0.535	0.830
Obs	300	300	300	300

** p<0.10, ** p<0.05, *** p<0.010*

Source: Author's calculation.

The interaction between RTAs and trade in services is both positive and significant (0.0220, $p < 0.05$), suggesting that countries more integrated into the global services economy are better positioned to translate RTA commitments into measurable gains in digital services. This result supports the theoretical argument that services trade intensity reflects a foundational readiness to benefit from digital commitments. Similarly, the interaction with the export volume index yields a positive and significant coefficient (0.0073, $p < 0.01$), indicating that economies with higher outbound trade dynamism are more capable of leveraging digital provisions in RTAs for scaling digital services—a finding consistent with models of trade elasticity in network goods (Goldfarb and Tucker, 2019). Further, the RTA interaction with import volume index (0.0119, $p < 0.01$) and external balance on goods and services (0.0234, $p < 0.05$) reinforces the notion that openness and macro-fiscal flexibility are critical enabling conditions. Higher imports signal absorptive capacity and competitive exposure, which incentivize digital adaptation (Görg, Hanley and Strobl, 2008), while stronger current account positions reflect the fiscal room to invest in digital infrastructure and institutional reforms.

These moderated effects are substantively important: they show that RTAs are not "silver bullets," but instruments whose effectiveness depends on complementary trade fundamentals. The negative and insignificant main effect of RTAs in models without interaction terms (e.g., –0.7610 and –1.3864) further highlights this point—RTAs may remain dormant in low-trade-capacity environments unless supported by enabling conditions.

Robustness tests. As a robustness check, the analysis was restricted to a subsample

of six economies: India, China, Philippines, Thailand, Malaysia, and Indonesia—each recording cumulative DDS exports exceeding $100 billion over the 20-year period. This high-exporter filter ensures that results are not driven by countries with marginal digital trade flows.

The re-estimated baseline specification, as well as models incorporating trade variables as moderators, are presented in Table A.2 of the Appendix. Across specifications, the sign, magnitude, and statistical significance of the RTA coefficients and interaction terms remain broadly consistent with the full-sample estimates, reinforcing the validity of the main findings and confirming that the observed effects are robust to sample composition.

Robustness is reinforced through the Callaway and Sant'Anna Difference-in-Differences estimations in Table 6. Here, consistently positive and significant average treatment effects (ATEs) post-treatment are observed, especially over longer horizons. For instance, in the 2015 treatment cohort, the ATE rises from 0.138 (2014–2018) to 0.684 (2014–2024); similarly, for the 2018 cohort, the ATE increases from 0.146 (2017–2019) to 0.960 (2017–2024).

These dynamic patterns confirm not only temporal robustness but also the presence of cumulative RTA effects, which compound over time as trade fundamentals align with digital architecture. Together, these results demonstrate that the benefits of RTAs for DDS are highly conditional, with trade integration, competitiveness, and fiscal strength acting as critical accelerators. Theoretically, this reinforces recent literature emphasizing that digital trade gains emerge not just from legal commitments but from their interaction with national capabilities (Lodefalk 2014; Beverelli, Fiorini, and Hoekman, 2017; Freund et al., 2021).

Table 6: Staggered Difference-in-Differences Estimation of RTA Impacts on DDS

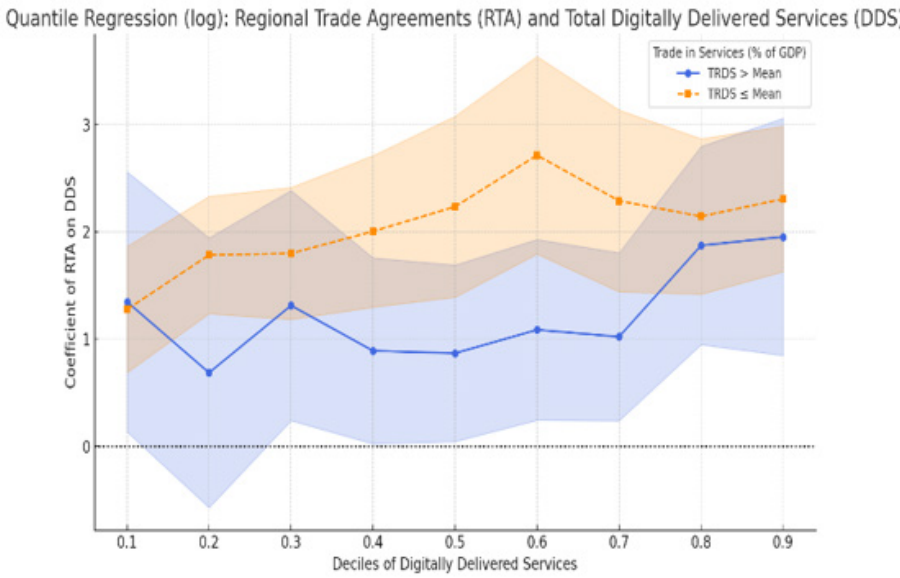
First Treatment Year	Time Period	Average Treatment Effect	Std. Error	P>|z|		First Treatment Year	Time Period	Average Treatment Effect	Std. Error	P>|z|
2015	2005–06	0.022	0.163	0.893		2018	2005–06	-0.272	0.163	0.095
2015	2006–07	0.241	0.151	0.110		2018	2006–07	0.098	0.114	0.388
2015	2007–08	-0.204	0.145	0.158		2018	2007–08	-0.324	0.206	0.116
2015	2008–09	-0.154	0.045	0.001		2018	2008–09	-0.131	0.030	0.000
2015	2009–10	0.005	0.050	0.912		2018	2009–10	-0.131	0.099	0.185
2015	2010–11	-0.106	0.095	0.262		2018	2010–11	-0.174	0.099	0.080
2015	2011–12	-0.150	0.126	0.234		2018	2011–12	-0.148	0.139	0.288
2015	2012–13	-0.001	0.069	0.991		2018	2012–13	0.111	0.138	0.421
2015	2013–14	-0.003	0.061	0.957		2018	2013–14	-0.132	0.034	0.000
2015	2014–15	-0.011	0.039	0.786		2018	2014–15	-0.026	0.076	0.733
2015	2014–16	0.035	0.137	0.798		2018	2015–16	0.048	0.107	0.655

First Treatment Year	Time Period	Average Treatment Effect	Std. Error	P>|z|		First Treatment Year	Time Period	Average Treatment Effect	Std. Error	P>|z|
2015	2014–17	0.050	0.021	0.019		2018	2016–17	-0.047	0.048	0.327
2015	2014–18	0.138	0.048	0.004		2018	2017–18	0.036	0.044	0.417
2015	2014–19	0.233	0.111	0.036		2018	2017–19	0.146	0.068	0.031
2015	2014–20	0.467	0.152	0.002		2018	2017–20	0.485	0.135	0.000
2015	2014–21	0.530	0.170	0.002		2018	2017–21	0.396	0.162	0.014
2015	2014–22	0.202	0.049	0.001		2018	2017–22	0.282	0.138	0.042
2015	2014–23	0.415	0.125	0.001		2018	2017–23	0.645	0.254	0.011
2015	2014–24	0.684	0.220	0.002		2018	2017–24	0.960	0.407	0.019

Source: Author's calculation.

Distributive Heterogeneity Across Country Groups and Trade Moderators. The quantile regressions in Figures 1–4 reveal distinct patterns in how RTAs influence DDS across different trade environments. Figure 1 shows that countries with above-mean trade in services exhibit stronger and more stable RTA effects on DDS across all deciles. This supports theories of services-led trade multipliers, where prior integration into services trade enhances responsiveness to digital provisions (Del Prete and Rungi, 2017).

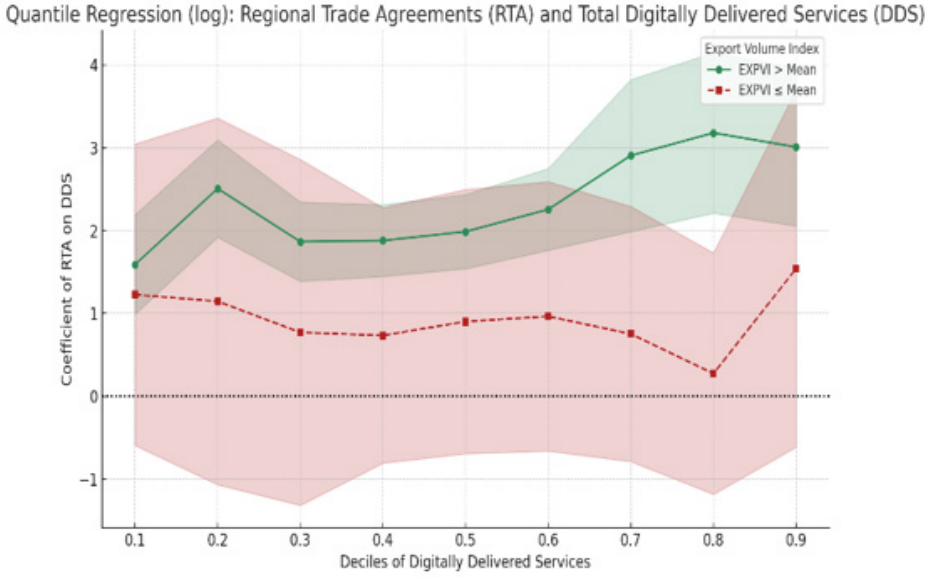
Figure 1. Interaction Effect of RTAs on DDS by Trade in Services



Source: Authors' estimation. Data from the WTO Trade in Services Database (2005–2024). Bootstrapped 90% confidence intervals shown in shaded bands

In contrast, below-mean countries show greater volatility and flatter slopes, indicating limited absorptive capacity. Figure 2 highlights that countries with higher export volume indices benefit significantly more from RTAs, particularly in upper DDS deciles, reflecting the advantages of scale and network effects in digital trade (Anderson and van Wincoop, 2003). Below-mean exporters remain trapped at lower coefficient levels, suggesting limited returns from RTAs when export dynamism is weak.

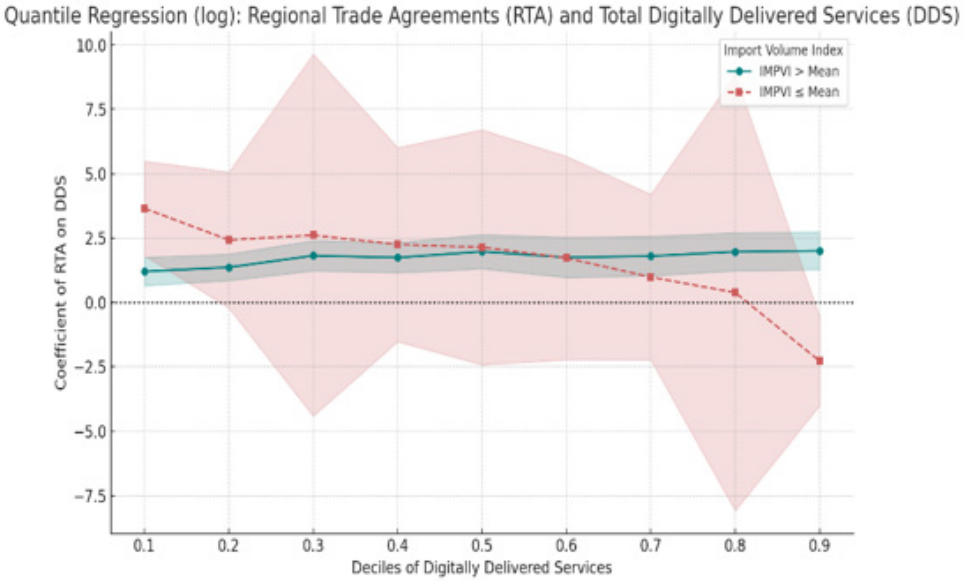
Figure 2. Interaction Effect of RTAs on DDS by Export Volume Index



Source: Authors' estimation. Data from the WTO Trade in Services Database (2005–2024). Bootstrapped 90% confidence intervals shown in shaded bands.

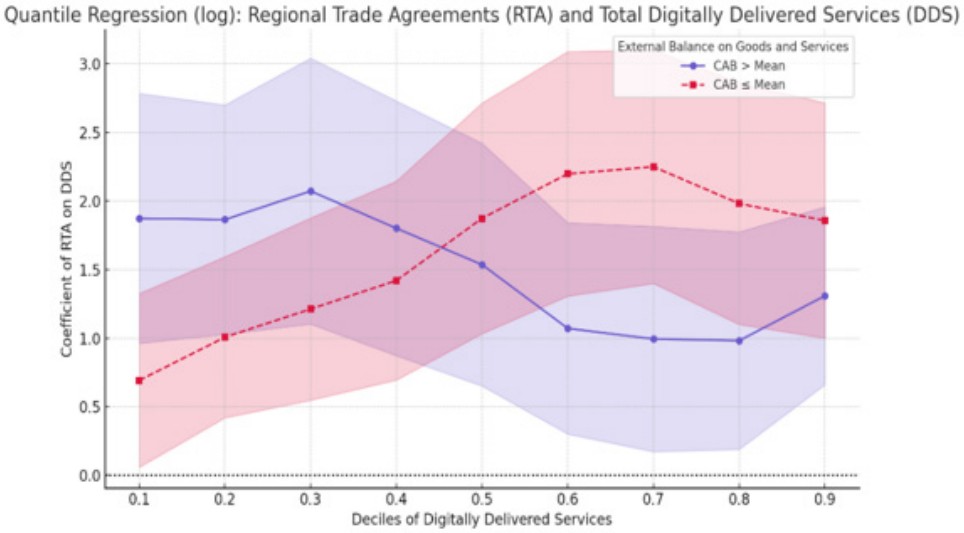
In Figure 3, import openness (via the Import Volume Index) exhibits a different profile: above-mean countries consistently derive moderate RTA benefits across quantiles, while below-mean countries see a declining trend in RTA impact at higher DDS levels. This mirrors findings from structural openness literature that associate import flows with technological diffusion and competitive upgrading (Coe and Helpman, 1995). Figure 4 focuses on external balance on goods and services, showing that countries with stronger current accounts benefit more evenly across DDS deciles. Countries with deficits show more erratic patterns, reinforcing the notion that macroeconomic stability underpins effective policy transmission (Rodrik, 2013).

Figure 3. Interaction Effect of RTAs on DDS by Import Volume Index



Source: Authors' estimation. Data from the WTO Trade in Services Database (2005–2024). Bootstrapped 90% confidence intervals shown in shaded bands.

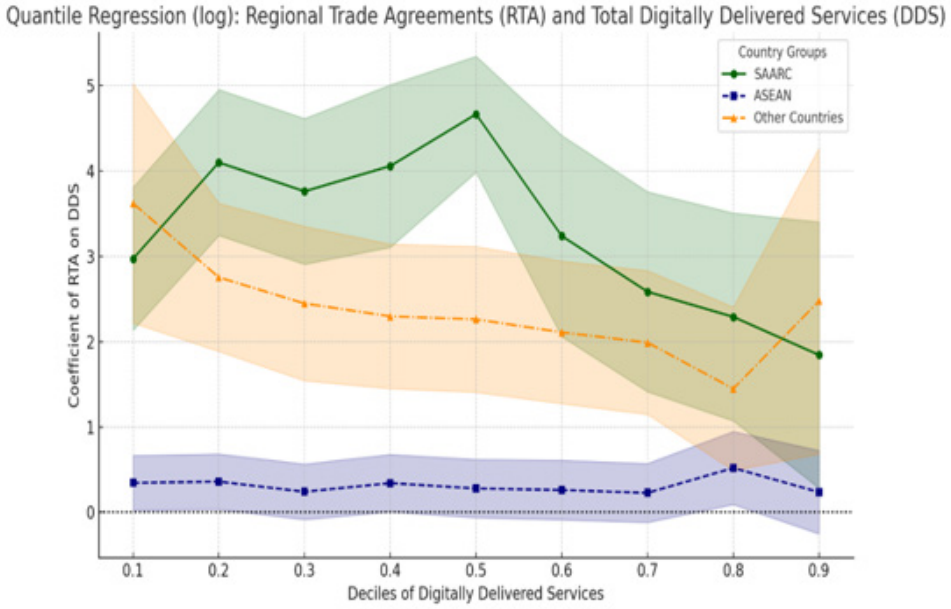
Figure 4. Interaction Effect of RTAs on DDS by External Balance on Goods and Services



Source: Authors' estimation. Data from the WTO Trade in Services Database (2005–2024). Bootstrapped 90% confidence intervals shown in shaded bands.

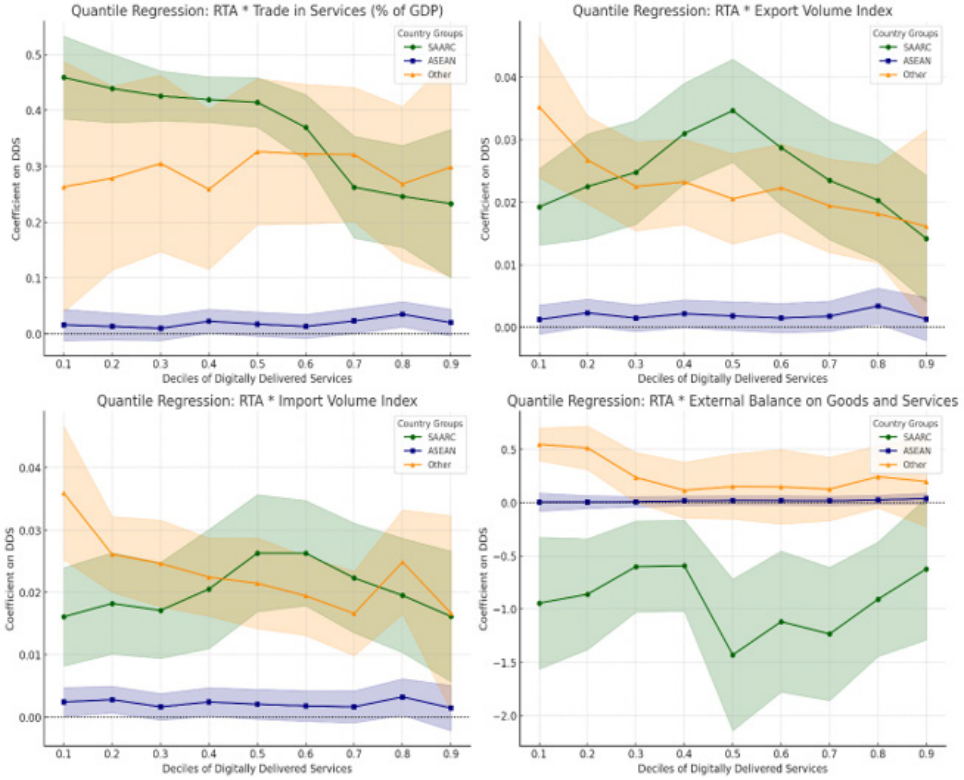
Figures 5 and 6 illustrate regional heterogeneity. SAARC economies display the steepest RTA coefficients, particularly in lower DDS deciles, reflecting catch-up dynamics enabled by RTAs (Fernandes et al., 2020). ASEAN, however, shows muted effects, possibly due to pre-existing digital integration outside formal RTAs. "Other" economies occupy an intermediate space with moderate but steady gains. These results affirm that RTAs act as policy multipliers, with their efficacy shaped by trade fundamentals and macroeconomic context (Mulabdic, Ruta and Osnago, 2017).

Figure 5. Distributive Heterogeneity of RTA Impacts on DDS across Country Groups



Source: Authors' estimation. Data from the WTO Trade in Services Database (2005–2024). Bootstrapped 90% confidence intervals shown in shaded bands.

Figure 6. Comparative Impact of RTAs on DDS across Trade Moderator Thresholds (above vs. below mean levels)



Source: Authors' estimation. Data from the WTO Trade in Services Database (2005–2024). Bootstrapped 90% confidence intervals shown in shaded bands.

VI. POLICY RECOMMENDATIONS

The empirical findings of this study offer compelling evidence that RTAs with digital trade provisions contribute significantly to the expansion of digitally delivered services (DDS) across a group of 15 emerging Asian economies. However, the impact is highly heterogeneous, driven by trade capacity, external balances, and regional dynamics. While countries like Viet Nam, Malaysia, and China demonstrate higher DDS responsiveness to RTAs due to advanced export structures and macroeconomic stability, others like Nepal, Myanmar, and Bangladesh display more modest and uneven gains. The quantile regressions further reinforce that digitally mature economies with stronger trade fundamentals- especially in services trade, export competitiveness, and import openness- translate digital trade commitments into more substantial DDS growth. The findings also highlight that RTAs act not in isolation but in interaction with

national capabilities, and their full benefits are realized when supportive domestic conditions align with external liberisation efforts.

For policymakers in South and Southeast Asia, these insights underline the importance of moving beyond formal treaty commitments towards strengthening domestic digital ecosystems. Current policies in several countries- such as Bangladesh's narrow data governance structure, Pakistan's underdeveloped fintech regulations, or Nepal's limited cross-border digital interoperability—remain inadequate in exploiting the full spectrum of RTA-induced digital trade opportunities. For instance, while India and Indonesia have signed multiple RTAs with digital clauses, their restrictive data localization policies and digital protectionism often dilute the intended liberalizing effects of these agreements (Aaronson, 2021; Meltzer, 2019). Conversely, Malaysia and Viet Nam, with relatively liberal digital regulatory frameworks and investment in digital infrastructure, exemplify how policy alignment with RTA commitments yields meaningful trade gains. The policy imperative, therefore, lies in integrating national digital policies with international commitments to create a coherent, mutually reinforcing trade–technology nexus.

First, **countries must modernize and harmonize domestic digital regulations to align with RTA provisions on cross-border data flows, e-signatures, e-invoicing, and cybersecurity.** Current fragmented digital policies often create regulatory uncertainty, disincentivizing private sector engagement in digital exports. A unified digital regulatory framework, such as the one adopted by Singapore, can serve as a model for South Asian economies (Chander, 2014). Countries like Sri Lanka and Kazakhstan, which lag in comprehensive digital legal infrastructure, should prioritize legislative reforms that meet interoperability standards set by RTAs. These reforms will not only boost trade volumes but also strengthen participation in regional digital value chains.

Second, **governments must leverage RTAs as institutional platforms to attract and channel foreign direct investment into digital infrastructure and services. Investment incentives targeted at data centres**, cloud computing, and fintech platforms, aligned with RTA disciplines, can crowd in private capital. Viet Nam's successful alignment of its CPTPP commitments with its domestic digital industrial policy demonstrates how RTAs can act as both regulatory anchors and investment magnets (Chen and Nordås, 2021). Economies like Uzbekistan and Myanmar should adopt RTA-compliant investment screening mechanisms to assure investors of rule-of-law stability while maintaining strategic autonomy.

Third, **capacity building in digital skills and services employment must become a national priority.** The heterogeneity in RTA outcomes across countries reflects not only trade integration but also human capital readiness. While India and the Philippines have strong digital labour pools enabling service export growth, countries like Nepal and Bangladesh suffer from a shortage of digitally skilled workers. Policymakers should institute national digital skilling missions, funded through public-private partnerships

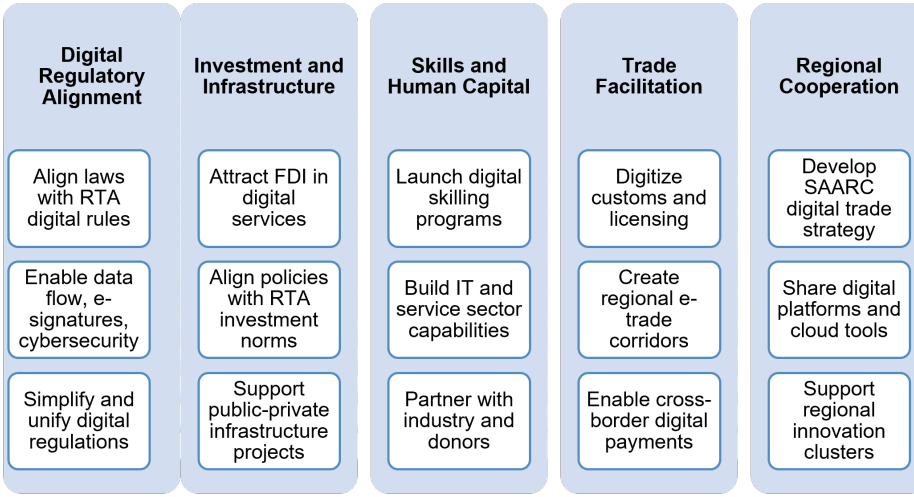
and supported by multilateral donors, to address this asymmetry (World Bank, 2021).

Fourth, **customs and logistics digitization should be accelerated to facilitate frictionless cross-border delivery of digital services.** Although RTAs increasingly cover digital trade facilitation, implementation remains weak. For example, ASEAN's Single Window platform could be emulated by SAARC nations to create an integrated digital trade corridor. Additionally, aligning national payment systems, customs protocols, and electronic licensing with RTA standards will improve interoperability and reduce non-tariff barriers.

Fifth, **data governance reforms are crucial to strike a balance between privacy, sovereignty, and openness.** India's evolving data protection framework, though ambitious, remains contentious due to localization mandates that contradict cross-border provisions in its RTAs. A modular, risk-based approach, similar to Japan's "Data Free Flow with Trust" principle, can help countries meet RTA commitments while safeguarding national interests (Aaronson and Leblond, 2018). Harmonized standards on encryption, algorithmic transparency, and AI governance can further future-proof RTA gains.

Finally, **regional cooperation mechanisms must be expanded beyond trade to include digital public goods, joint infrastructure projects, and regional innovation clusters.** The sharp intra-group divergence seen between SAARC and ASEAN economies in DDS growth indicates that without cooperative platforms, regional digital fragmentation will persist. A SAARC Digital Trade Framework, akin to ASEAN's Digital Masterplan 2025, could help lower regulatory divergence and promote cross-border digital innovation. These frameworks should incorporate academic collaboration, common cloud storage protocols, and coordinated cyber resilience strategies. The visual summary of the policy recommendations is presented in Figure 7.

Figure 7. Visual Summary of Policy Recommendations



Source: Author's illustration.

In conclusion, **the evidence suggests that RTAs offer substantial yet conditional benefits for digitally delivered services.** To contribute to attaining the SDGs, policymakers across these Asian economies must therefore pursue a dual-track strategy- leveraging RTAs as rule-based trade instruments while simultaneously upgrading domestic regulatory, institutional, and digital capability frameworks. Only then can the full potential of digital trade integration be realized across this diverse and rapidly evolving region.

VII. CONCLUSION

This study demonstrated that digital trade provisions in RTAs can meaningfully catalyse growth of digitally delivered services in emerging Asian economies, contributing to the achievement of the SDGs. By reducing cross-border frictions, enhancing regulatory interoperability, and strengthening trust in digital markets, such provisions can expand participation in services trade, improve access for micro, small and medium enterprises, and support higher-quality services employment in skill-intensive sectors. In this sense, digital RTAs support the objectives of SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure), while also advancing SDG 10 (reduced inequalities) by enabling firms outside major urban centres to engage in global markets, and SDG 17 (partnerships for the goals) through deeper, rules-based international cooperation.

From an inclusive growth perspective, the paper highlights how digital trade facilitation can translate external openness into productivity gains and earnings opportunities, conditional on complementary domestic digital readiness. Findings showed that RTAs with digital trade provisions significantly DDS exports across emerging Asian economies, with varied effects across countries, sectors, and trade environments. The novelty of the study lies in its theoretical depth-specifically, its incorporation of macroeconomic trade moderators, and its granular focus on individual DDS subcomponents, allowing for a more nuanced understanding of how and where RTAs exert influence.

Findings also revealed that the effectiveness of RTAs in promoting DDS is highly conditional on a country's trade orientation, macroeconomic stability, and structural readiness. Economies with higher trade in services, greater export/import openness, and stronger external balances are more likely to convert RTA commitments into tangible DDS gains, particularly in high-value sectors like financial services, intellectual property, and computer-based exports (Findlay and Hoekman 2021; Casalini and López González 2019). This highlights a central conclusion that digital trade integration can advance the SDGs only when embedded with complementary national strategies that build digital capabilities and absorptive capacity.

The core policy recommendation emerging from the analysis is that RTA-driven

digital trade integration must be complemented by robust domestic reforms in digital regulation, infrastructure, and human capital.

Going forward, future research should explore firm-level dynamics to better understand how digital RTAs affect export behaviours within industries. Additionally, regional comparative studies could deepen insights into how institutional and regulatory contexts shape the diffusion of digital trade benefits in the developing Asia and elsewhere in the developing world.

Note on Author

Dr. Avik Ghosh is an Assistant General Manager at the Reserve Bank of India, Kanpur, with 16 years of experience spanning corporate finance, financial inclusion, currency management, and auditing. An Electrical Engineering graduate and qualified Cost and Management Accountant, he holds the Financial Risk Manager certification and a diploma in machine learning. He holds a PhD in Economics from the Indian Institute of Technology Kanpur, specialising in development economics, public finance, and political economy.

REFERENCES

Aaronson, S. A. (2021). Why trade agreements are not setting information free: The lost history and reinvigorated debate over cross-border data flows, human rights, and national security. World Trade Review, vol. 20, No. 1, pp. 65–84.

Aaronson, S. A., and P. Leblond (2018). Another digital divide: The rise of data realms and its implications for the WTO. Journal of International Economic Law, vol. 21, No. 2, pp. 245–272. https://doi.org/10.1093/jiel/jgy019

Aghion, P., C. Antonin, and S. Bunel (2019). The Power of Creative Destruction: Economic Upheaval and the Wealth of Nations. Harvard University Press.

Aghion, P., D. Comin, P. Howitt, and I. Tecu (2005). When does domestic saving matter for economic growth? NBER Working Paper No. 12275. https://doi.org/10.3386/w12275

Ahmed, S., and A. Zlate (2014). Capital flows to emerging market economies: A brave new world? Journal of International Money and Finance, vol. 48, pp. 221–248. https://doi.org/10.1016/j.jimonfin.2014.05.015

Aizenman, J., Y. Jinjarak, and D. Park (2011). Capital flows and economic growth in the era of financial integration and crisis, 1990-2010, https://www.nber.org/system/files/working_papers/w17502/w17502.pdf

Alfaro, L., A. Chanda, S. Kalemli-Ozcan, and S. Sayek (2004). FDI and economic growth: The role of local financial markets. Journal of International Economics, vol. 64, No. 1, pp. 89–112. https://doi.org/10.1016/S0022-1996(03)00081-3

Anderson, J. E., and E. van Wincoop (2003). Gravity with gravitas: A solution to the border puzzle. American Economic Review, vol. 93, No. 1, pp. 170–192. https://doi.org/10.1257/000282803321455214

Antràs, P., and R. W. Staiger (2012). Offshoring and the role of trade agreements. American Economic Review, vol. 102, No. 7, pp. 3140–3183. http://dx.doi.org/10.1257/aer.102.7.3140

Avdjiev, S., M. Everett, P. R. Lane, and H. S. Shin (2020). Tracking the international footprints of global firms, BIS https://www.bis.org/publ/qtrpdf/r_qt1803f.htm

Bacchetta, M., C. Beverelli, and O. Cadot (2022). Trade in the digital era. World Trade Review, vol. 21, No. 1, pp. 1–16.

Baier, S. L., and J. H. Bergstrand (2007). Do free trade agreements actually increase members' international trade? Journal of International Economics, vol. 71, No. 1, pp. 72–95. https://doi.org/10.1016/j.jinteco.2006.02.005

Baldwin, R. (2016). The Great Convergence: Information Technology and the New Globalization. Harvard University Press.

Baldwin, R and S Evenett (eds) (2020), 'COVID-19 and Trade Policy: Why Turning Inward Won't Work', CEPR Press, Paris & London. https://cepr.org/publications/books-and-reports/covid-19-and-trade-policy-why-turning-inward-wont-work

Beverelli, C., M. Fiorini, and B. Hoekman (2017). Services trade policy and sustainable development. World Development, vol. 99, pp. 1–14. https://doi.org/10.1016/j.worlddev.2018.07.015

Beverelli, C., S. Neumueller, and R. Teh (2015). Export diversification effects of the WTO Trade Facilitation Agreement. World Development, vol. 111, pp. 31–45. https://doi.org/10.1016/j.worlddev.2015.07.009

Borchert, I., B. Gootiiz, and A. Mattoo (2014). Policy barriers to international trade in services: Evidence from a new database. World Bank Economic Review, vol. 28, No. 1, pp. 162–188. https://doi.org/10.1093/wber/lht017

Burri, M. (2021). Data flows and global trade law. In M. Burri (Ed.), Big Data and Global Trade Law (pp. 11–41). Cambridge University Press.

Callaway, B., and P. H. C. Sant'Anna (2021). Difference-in-differences with multiple time periods. Journal of Econometrics, vol. 225, No. 2, pp. 200–230. https://doi.org/10.1016/j.jeconom.2020.12.001

Casalini, F., and J. López González (2019). Trade and Cross-Border Data Flows. OECD Trade Policy Papers, No. 220. https://doi.org/10.1787/b2023a47-en

Chander, A. (2014). How law made Silicon Valley. Harvard International Law Journal, vol. 63, No. 1, pp. 141–196.

Chen, L., and H. K. Nordås (2021). Digital Trade and Development: Cross-Border Data Flows and Regulatory Spillovers. UNCTAD Research Paper No. 66. https://unctad.org/system/files/official-document/der2021_en.pdf

Coe, D. T., and E. Helpman (1995). International R&D spillovers. European Economic Review, vol. 39, No. 5, pp. 859–887. https://doi.org/10.1016/0014-2921(94)00100-E

Del Prete, D., and A. Rungi (2017). The smile curve at the firm level: Where value is added along supply chains. Economics Letters, vol. 155, pp. 11–15. https://doi.org/10.1016/j.econlet.2017.12.038

Duranton, G., and D. Puga (2004). Micro-foundations of urban agglomeration economies. Handbook of Regional and Urban Economics, vol. 4, pp. 2063–2117. https://doi.org/10.1016/S1574-0080(04)80005-1

Eichengreen, B., and P. Gupta (2013). The two waves of service-sector growth. Oxford Economic Papers, vol. 65, No. 1, pp. 96–123.

Ferencz, J. (2019). The OECD Digital Services Trade Restrictiveness Index. OECD Trade Policy Papers, No. 221. https://doi.org/10.1787/16ed2d78-en

Ferracane, M. F., and E. van der Marel (2020). Do data policy restrictions inhibit trade in services? Review of World Economics, vol. 156, No. 4, pp. 727–776. https://doi.org/10.1007/s10290-021-00417-2

Fernandes, A., A. Mattoo, H. Nguyen, and M. Schiffbauer (2020). The role of services in economic transformation—with an application to Kenya. World Bank Economic Review, vol. 34, No. 1, pp. 1–28.

Findlay, C., and B. Hoekman (2021). Value chain approaches to reducing policy spillovers on international business. Journal of International Business Policy, vol. 4, pp. 390–409. https://doi.org/10.1057/s42214-020-00083-5

Freund, C., and D. Weinhold (2004). The effect of the internet on international trade. Journal of International Economics, vol. 62, No. 1, pp. 171–189. https://doi.org/10.1016/S0022-1996(03)00059-X

Freund, C., A. Mattoo, N. Rocha, and M. Ruta (2021). The Economics of Deep Trade Agreements. World Bank. https://documents1.worldbank.org/curated/en/574231626150910037/pdf/The-Economics-of-Deep-Trade-Agreements.pdf

Goldfarb, A., and C. Tucker (2019). Digital economics. Journal of Economic Literature, vol. 57, No.

1, pp. 3–43. https://doi.org/10.1257/jel.20171452

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. Journal of Econometrics, vol. 225, No. 2, pp. 254–277. https://doi.org/10.1016/j.jeconom.2021.03.014

Görg, H., A. Hanley, and E. Strobl (2008). Productivity effects of international outsourcing: Evidence from plant-level data. Canadian Journal of Economics, vol. 41, No. 2, pp. 670–688. https://doi.org/10.1111/j.1540-5982.2008.00481.x

Heuser, C., and A. Mattoo (2017). Services Trade and Global Value Chains. World Bank Policy Research Working Paper No. 8126. https://hdl.handle.net/10986/27629

Hoekman, B., and A. Mattoo (2011). Services Trade Liberalization and Regulatory Reform. World Bank Policy Research Working Paper No. 5517. https://doi.org/10.1596/1813-9450-5517

Horn, H., P. C. Mavroidis, and A. Sapir (2010). Beyond the WTO? An anatomy of EU and US preferential trade agreements. The World Economy, vol. 33, No. 11, pp. 1565–1588. https://doi.org/10.1111/j.1467-9701.2010.01273.x

Lanz, R., and A. Maurer (2015). Services and Global Value Chains. WTO Staff Working Paper ERSD-2015–03. https://doi.org/10.30875/cb789e31-en

Lawrence, R. Z. (1996). Regionalism, Multilateralism, and Deeper Integration. Brookings Institution Press.

Liu, T., and W. T. Woo (2018). Understanding the U.S.-China Trade War. China Economic Journal, vol. 11, No. 3, pp. 319–340. https://doi.org/10.1080/17538963.2018.1516256

Lodefalk, M. (2014). The role of services for manufacturing firm exports. Review of World Economics, vol. 150, No. 1, pp. 59–82. https://doi.org/10.1007/s10290-013-0171-4

López González, J., and M. A. Jouanjean (2017). Digital Trade: Developing a Framework for Analysis. OECD Trade Policy Papers, No. 205. https://doi.org/10.1787/524c8c83-en

López González, J., and M. A. Jouanjean (2020). Digital Trade and Market Openness. OECD Trade Policy Papers, No. 217. https://doi.org/10.1787/1bd89c9a-en

Markusen, J. R. (2005). Modeling the Offshoring of White-Collar Services. NBER Working Paper No. 11827. http://www.nber.org/papers/w11827

Mattoo, A., N. Rocha, and M. Ruta (Eds.) (2020). Handbook of Deep Trade Agreements. World Bank Publications. https://doi.org/10.1596/978-1-4648-1539-3

Melitz, M. J., and S. J. Redding (2014). Heterogeneous firms and trade. In Handbook of International Economics, vol. 4 (pp. 1–54). Elsevier. https://doi.org/10.1016/B978-0-444-54314-1.00001-X

Meltzer, J. P. (2019). A Digital Trade Policy for the US: Value Chains and the Digital Economy. Brookings Institution Working Paper.

Miroudot, S. (2019). Services and Manufacturing in Global Value Chains: Is the Distinction Obsolete?. ADBI Working Paper 927. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/services-and-manufacturing-global-value-chains

Monteiro, J. A., and R. Teh (2017). Provisions on Electronic Commerce. WTO Working Paper ERSD-2017–11. https://www.wto.org/english/res_e/reser_e/ersd201711_e.htm

Mulabdic, A., M. Ruta, and A. Osnago (2017). Deep Integration and UK-EU Trade Relations. World Bank Policy Research Working Paper No. 7947. https://doi.org/10.1596/1813-9450-7947

Rodrik, D. (2006). The social cost of foreign exchange reserves. International Economic Journal, vol. 20, No. 3, pp. 253–266. https://doi.org/10.1080/10168730600879331

Rodrik, D. (2013). Unconditional convergence in manufacturing. The Quarterly Journal of Economics, vol. 128, No. 1, pp. 165–204. https://doi.org/10.1093/qje/qjs047

Rodrik, D. (2018a). Populism and the economics of globalization. Journal of International Business Policy, vol. 1, No. 1–2, pp. 12–33. https://www.nber.org/papers/w23559.

Rodrik, D. (2018b). Straight Talk on Trade. Princeton University Press. https://doi.org/10.1515/9781400888900

Taglioni, D., and D. Winkler (2016). Making Global Value Chains Work for Development. World Bank. http://documents.worldbank.org/curated/en/450521467989506537

van der Marel, E., and B. Shepherd (2013). Services trade, regulation and regional integration: Evidence from sectoral data. The World Economy, vol. 36, No. 11, pp. 1393–1405. https://doi.org/10.1111/twec.12083

Williamson, O. E. (1985). The Economic Institutions of Capitalism. Free Press.

World Bank (2021). The Global Economic Prospects: Digitalization and Human Capital in Developing Economies. World Bank Group.

World Bank (2024). World Development Indicators. World Bank Group. https://databank.worldbank.org/source/world-development-indicators

World Trade Organization (2024). WTO Trade in Services Database. https://data.wto.org

APPENDIX

Figure A.1. Trends in digitally delivered services (DDS) by country group in emerging Asia (2005–2024)

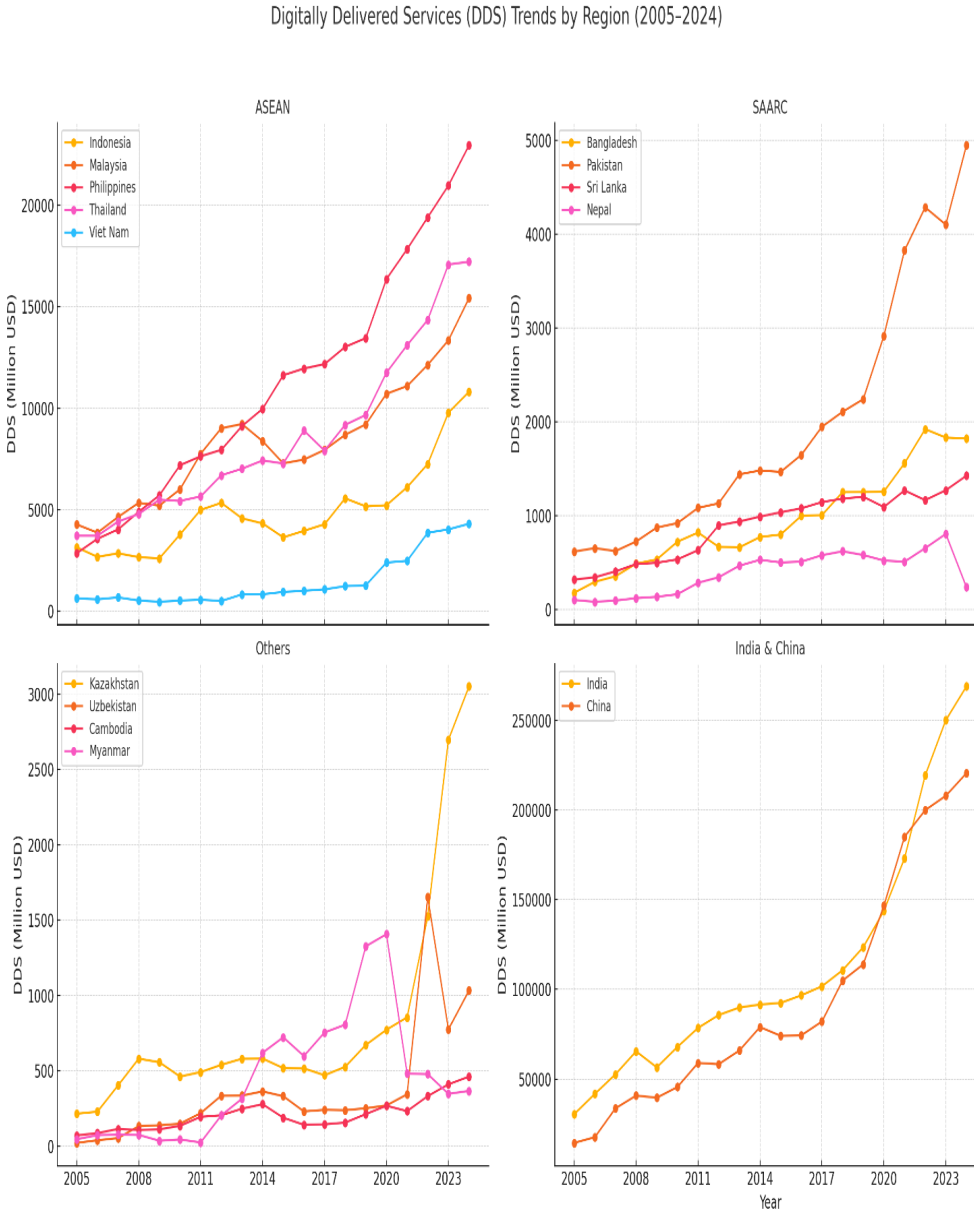
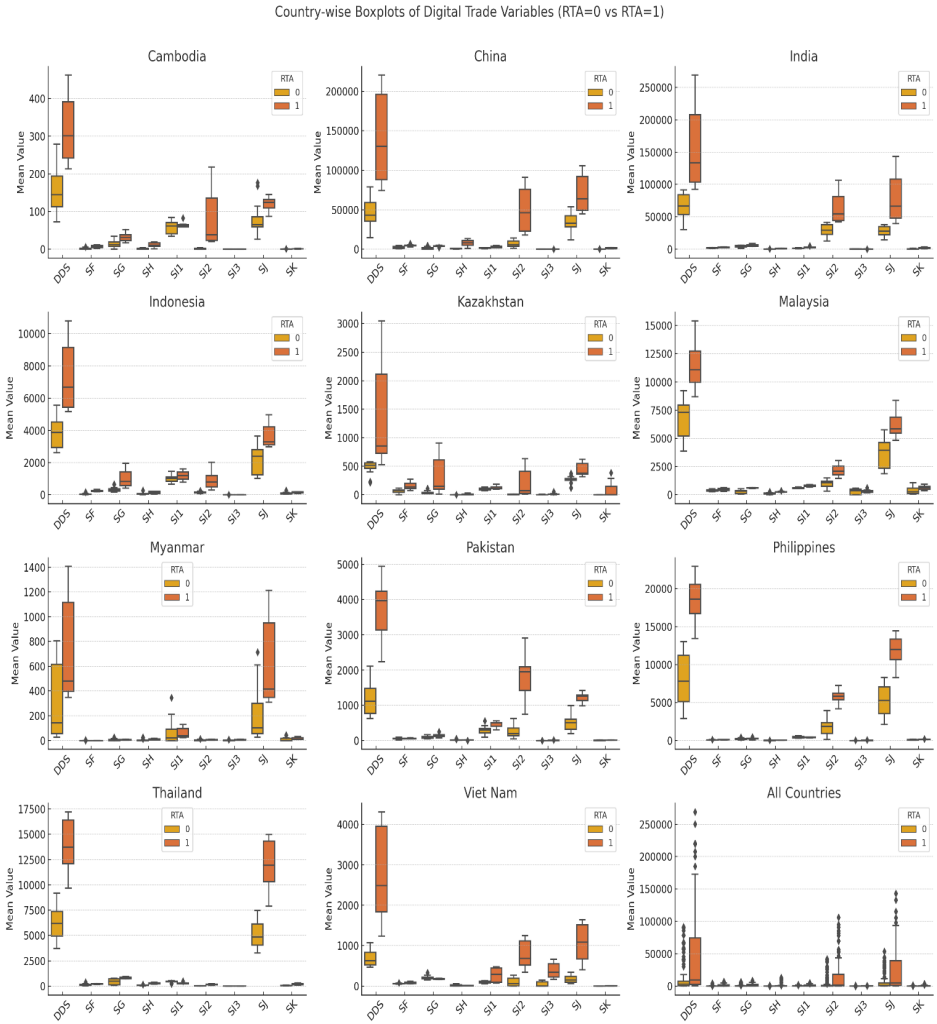


Figure A.2. Country-wise Distribution of Digitally Delivered Services and

Components by RTA Status (RTA=0 vs RTA=1)



Source: Author's illustration.

Note. DDS: Total digitally delivered services, SF: Insurance and pension services, SG: Financial services, SH: Charges for the use of intellectual property, SI1: Telecommunications services, SI2: Computer services, SI3: Information services, SJ: Other business services, SK: Personal, cultural, and recreational services

Table A.1. Country DDS Position, Top Global DDS Partner

Country	Total DDS (million $)	Mean DDS (million $)	Top DDS Partner
India	2241306.42	112065.32	United States
China	1863952.49	93197.62	United States
Philippines	222696.04	11134.8	United States
Thailand	170821.21	8541.06	China
Malaysia	167017.54	8350.88	Singapore
Indonesia	98745.3	4937.26	Singapore
Pakistan	39045.18	1952.26	United States
Viet Nam	28791.49	1439.57	China
Bangladesh	19223.72	961.19	United States
Sri Lanka	17940.34	897.02	United States
Kazakhstan	16255.47	812.77	Russia
Myanmar	8815.96	440.8	China
Nepal	7884.59	394.23	India
Uzbekistan	7170.95	358.55	Russia
Cambodia	4116.37	205.82	China

Source: Author's illustration.

Table A.2. Robustness Check for High-Export DDS Economies

	Total DDS	Total DDS	Total DDS	Total DDS	Total DDS
RTA	0.0580*	0.0602	1.8253***	0.9024**	0.0647
	(0.032)	(0.122)	(0.388)	(0.378)	(0.118)
RTA # Trade in services		0.0115**			
		(0.005)			
RTA # Export volume index			0.0162***		
			(0.003)		
RTA # Import volume index				0.081***	
				(0.003)	
RTA # External balance on goods and services					0.0056*
					(0.003)
GDP (annual % growth)	0.0035	-0.0052	-0.0080	-0.0045	0.0030
	(0.009)	(0.012)	(0.009)	(0.009)	(0.006)

	Total DDS	Total DDS	Total DDS	Total DDS	Total DDS
Foreign direct investment, net inflows (% of GDP)	0.0174	0.0021	0.0298	0.0111	0.0127
	(0.027)	(0.021)	(0.024)	(0.026)	(0.015)
Employment in services (% of total employment)	0.1121***	0.0418**	0.1101***	0.1091***	0.1113***
	(0.011)	(0.019)	(0.010)	(0.010)	(0.019)
Gross savings (% of GNI)	-0.0185**	-0.0147**	-0.0125*	-0.0122	-0.0169*
	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)
constant	5.1673***	7.6499***	5.0782***	5.1395***	5.1586***
	(0.561)	(0.774)	(0.507)	(0.546)	(0.881)
Estimation Method	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect
Control Variables	YES	YES	YES	YES	YES
Time Fixed Effect	YES	YES	YES	YES	YES

** p<0.10, ** p<0.05, *** p<0.010*
Source: Author's calculation.

Special theme: Enabling accessibility and inclusion through digital trade and e-commerce

BUILDING INCLUSIVE ECONOMIC GROWTH IN ASIA WITH MODE 1 FINANCE AND INSURANCE SERVICE EXPORTS: ROLE OF DIGITAL TRADE PROVISIONS IN FREE TRADE AGREEMENTS

Deeparghya Mukherjee[1]

Email: deeparghya@iimnagpur.ac.in

This study empirically assesses the impact of multiple digital trade and e commerce–related commitments on services exports, with comparative insights between the Association of Southeast Asian Nations and East Asia and focusing the period after 2018, including COVID-19 and the recovery from it. The findings show that provisions on cybersecurity, non-taxation of e commerce, data and consumer protection, dispute settlement coherence, intellectual property safeguards, and restrictions on source code disclosure significantly enhance services exports. The mentioned attributes in turn promote multiple United Nations Sustainable Development Goals (SDGs), namely: SDGs 8, 9, 12 and 17.

Keywords: finance and insurance services exports, e-commerce, Asia, SDGs

JEL classification: F13, F14, F68

[1] Deeparghya Mukherjee is an Associate Professor of Economics at the Indian Institute of Management Nagpur. The author is indebted to Dr. Jong Woo Kang, Director for Regional Cooperation and Integration with the Economic Research and Development Impact Department at the Asian Development Bank whose comments helped shape and significantly improve the current paper. Thanks are also due to the participants at the ATTN Forum 2025 in Tokyo for their insightful comments and suggestions which the author has tried to integrate into the present draft.

I. INTRODUCTION

Services trade has been growing as a share of world trade consistently and this is accompanied by the growth of services trade agreements. Digital tradability of a number of services has enabled faster growth in e-commerce-driven services trade, especially in the period after COVID-19. Digital trade is hailed to promote sustainability and specific United Nations (UN) sustainable development goals (SDGs). As the world tries to build resilience and a more sustainable future, the understanding of the effects of specific digital trade provisions in furthering exports of critical services like finance and insurance would help meet the SDGs and further enable inclusive growth of Asia. As an engine of global economic growth steered by East and Southeast Asia, Asia remains a significant exporter of financial and insurance services. Trade agreements that include digital trade facilitating commitments have proliferated as economies aim to grow overseas sales of services through digital channels. Asian countries are no exception, making it important to explore the effect of digital trade and e-commerce-related commitments on growing services exports from the region. This may help policy makers focus on specific provisions in negotiating trade agreements or in implementing appropriate domestic reforms facilitating digital commerce and thus promoting sustainability.

Digital trade of services occurs primarily through mode 1 (cross-border transfer) under the General Agreement on Trade in Services of the World Trade Organization (WTO).[2]Indeed, post-pandemic data trends reveal that services exports from developing economies like India are increasingly moving towards mode 1 rather than mode 4 (through movement of natural persons) or other modes. Mode 1 services exports are typically driven by digital channels and e-commerce. Facilitating services trade through agreements increasing digital depth are typically expected to grow services exports through mode 1.

The growth rate of services trade across the world during 2005–2023 averaged around 6%. Digitally delivered services trade grew at 7.4% as opposed to 4.7% for non-digitally delivered services in the period (OECD, 2025). Asia's share of global services exports increased from 20% in 2005 to 30% in 2022,[3] as its countries signed trade agreements spanning facilitation in goods and services trade.

Digital trade is facilitated through commitments in digital provisions facilitating e-commerce, although such commitment varies widely in scope and depth as negotiating economies balance priorities. Scope is "horizontal" (Hoffmann, Osnago and Ruta, 2017), i.e., the breadth of coverage of areas of commitments like data

[2] See the General Agreement on Trade in Services (GATS) Training module, Chapter 1. https://www.wto.org/english/tratop_e/serv_e/cbt_course_e/c1s3p1_e.htm

[3] Calculated by the author using WTO trade in services by mode of supply (TISMOS) statistics

protection, environment, competition policy, depth; "vertical depth" is the liberalizing content of commitments a country achieves on these fronts. Typically, agreements with a single chapter covering all aspects of facilitating e-commerce, consumer protection, data protection, and digital flows are said to be less deep than agreements with dedicated chapters on each of these setting rules on how these commitments would be implemented and be legally binding.

Services trade agreements and the depth of digital agreements in Asia varies among trade partners with whom Asian countries have services trade agreements. While countries like Singapore and the ROK—closely followed by Indonesia and Viet Nam—have services trade agreements with developed nations and trade groups (United States, United Kingdom, European Free Trade Association) and developing nations, most other Asian countries have services-based agreements mainly only amongst Asian countries. This is true for countries like India, the People's Republic of China (PRC), Malaysia, Thailand and Australia. Digital depth or mode-wise depth of trade agreements also varies. The difference in commitments across trade agreements is expected to create differences in digitally traded services export trends and hence can generate interesting inferences about the effectiveness of the commitments in growing services trade in select sectors.

Apart from a few recent studies, digital scope and depth of services trade agreements and their effects on specific services exports remain thinly researched. Additionally, few studies have tried to analyse the effect of digital depth by mode of services exports. This is especially true for studies related to Asian countries. Understanding the influence of specific provisions in promoting digital services trade is further important as it helps reduce carbon footprints through paperless processes. Estimates suggest that completely digitalizing an international transaction saves around 1.5 trees (Duval & Hardy, 2021). Our study thus focuses on two services and studies their exports through mode 1 from Asian economies and tries to unearth the effects of e-commerce facilitating commitments in trade agreements in growing services exports.

Analysing WTO trade in services by mode of supply (TISMOS) data reveals that financial services, insurance and pension services are traded through mode 1 alone as opposed to other services.[4] Financial services include financial intermediation services and other explicitly charged financial services. Insurance and pension services include direct life and freight insurance, reinsurance, auxiliary insurance, pension and standardized guarantee services.[5] Appropriate policy formulation to promote digital delivery of cross-border finance and insurance services have the potential to

[4] See the TISMOS database at https://www.wto.org/english/res_e/statis_e/gstdh_mode_supply_e.htm

[5] See extended balance of payments classification (EBOPS 2010) https://web-archive.oecd.org/2014-06-16/308081-EBOPS-2010.pdf

promote sustainability goals, especially: (a) economic growth (SDG 8), (b) industrial growth and innovation (SDG 9), (c) reduce inequalities through greater access to finance (SDG 10) and (d) cross-border partnerships aimed at achieving the SDGs (SDG 17), thus laying the foundations for inclusive growth in Asia.

II. REVIEW OF RELATED LITERATURE

Watson, Berton and Zinklan (2000) infer that analysis of digitally deliverable services could be impossible without factoring in the effects of e-commerce. As per early estimates, short-run growth in services exports was 1.7%due to a 10% increase in internet penetration (Freund and Weinhold, 2002). Wymbs (2000) shows how the internet alters the nature of information asymmetry between buyers and sellers, changing business perspectives and profitability. E-commerce, due its ability to link buyers and sellers across countries, helps services industries scale up seamlessly without increasing inputs proportionately. Electronic searches for the right insurance, completion of bank transactions and handling customer queries can reduce costs by 15 to 20 per cent on average and for higher efficiencies the savings could go up to 80 per cent (OECD, 1998) (Margherio, 1998). The criticality of policies to reduce digital imbalances across regions in Asia and integrating digital trade policies into regional agreements are fundamental to achieving the SDGs (Anukoonwattaka et al., 2024).

In understanding the role of digital technology in furthering services exports, Wajda-Lichy, et al. (2022) establish the importance of both broadband and traditional internet connectivity for furthering services exports. Exports and imports of information and communication technology (ICT) goods are further found to influence services exports. Nasir and Kalirajan (2016) emphasize the need to reduce behind-the-border restrictions in Asian economies, apart from strengthening ICT infrastructure and increasing the number of graduates to catch up with developed economies in exporting modern services. Xing (2018) notes the importance of ICT infrastructure and secured servers for exploiting the e-trade potential of developing and least developed countries. Digital trade policies have a particularly important role in promoting sustainable development through appropriate digital literacy and lowering of digital trade barriers. They help promote inclusivity and serve as a building block for inclusive development in developing economies of Asia in particular (Baker & Le, 2023). Finance and insurance are essential services whose access to developing areas as well as medium and small market enterprises (MSMEs) increase drastically through facilitation of digital trade policies and thus help inclusive development (UNESCAP, 2023).

While many countries have facilitated digital trade through development of appropriate IT infrastructure and cheaper data, some countries tend to restrict digital trade to benefit local producers. Digital trade restrictions include restricting cross-border data flows, data localization and imposing digital service taxes (Kofler and Sinig, 2019). For PRC, cross-border e-commerce is found to have had greater incremental effect

on services exports to Belt and Road countries. Higher cross-border e-commerce are also found to lower the influence of distance for services trade (Yin and Choi, 2023). Services trade in low-income countries and the professional service sectors is more heavily impacted by restrictive measures (Jafari and Tarr, 2017).

Digital trade agreements and e-commerce related commitments have thus become part of most modern trade agreements and several studies try to unearth their effects. Agreements between developed countries include the highest number of digital trade provisions compared to agreements between developed and developing economies, which contain a little over half the number of such provisions. Agreements between developing nations had about a third of the digital provisions of developed economy agreements (Wu, Luo and Wood, 2023).

Studies often calculate the depth of commitments for more accurate estimation. Roy (2011), Lee (2019), Chen and Shen (2024) define deep service trade agreements as those covering most-favoured-nation treatment, non-establishment of commercial presence, the movement of natural persons and ex-post review provisions. The deepest trade agreement is the one which includes implementable provisions for all four. Chen and Shen (2024) find that out of 646 trade agreements, 156 are general and 177 are in-depth services trade agreements.

The expansionary effect of deep trade agreements is estimated to be around 21.5 per cent as compared to 16.5 per cent of the more general trade agreements. Deep service trade agreements are effective in addressing behind the border restrictions, thus reducing service trade cost and improving business environment. Wang and Liu (2025) find that digital trade rules raise domestic value added of services exports. Greater depth and breadth of digital trade rules can strengthen the effect, especially for highly digitized sectors.

The above studies make clear the consensus in the literature about the positive effects of digital technology and deep commitments on services exports. However, the effects of specific e-commerce facilitating provisions on mode 1 services trade, particularly for digitally delivered services such as financial services and insurance and pension services, remain largely unexplored. This study addresses this gap. The two services are selected as TISMOS statistics reveal that these services are exported through mode 1 only. E-commerce provisions may be primarily designed in trade agreements to facilitate goods trade internationally. However, financial services exports and insurance and pension services exports growth may be further triggered to support goods trade. Thus, over and beyond the facilitation of services trade through investment or services chapters, facilitation of e-commerce in general has potential to improve financial and insurance services exports.

Finally, digital trade openness and e-commerce facilitation is expected to impact both services exports and imports. However, due to limited available data on imports

of financial and insurance and pension services for Asian economies, the present study only focuses on estimating the effect on exports.

III. DATA AND METHODOLOGY

Bilateral trade statistics. To decipher the effects of e-commerce-related provisions on exports of the selected services, this study uses statistics from multiple data sources after establishing consistency between the sources. Bilateral services trade statistics are available from the WTO-OECD Balanced Trade in Services Dataset (BATIS). The TISMOS provides exports of services from a given country to the world by mode of service delivery. The trade value of the BATIS and the TISMOS match exactly for almost all years for every country and, for mismatches, the variation is minuscule.[6] Hence, although mode-wise bilateral trade data are unavailable in either data source, the fact that all trade of the selected services is conducted through mode 1 (TISMOS) is used to derive bilateral services trade statistics for each Asian country from the WTO-OECD BATIS database.

The Asian economies included in the sample are Afghanistan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; PRC; Taipei,China; Hong Kong, China; Democratic People's Republic of Korea; India; Indonesia; Japan; Republic of Korea (ROK); Lao People's Democratic Republic (PDR); Malaysia; Mauritius; Myanmar; Nepal; Pakistan; Philippines; Singapore; Sri Lanka; Thailand; and Viet Nam. For the sampled countries, bilateral export statistics are compiled for 50, 47 and 40 trading partners worldwide for financial services and insurance and pension services, respectively, subject to data availability. The sample period is 2005–2023.

Trade agreements. The study sourced the scope (horizontal breadth) and depth (vertical depth) indicators from the Deep Trade Agreements Database of the World Bank.[7] This database sources around 400 trade agreements from the WTO Regional Trade Agreements database. Specifically, it used the data protection indicators for calculation of the scope indicator and depth is sourced from provisions for cross-border data transfers (listed as new areas of agreement). Finally, the study creates indicators for the number of chapters attributed to services trade by modes, as described in the next subsection.

To investigate the role of e-commerce related provisions, i.e., going deeper into the trade enabling effect of e-commerce provisions, the study uses the Trade Agreement Provisions on Electronic-Commerce and Data (TAPED) dataset due to Burri and Lazo

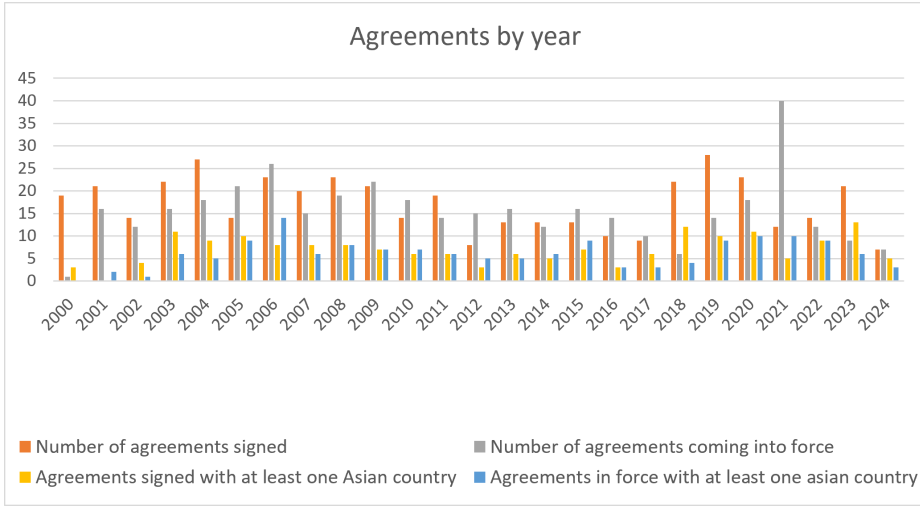
[6] Appendix 1 provides export figures for each of the two service categories from the sample Asian economies to the world. This is provided for three time points, and readers may check the consistency.

[7] See the Deep Trade Agreements Database, World Bank; https://datatopics.worldbank.org/dta/table.html

Polanko, (2020). It uses the latest version published in November 2024, data from 465 treaties to obtain statistics on commitments with respect to facilitation of e-commerce and data transfers. The study presents a snapshot of the trade agreements covered in the TAPED dataset and highlight the enforcement of e-commerce facilitation related commitments in trade agreements across the world below.

Figure 1 shows that signing and enforcement of trade agreements were on the rise from 2000 until the great financial slowdown after which global enthusiasm in trade agreements seem to have gone down but more trade agreements signed in the past started coming into force. Notably, in the aftermath of the US-PRC trade tension of 2017, the number of trade agreements signed increased significantly and the COVID-19 pandemic saw many signed agreements implemented. Between 2018 and 2021, signing of trade agreements increased notably, with the highest number of agreements entering into force in 2021, after the pandemic onset. The trend of agreements containing at least one Asian economy mirrored the overall trend. In most years almost half the agreements signed globally contained an Asian partner.

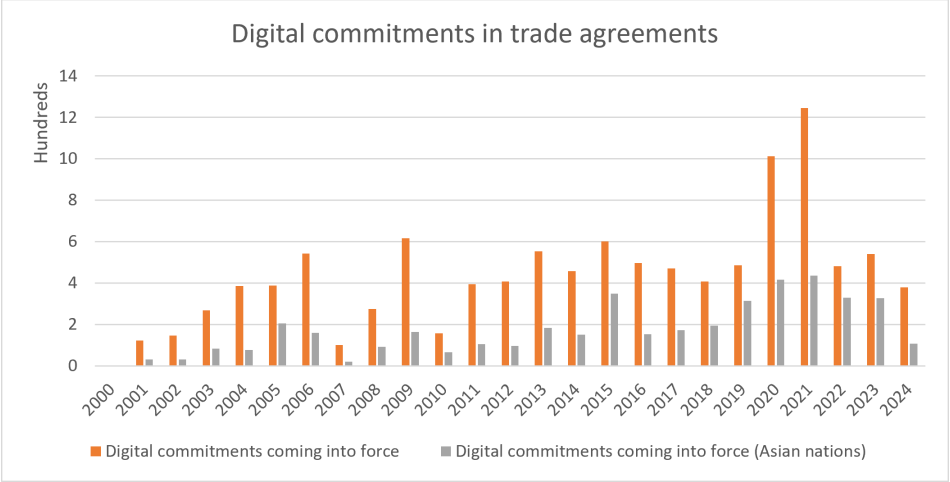
Figure 1. Agreements signed and enforced by year



Source: Author's compilation using TAPED dataset.

The study looks at the number of digital trade facilitation commitments. In figure 2, it sums up the extent of commitment scores across all dimensions which facilitate digital trade including e-commerce, data dedicated provisions, new data economy issues, cross-cutting issues to e-commerce, data-dedicated and new data economy provisions and intellectual property. For each agreement it sums up the level of commitments (0 to 2) under each granular subsegment for each of the mentioned heads. This is finally summed up by the year in which the said agreement(s) came into force.

Figure 2. Digital commitments in free trade agreements coming into force by year



Source: Author's compilation using TAPED dataset (2024 release).

Digital trade enabling initiatives began rising phenomenally within the onset of the pandemic and similar trends are observed in the Asian economies. In 2020 and 2021, the number of provisions enabling digital trade increased drastically and Asian countries took a lead in this trend, as almost 50 per cent of the commitments coming into force were part of a trade agreement where an Asian economy was present.[8]

The study uses e-commerce related provisions to arrive at key explanatory attributes for estimating exports from the two service categories using the gravity framework. It first describes the construction of the scope and depth variables followed by the construction of e-commerce related provisions in the following sub-section.

Construction of scope and depth variables. The study calculates digital depth of services trade agreements using Chapter 4 of the Deep Trade Agreements Database of the World Bank (Batshur, et al., 2024).[9] The database lists around 400 trade agreements which cover both goods and services chapters. The scope indicators are sourced from "horizontal depth", i.e., a parameter like data protection (in the case of the present study). If the agreement does not mention anything about data protection, the variable takes a value of zero. The value changes to one when a legally enforceable commitment is made but is excluded from dispute settlement provision. These are said to be "soft" commitments implying wordings like "best

[8] In the post-pandemic phase the numbers seem to have come down. However, e-commerce provisions for all the new agreements are not coded for these years. Hence, the actual number may be higher.

[9] Deep trade Agreements, The World Bank, https://datatopics.worldbank.org/dta/table.html

efforts to comply with a provision" or "recognize the importance" or "promote" or "shall work towards", implying that non-compliance cannot be brought under dispute settlement. Finally, the value changes to two if the provision is mentioned and is legally enforceable. In such cases, binding commitments are made with wordings like "shall take appropriate measures" or "must". They may also have specific dates by which the commitment made would be realized. For each exporting-importing country, values are summed across all active agreements for a particular year to arrive at the scope of data protection and hence digital trade facilitation for the exporter-importer for the respective year. Symbolically,

$$Scope_{dataprov_{ijt}} = \sum_{k=1}^{400} Data^{ijt}_{prov_k}$$

$Data^{ijt}_{prov_k}$ is the score (0 or 1 or 2) between trade partners i and j due to a possible trade agreement k for year t. If the country pair does not have an active agreement, the default value is zero. The score is summed up across all the trade agreements to arrive at the $Scope_{dataprov_{ijt}}$ used as an explanatory attribute in the preliminary model.

In similar fashion, two variables are used to check the effect of depth of the trade agreement in facilitating exports of the said services from Asian economies. The two depth indicators reflect (1) the presence of provisions that capture new issues like cross-border data flows and (2) the structure of the agreement, i.e., whether all four modes are captured in one chapter (A), or all in one chapter plus a separate chapter for investments (B), separate chapters on cross-border trade in services and investment (like NAFTA) (C) and finally separate chapters for cross-border trade, investments and for transfer of natural persons (D). In the case of the second variable, numbers 1 to 4 are awarded to reflect incremental depth/commitment for services trade liberalization and specifically cross-border trade in services, i.e., mode 1. The variable is constructed as follows:

$$dep1_{crosbrd_{dta_{ijt}}} = \sum_{k=1}^{400} dep1^{ijt}_{crsdta_k}$$

Where $dep1_{crsdta_k}$ takes a value of 0, 1 or 2 for the kth active agreement between exporter i and importer j in year t. This is summed across the k agreements to arrive at the composite score $dep1_{crosbrd_{dta_{ijt}}}$ which enters the model as a possible explanatory attribute. The second variable is constructed as follows:

$$dep1_{serv_{str_{ijt}}} = \sum_{k=1}^{400} Depserv_str^{ijt}_k$$

Where $Dep_{serv}{}_{str_{ijt}}$ is the score between one and four for the kth active trade agreement

where country i the exporting country and country j the importing country figure. In case country i is not a part of any agreement in that time period, the automatic assigned value is zero. Summing up across all trade agreements in time period t yields $Depserv_str_{itj}$ which enters the model as a possible explanatory attribute. The effects of scope and depth variables on exports are then estimated using the gravity model, workhorse framework of the empirical trade literature. The estimated model is:

$$Exports_{ijt} = \alpha_0 + \alpha_1 * fta_{ijt} + \alpha_2 * Scope_{dataprov_{ijt}} + \alpha_3 * dep1_{crosbrd_{dta_{ijt}}} + \alpha_4 * Dep_{serv_{str_{ijt}}} + \beta_{it} + \gamma_{jt} + \vartheta_{ij} + \epsilon_{ijt} \quad \text{.....(1)}$$

Where $Exports_{ijt}$ refers to the exports of financial and insurance and pension services respectively, estimated separately. fta_{ijt} refers to the presence of an free trade agreement (FTA) between the exporter and importer countries i and j , β_{it} refers exporter-time fixed effects, γ_{jt} refers to the importer-time fixed effects and ϑ_{ij} refers to exporter-importer fixed effects. These fixed effects capture exporter and importer specific attributes by time and hence per capita GDPs are not included. The exporter-importer fixed effects capture all bilateral time invariant factors like distance which again are not used as explanatory variables. The model is estimated separately for the ten nation Association of Southeast Asian Nations (ASEAN) exporters and east Asia exporters to unravel effects to exporters of these services from the respective regions. Given collinearity between the fta_{ijt} and the other scope and depth variables, the empirical analysis first includes fta_{ijt} variable and a total depth variable (composite of all depth variables) after which the sample is split to get separate estimates for East Asia and ASEAN countries. Hence the two specific estimations performed from (1) are:

$$Exports_{ijt} = \alpha_0 + \alpha_1 * fta_{ijt} + \alpha_2 * tot_depth_{ijt} + \beta_{it} + \gamma_{jt} + \vartheta_{ij} + \epsilon_{ijt} \quad \text{.....(1.1)}$$

The model is subsequently estimated without the fta_{ijt} variable with the mentioned scope and depth variables only which are not colinear:

$$Exports_{ijt} = \alpha_0 + \alpha_1 * Scope_{dataprov_{ijt}} + \alpha_2 * dep1_{crosbrd_{dta_{ijt}}} + \alpha_3 * Dep_{serv_{str_{ijt}}} + \beta_{it} + \gamma_{jt} + \vartheta_{ij} + \epsilon_{ijt} \quad \text{.....(1.2)}$$

For deeper results and to specifically explore the role of e-commerce trade facilitation, the analysis is extended to find out the effects of e-commerce facilitation in trade agreements and respective effects on trade flows. Information on these provisions are sourced from the TAPED dataset. Table 1 lists the specific attributes considered.

Table 1. E-commerce provisions used to estimate effects on services exports

Variable	Description
$EC_3_sum_{ijt}$	Captures if the exporter (i) and importer (j) who at time t are a part of a trade agreement with (a) e-commerce chapter together with the services chapter, (b) includes provisions to indicate which chapter takes precedence in case of conflicts (in case of separate chapters on investments, services and e-commerce) (c) there is a commitment not to impair intellectual property rights (IPR) for e-commerce transactions
$Dig.Trade\ Facilitation_{ijt}$	Captures if exporter (i) and importer (j) who at time t are a part of a trade agreement which facilitates (a) paperless trading, (b) contains provisions on electronic transfer of record and (c) promotes customs procedures automatization
$Source\ Code_{ijt}$	Captures if exporter (i) and importer (j) who at time t are a part of a trade agreement which (a) prohibits transfer or access to source code/algorithms owned by a citizen or company in the exporting country as a condition to import, (b) non-requirement for transfer of any proprietary information related to cryptography from exporter to importer.
$\#\ Articles\ std_{ijt}$	The standardised value of number of articles addressing e-commerce or digital trade in chapters or annexes in trade agreements between exporter i and importer j at time t.
$Consumer\ Protection_{ijt}$	Captures if exporter (i) and importer (j) who at time t are a part of a trade agreement which makes provisions for (a) protection of consumers using e-commerce, (b) promotes cooperation between national consumer protection agencies, (c) requiring consumer consent for sending unsolicited commercial electronic messages etc.

In table 1, for each variable (except # Articles std), the subcategories mentioned in the description take a value of 0,1 or 2 depending on the degree of commitment (no/soft/hard). These values are added up at the level of each agreement. If an importer or exporter is bound by the agreement at time t then the variable used in the estimation takes the obtained summed value. If an exporter-importer pair is part of multiple agreements with likewise provisions or with minor variations, the value for each agreement is summed up and used in the estimation.[10] The number of articles in a trade agreement between two trade partners is standardized across agreements and the value of the same is used for estimation.

The above variables are selected beyond other variables listed by the extant literature.[11]

[10] A robustness check was conducted on this using the average value across trade agreements between the exporter and importer at the time point t or the maximum value. There is no qualitative difference in the results obtained implying that most exporter-importer pairs are bound by a single agreement.

[11] The TAPED has many other relevant attributes which facilitate e-commerce. However, most of the attributes come out to be collinear with the chosen ones or are sparsely coded leading to data loss. Hence, they have been excluded. It was observed that countries which commit to more e-commerce facilitative provisions tend to commit to most of them simultaneously.

Some of these include: market access for e-commerce transactions, customs duty waivers on e-commerce products or services, non-imposition of taxes or regulations, access to the internet for e-commerce, net neutrality, cybersecurity, provisions on cooperation on ICT between parties to the agreement, stakeholder involvement in formulating e-commerce policies and explicit presence of e-commerce related disputes in dispute resolution chapters. Findings show that these measures have a very high degree of collinearity with one or the other of the selected variables reported in table 1. Hence, the variables chosen would sufficiently capture the extent of e-commerce facilitation, and the following models are estimated separately for each service type:

$$\text{Exports}_{ijt} = \alpha_0 + \alpha_1 * EC3_{Sum_{ijt}} + \alpha_2 * \text{Dig.Trade facilitation}_{ijt} + \alpha_3 * \text{Source code}_{ijt} + \beta_{it} + \gamma_{jt} + \vartheta_{ij} + \epsilon_{ijt} \quad .....(2.1)$$

Due to collinearity, the following specifications are estimate separately:

$$\text{Exports}_{ijt} = \alpha_0 + \alpha_1 * \#\text{Articles std}_{ijt} + \beta_{it} + \gamma_{jt} + \vartheta_{ij} + \epsilon_{ijt} \quad .....(2.2) \text{ and}$$

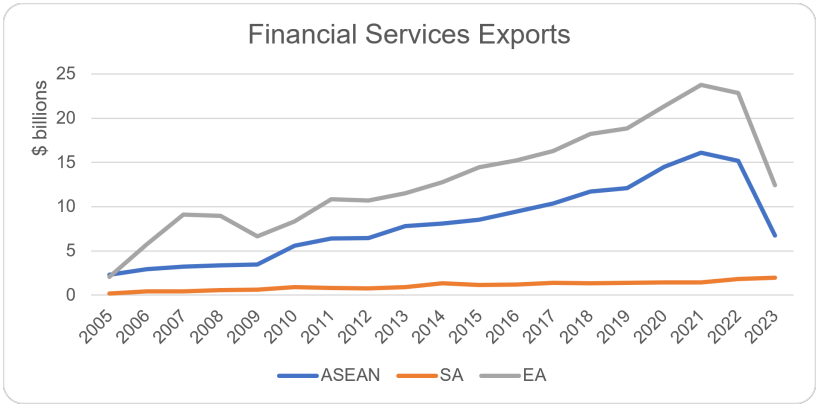
$$\text{Exports}_{ijt} = \alpha_0 + \alpha_1 * \text{Consumer Protection}_{ijt} + \beta_{it} + \gamma_{jt} + \vartheta_{ij} + \epsilon_{ijt} \quad .....(2.3)$$

Each of the equations (1.1) through (2.3) are estimated using the Poisson Pseudo Maximum likelihood (ppml) with high dimensional fixed effects (hdfe). This is in line with the estimation methods used in the literature given the presence of a number of zeros in the dependent variable, i.e., exports of the selected services as well as tackling heteroscedasticity issues (Santos Silva and Tenreyro, 2006). The use of exporter-year, importer-year and exporter-importer fixed effects handles endogeneity due to trade agreements and in line with Baier and Bergstrand (2007). Basic trend analyses of exports of each service from Asia are presented first, followed by the estimation results in the subsequent sections.

Services exports: Analysing basic trends. Basic trends of financial and insurance and pension services exports from Asia and its sub-regions i.e., ASEAN, East Asia and South Asia are examined. Regional similarities in trends and country shares in exports from a region are reflected upon to help interpret results obtained in the more detailed empirical analyses in the next section.

Financial services exports. Figure 3 presents financial services exports from East Asia, ASEAN and South Asia.

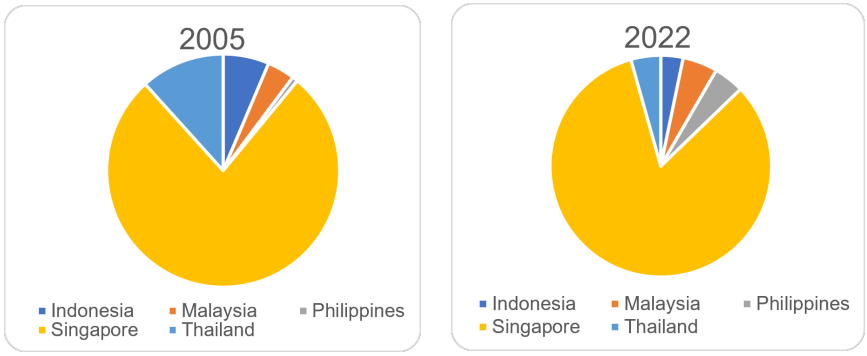
Figure 3. Financial services exports from ASEAN, East Asia and South Asia



Source: Author's compilation using TISMOS statistics.[12]

East Asia has the highest share of exports of financial services followed by the ASEAN countries and South Asia. Financial services exports in the latter have grown at a far lesser rate and are a fraction of other Asian regions in this study (figure 3). Post-pandemic, ASEAN exports decreased more than they did in East Asia, and South Asia's exports of financial services did not decline. More than 90% of South Asia's financial services exports are attributable to India alone.

Figure 4. Financial services export shares among ASEAN-5 countries



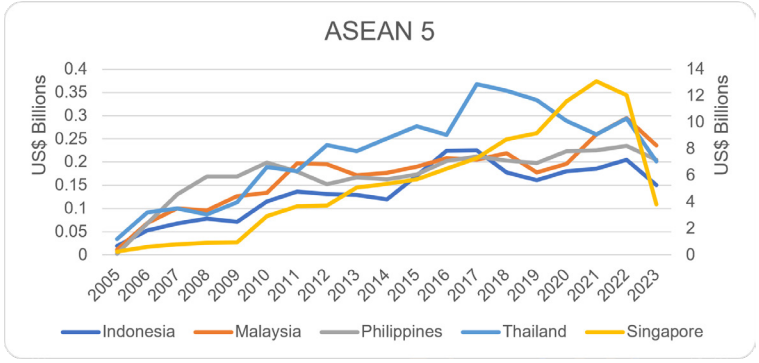
Singapore has held the highest share of financial services exports, exceeding 45% in total financial services exported from the ASEAN-5 countries.[13] Between 2005 and 2023 the shares of Thailand and Indonesia have shrunk while Malaysia and

[12] All figures up to figure 18 are sourced from the TISMOS database and, as such, the source is not repeated for each figure.

[13] The other five ASEAN countries are not shown, as their share is extremely small compared to the five countries shown here.

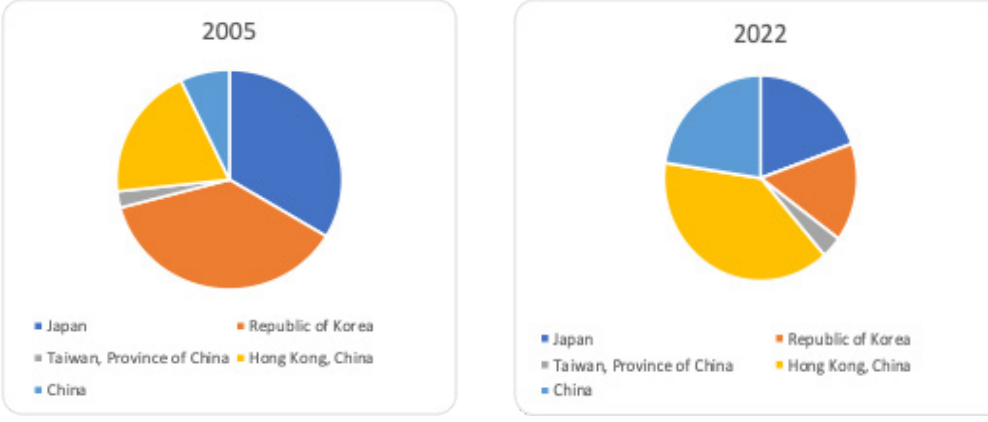
Philippines have seen increases in their shares. Focusing on the time trends, figure 5 reveals that financial services exports from Thailand and Indonesia peaked in 2017 and declined thereafter. This is not true for Malaysia and Philippines, whose exports have grown steadily and the value only declined in 2023. Singapore's values are to be read off the right axis as it is an outlier compared to the rest of ASEAN. Steady growth is observed in Singapore's financial services exports until 2021 and a fall in exports in 2022 and 2023.

Figure 5. Country shares in financial services exports among ASEAN-5 economies



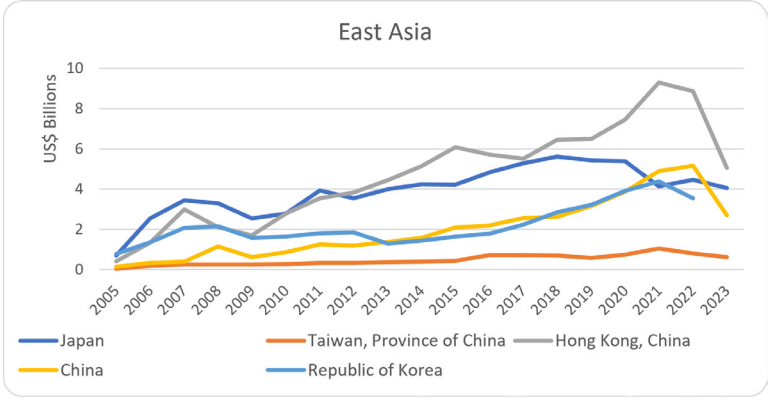
Focusing on East Asia shows that PRC and Hong Kong, China have together increased their shares in total East Asian exports of financial services. Japan's share has shrunk while Taipei,China's share increased by 1% between 2005 and 2022 (figure 6). The ROK's share also declined in contrast to the phenomenal rise of Hong Kong, China and PRC. The ROK's share decreased from 37% in 2005 to around 15% in 2022.

Figure 6. Country shares in total financial services exports from East Asia



Hong Kong, China is the largest exporter of financial services in East Asia and has performed consistently better than Japan since 2010 (figure 7). The ROK stands out with a steady increase in financial services exports from 2013 and did not experience the massive drop in 2022 or 2023 that Hong Kong, China; PRC; and Japan did.

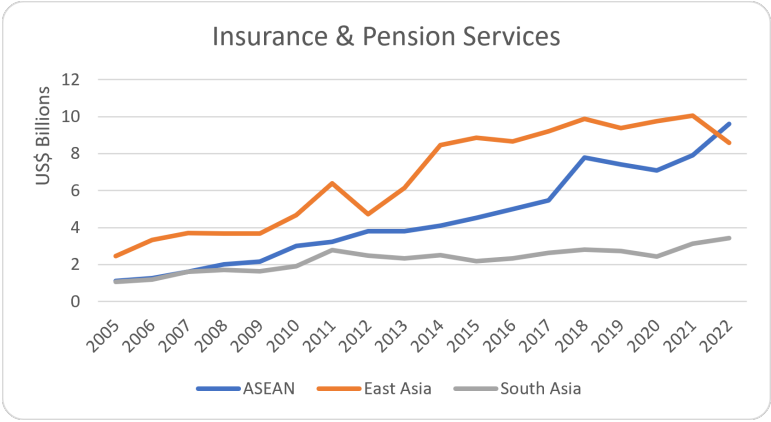
Figure 7. Financial services exports from East Asia



Given low volumes across countries in South Asia, similar analysis is not presented; however, India accounts for more than 90% of exports of financial services from South Asia and its time trend is as observed in figure 3. It has not faced the kind of fluctuations seen in East Asia and the value remains humble on compared with the other Asian regions in this study.

Insurance and pension services. In insurance services, while East Asia has had the highest regional share traditionally, in the aftermath of the pandemic, ASEAN has exported higher value and as of 2022 had higher exports of insurance and pension services than East Asia (figure 8). South Asia's exports of insurance and pension services remain much lower but have grown post-pandemic, in contrast to East Asia.

Figure 8. Regional trends in exports of insurance and financial service



Delving deeper into ASEAN trends first, Singapore's share of exports dominates all other countries in ASEAN, and the share has only increased, reaching 86% in 2022. Malaysia has seen its share decline from 25% in 2005 to 6% in 2022 (figure 9).

Figure 9. Country shares in insurance and pension services exports

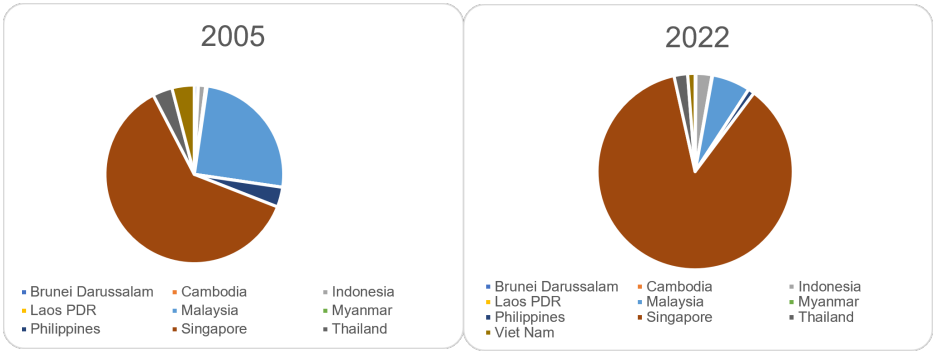
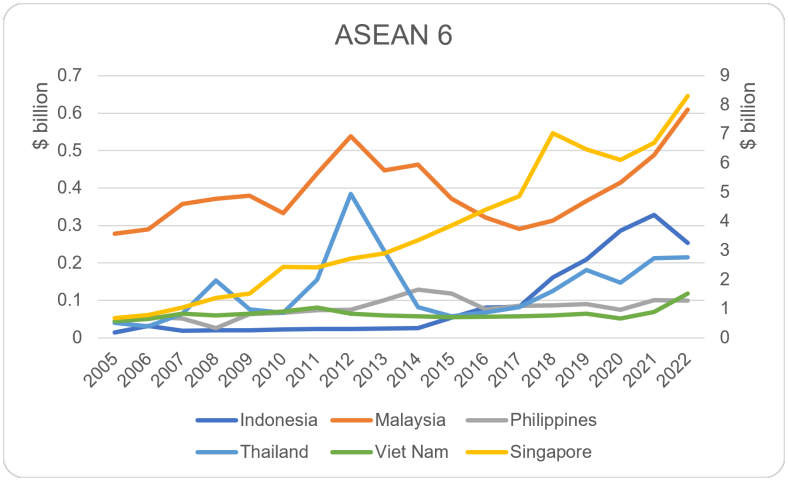


Figure 10 shows continuous growth in exports of insurance services for Malaysia from 2017, despite its declining share seen above, followed by Indonesia and Thailand. Viet Nam is seen to be picking up in the post-pandemic phase. Singapore's values are measured along the right axis given its values are much larger than other countries in the graph. It maintains its share being the fastest growing exporter of said services. Exports from Singapore increased consistently from 2008. While COVID-19 led to a decline in exports from Singapore, they have picked up since 2021. The decline in financial services exports in the previous sub-section is not seen for insurance and pension services.

Figure 10. Exports of insurance and pension services from key ASEAN economies



Turning to East Asia, between 2005 to 2022 PRC's share in east Asia's exports has more than doubled from 22 per cent to 53 per cent (figure 11). Japan accounts for a quarter of insurance services exported from Asia as of 2022 and its share has shrunk. Shares of ROK; Hong Kong, China; and Taipei,China have also gone down during the sample period.

Figure 11. Country shares in East Asian exports of insurance and pension services

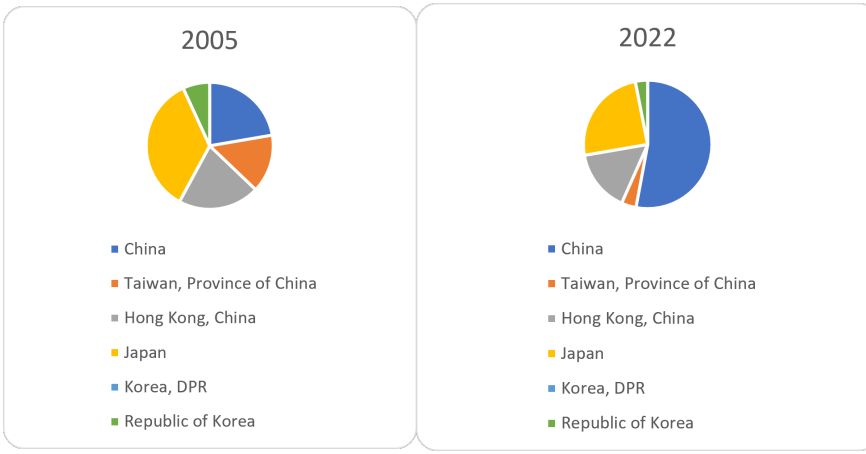
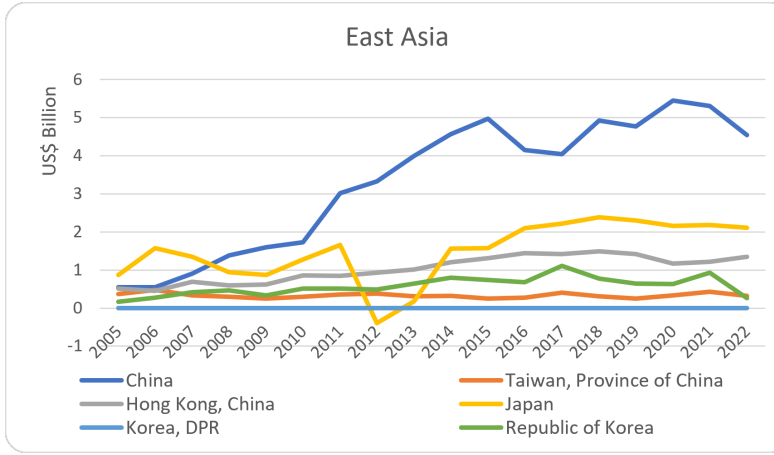


Figure 12 shows a pronounced rise in exports of insurance services from PRC after 2010 which hit a plateau during the first era of US President Donald Trump and the US-PRC trade tension. Japan, the second largest exporter of insurance services in East Asia, has seen fluctuations in the aftermath of the financial crisis but has been steady with no growth. The level of insurance services exports has been almost constant without much growth for Japan; Hong Kong, China; Taipei,China; and the ROK.

Figure 12. Insurance and pension services exports from East Asia



For insurance and pension services, ASEAN shows promising growth in the recent past while East Asia has stabilized. This has resulted in ASEAN moving past East Asia in its total value of exports of insurance and pension services. South Asia's trends are in line with India and similar to what is reflected in figure 8. Slow growth is observed in the export of insurance and pension services.

While the broad trends for ASEAN and East Asia for financial and insurance services are broadly similar, notable differences are observed. The following section examines the role of digital trade facilitation and the depth in e-commerce-related commitments in influencing either of the two services exports, building on the trends discussed in the present section.

IV. ESTIMATION RESULTS

The study sequentially presents estimation results for financial services exports and insurance and pension services exports.

It begins with the effect of the presence of free trade agreements, the total depth of agreements and their role in facilitating exports from Asia as a whole followed by region specific results for East Asia and ASEAN respectively (see equation 1.1). The results are presented separately for the whole period as well as specifically for post-2018, which marks the onset of COVID-19 and any changes in patterns following COVID-19.

Second, the study presents results capturing the effect of scope, i.e., data protection scope in the trade agreements, commitments on cross-border data transfers, and a more detailed structure of the services trade agreement on service exports (reflected in a higher number of chapters dealing with various aspects of services trade). The results are reported separately for the full sample period and for the post-2018 period (see equation 1.2).

Third, the analysis examines the effects of facilitating e-commerce provisions in trade agreements and their effect on Asian exports, East Asian exports and ASEAN exports of the services for the whole period and post-2018 (see equations 2.1 to 2.3 above). The next subsection focuses on financial services, followed by an analysis of insurance and pension services.

Financial services. Benchmark regression results (Table 2) suggest that a trade agreement has a significant positive impact on Asian exports of financial services, and the impact is higher for exports from ASEAN nations. However, an FTA's effect on exports of financial services from the East Asian countries is absent.

FTAs have become more important in promoting exports from ASEAN and Asia in general since the COVID-19 pandemic. However, this effect is absent when one talks about exports of financial services from East Asian economies.

Table 2. Estimation results for financial services exports from Asia

	(1) Asian exports	(2) Asian exports	(3) ASEAN exports	(4) East Asia exports	(5) Asian exports post-2018	(6) ASEAN exports post-2018	(7) East Asia exports post-2018
FTA	0.12*	0.17*	0.29**	-0.10	0.32***	0.33**	0.20
Total depth		-0.00	0.00	-0.00	-0.00	-0.00	-0.00
Constant	6.42***	6.42***	6.15***	6.65***	6.77***	6.43***	7.08***
N	4671	4671	2987	2697	1386	876	791
Exporter-time	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-time	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Pseudo	0.97	0.96	0.96	0.98	0,98	0.98	0.99

Source: Author's computation.

As financial services support goods trade in East Asia (Urata and Kiyota, 2003) (Urata and Kiyota, 2003), and PRC's exports have grown phenomenally even without trade agreements alongside a marked rise in financial services exports, this pattern helps explain the results obtained. Irrespective of whether goods are exported through digital e-commerce or otherwise, trade finance services, insurance services for goods exported (digitally or otherwise), easy loan services for goods exported through e-commerce are a necessity.

While other digitally delivered services may be exported either on their own or when goods are traded digitally, financial intermediation services may be traded even when goods are traded through traditional channels. In our results, total digital depth of agreements seems to have no impact on exports of financial services through mode 1 from Asia. The following estimation results therefore examine whether specific depth-related provisions affect financial services exports from the region differently.

The inclusion of data protection in services trade agreements has always positively facilitated financial services exports from East Asia (Table 3). However, the same is not true for the Asian region in general. In fact, provisions of data protection have inhibited financial services exports from the region and especially from Southeast Asia. In the post-2018 phase, however, data protection provisions positively affect financial services exports from both ASEAN and East Asia.

Greater depth of agreements in facilitating cross-border data transfers have negatively affected financial trade flows (Table 3). It appears that countries signing up for greater depth in cross-border data flows need not be exporting a lot of financial

services. Finally, addressing various modes through different chapters rather than in one single chapter (expecting deeper commitments) does not seem to influence financial services exports from Asia.

Table 3. Estimation results for scope and depth indicators influencing Asian financial services exports

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Asian exports	ASEAN exports	East Asia exports	Asian exports post-2018	ASEAN exports post-2018	East Asia exports post-2018
Data protection	-0.23***	-0.31***	0.97***	0.10	0.24*	0.52*
Cross-border flow	-0.40***	-0.08	-0.45*	-1.73***	-2.30***	(omitted)
Structure	0.01	-0.05	-0.18***	-0.17*	-0.26**	0.03
Constant	6.49***	6.27***	6.83***	7.35***	6.86***	6.98***
N	4671	2987	2697	1386	876	791
Exporter-fixed	Yes	Yes	Yes	Yes	Yes	Yes
Importer-fixed	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-im-porter	Yes	Yes	Yes	Ye	Yes	Yes
Pseudo R^2	0.97	0.96	0.98	0.98	0.98	0.99

Source: Author's computation.

Hence deeper commitments in general do not seem to affect financial services exports from Asia, but wider scope in FTAs with provisions guarding data protection have become relatively more important in the immediate past only. Provisions of data protection along with other commitments came into force in a major way after 2018 (figure 2) and these in turn would have impacted the growing relevance of the same post-2018. Further analysis focuses on e-commerce specific provisions and assesses their influence on financial services exports from Asia, East Asia and ASEAN.

Asia. Successive trials with alternate attributes of facilitating e-commerce through trade agreements have led to the results presented in table 4. Most agreements which facilitate e-commerce and digital trade cover all the attributes discussed. Hence, the attributes are highly correlated and are not included simultaneously in the same estimation exercise. The presented results include the attributes which show the most significant results.

Table 4. Estimation results of e-commerce depth indicators influencing financial services exports from Asia

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Asian exports	Asian exports	Asian exports	Asian exports post-2018	Asian exports post-2018	Asian exports post-2018
EC3_sum	0.08***			0.06*		
Dig. trade facilitation	-96.23***			-23.93		
Source code protection	30.90**			26.01*		
# articles std		3.36			9.00***	
Consumer protection			0.10**			0.15***
Constant	6.45***	6.44***	6.43***	6.84***	6.83***	6.82***
N	4671	4671	4671	1386	1386	1386
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.97	0.97	0.97	0.98	0.98	0.98

Source: Author's computation.

The EC3_sum attribute captures greater depth in the trade agreement through clear indications of which one would take precedence in case of conflict between multiple chapters, such as e-commerce, investment and services. It also captures if intellectual property protection in the context of e-commerce transactions is guaranteed. Such clarity is found to be extremely helpful in facilitating financial services exports. Digital trade facilitation deals with paperless customs procedures and electronic transferrable records. Such provisions are found to have had a significant negative impact on financial services exports from Asia, although post-2018, the effect, although still negative, is insignificant. As this attribute is expected to primarily affect goods trade, the effect on financial services exports may be peripheral and not direct. Additionally, as observed in table 4, provisions for electronic transfer of records, etc., have had a negative impact on financial services exports in general.

Finally, agreements that prohibit the transfer or access to the source code of software, algorithms, proprietary information about cryptography, encrypted communication etc.—as a condition for import, distribution of software and other things—have a highly significant effect on exports of financial services from Asia. This effect is strongest in facilitating financial services exports. Post-2018, other depth conditions have become more important, but this attribute still has a very strong effect on facilitating financial services exports. The number of articles dealing with e-commerce is often used as a measure of depth of commitments. Post-2018, this attribute

becomes highly significant in explaining financial services exports and remains highly correlated with other attributes. This is therefore reported separately in columns (2) and (5), respectively for the entire sample period and the post-2018 period. Finally, provisions committing to consumer protection in e-commerce transactions in free trade agreements is extremely important for increasing financial services exports from Asia. This is expected. The discussion next examines the specific effects observed for East Asian and ASEAN economies.

East Asia. When focusing on East Asian economies alone, the results run counter to what has been observed (Table 5). East Asian exports of financial services are negatively affected by greater commitments to EC3, i.e., clear directions on which chapter takes precedence among e-commerce, services or investments in the case of conflicts, protection of IP rights in e-commerce transactions, etc. It is possible that East Asia has been a significant exporter of financial services (such as Japan) from before such commitments were made and in post-2018, but the effects of this turn out to be insignificant.

Table 5. Estimation results of e-commerce depth indicators influencing financial services exports from East Asia

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	East Asia exports	East Asia exports	East Asia exports	East Asia exports post-2018	East Asia exports post-2018	East Asia exports post-2018
EC3_sum	-0.09**			-0.04		
Dig. trade facilitation	-36.49			26.09		
Source code protection	8.07			13.71		
# articles std		-6.72***			2.33	
Consumer protection			-0.15***			-0.02
Constant	6.64***	6.56***	6.58***	7.11***	7.06***	7.09***
N	2697	2697	2697	791	791	791
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.98	0.97	0.98	0.98	0.98	0.98

Source: Author's computation.

Digital trade facilitation through paperless trade or protection against the requirement of sharing source code, appropriate encryption, etc., have no impact on exports of financial services from East Asia. Provisions for consumer protection in case of e-commerce transactions seems to have no impact in the post-2018 period and

shows a negative impact in the whole period of study. Once again, it may be possible that high values of exports from East Asia before such commitments came into the picture of free trade agreements may justify these results.

ASEAN. In the ASEAN case (table 6), e-commerce related depth—i.e., intellectual property rights protection, directions towards precedence of commitments in case of conflicts across services, investment and e-commerce chapter—the presence of e-commerce in the services chapter helps promote financial services for its exports. Digital trade facilitation has a seemingly negative impact whose significance is reduced in post-2018. Protection against sharing source code, algorithms of software are found to be relatively insignificant in promoting exports of financial services from ASEAN post-2018. General e-commerce depth of the agreement measured through number of commitments is highly significant as is consumer protection in promoting exports of financial services from ASEAN. The next section examines insurance services, comparing the results with those for financial services.

Table 6. Estimation Results for E-commerce Depth Indicators Influencing Financial Services Exports from ASEAN

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	ASEAN Exports	ASEAN Exports	ASEAN Exports	ASEAN Exports post-2018	ASEAN Exports post-2018	ASEAN Exports post-2018
EC3_sum	0.26***			0.34***		
Dig. trade facilitation	-107.63***			-82.50**		
Source code protection	31.95*			-7.37		
# articles std		17.18***			12.43***	
Consumer Protection			0.27***			0.20***
Constant	6.22***	6.19***	6.20***	6.54***	6.51***	6.52***
N	2987	2987	2987	876	876	876
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-Importer	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.97	0.97	0.96	0.98	0.98	0.98

Source: Author's computation.

Insurance and pension services. Columns 1 and 2 in table 7 reveal that for total exports of insurance and pension services from Asia, free trade agreements and the overall depth of trade agreements have had a positive influence on exports. This

contrasts with financial services exports, in which overall depth had no influence. However, a closer examination indicates that exports of insurance and pension services from ASEAN remain unaffected by the presence of an FTA over the full sample period but are positively influenced in the more recent post-2018 period. This contrasts with the trends in East Asia, where FTAs have not influenced exports in the recent past but have had positive influence in the whole sample period.

Table 7: Estimation results for insurance and pension services exports

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Asian exports	Asian exports	ASEAN exports	East Asia exports	Asian exports post-2018	ASEAN exports post-2018	East Asia exports post-2018
FTA	0.23**	0.16*	-0.03	0.76***	0.23**	0.25**	0.22
Total depth		0.35*	-0.12	0.04	-0.09	-0.43**	0.24
Constant	4.62***	4.60***	4.89***	3.65***	4.67***	4.76***	4.18***
N	4715	4715	2954	2695	1458	897	858
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.93	0.92	0.93	0.88	0.95	0.95	0.94

Source: Author's computation.

While ASEAN exports were influenced by the presence of FTAs, total depth had a negative influence on the exports. Further analysis is undertaken by incorporating additional indicators of FTA depth in the subsequent results. Table 8 indicates that provisions of cross-border data flows in FTAs have facilitated exports of insurance and pension services from Asia, particularly from ASEAN economies. This is not true about exports from East Asia. East Asian exports have been strongly influenced by overall depth of agreements, reflected by a greater number of chapters of services trade commitments by mode. Post-2018, Asian exports continue to be influenced by cross-border data flow commitments along with ASEAN. Data protection commitments, which were more important for financial services exports have no significance for insurance and pension services.

Table 8. Estimation results of scope and depth indicators on Asian exports of insurance and pension services

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Asian exports	ASEAN exports	East Asia exports	Asian exports post-2018	ASEAN exports post-2018	East Asia exports post-2018
Data protection	0.10	0.05	0.29	-0.10	-0.24	0.05
Cross-border flow	0.52**	0.84***	-0.41	0.49*	0.77**	(omitted)
Structure	0.03	-0.18***	0.25***	-0.17	-0.15	-0.34**
Constant	4.62***	4.97***	3.53***	4.97***	4.90***	5.33***
N	4715	2954	2695	1458	897	858
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.92	0.93	0.88	0.95	0.95	0.93

Source: Author's computation.

The subsequent subsections examine specific e-commerce-related provisions and their influence on insurance and pension services exports, with particular attention to post-2018 effects.

Asia. Estimation results for the impact of e-commerce related depth on insurance and pension services exports from Asia (Table 9) differ significantly from what was observed for financial services exports. Columns (1) and (4) are examined first. The EC3_sum (which captures the clarity of precedence in case of conflict between provisions across chapters on e-commerce, services or investment, the importance of intellectual property rights protection in e-commerce transactions) does not seem to be of as much importance for facilitating insurance and pension services trade as it was for financial services. The importance of the attribute has emerged after 2018.

Table 9. Estimation results for e-commerce depth indicators influencing insurance and pension services from Asia

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Asian exports	Asian exports	Asian exports	Asian exports post-2018	Asian exports post-2018	Asian exports post-2018
EC3_sum	0.08			0.05*		
Dig. trade facilitation	64.24*			38.90*		
Source code protection	-10.36			-11.83		
# articles std		3.62			-1.58	
Consumer protection			0.07			0.02
Constant	4.61***	4.68***	4.69***	4.66***	4.78***	4.75***
N	4715	4715	4715	1458	1458	1458
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Pseudo	0.92	0.92	0.92	0.95	0.95	0.95

Source: Author's computation.

In contrast with financial services, digital trade facilitation is of significant importance in promoting insurance and pension services exports from Asia. This is possible because a good part of insurance services exports could be linked to trade in products and paperless international commerce may increase insurance services exports. The attribute is most important in promoting insurance and pension services exports. Turning to the non-requirement of sharing the source code, algorithm of software or encrypted information, this attribute is significant in explaining variation in insurance services exports from Asia. Once again, this is in contrast with what was observed in financial services exports. Columns (2), (3), (5) and (6) reveal that depth of e-commerce-related commitments measured by number of articles dedicated to e-commerce in the agreement and consumer protection for digital transactions does not matter in promoting insurance and pension services exports.

East Asia. When the estimation results are analysed for East Asia alone (Table 10), the observed trends differ markedly from the rest of Asia. Provisions related to intellectual property protection for e-commerce related transactions, focused hierarchy of chapters in case of conflicts between services, investment and e-commerce chapters etc., comes out as highly significant for exports of insurance and pension services from East Asia. Digital trade facilitation—i.e., paperless trade of commodities, which was very important for the whole Asian region—is insignificant for exports from East Asia, but post-2018 has played a negative role in promoting insurance services exports, similar to the results for financial services in the previous subsection. Finally, protection for source code, algorithms and encryption have only become significant post-2018 and are found to promote insurance services exports. Consumer protection for e-commerce transactions is also found to positively affect insurance services exports from East Asia on expected lines. An increased number of articles dedicated to e-commerce in a trade agreement does not help promote exports of insurance services.

Table 10. Estimation results of e-commerce depth indicators influencing insurance and pension services exports from East Asia

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	East Asia exports	East Asia exports	East Asia exports	East Asia exports post-2018	East Asia exports post-2018	East Asia exports post-2018
EC3_sum	0.17***			0.12***		
Dig. trade facilitation	74.13			-104.07**		
Source code protection	-63.48**			61.70***		
# articles std		5.17			0.88	
Consumer protection			0.22***			0.13*
Constant	3.66***	3.85***	3.79***	4.39***	4.37***	4.27***

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	East Asia exports	East Asia exports	East Asia exports	East Asia exports post-2018	East Asia exports post-2018	East Asia exports post-2018
N	2695	2695	2695	858	858	858
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes
R^2 pseudo	0.88	0.88	0.88	0.94	0.94	0.94

Source: Author's computation.

ASEAN. For ASEAN (Table 11), digital trade facilitation through paperless trading and promotion of e-commerce emerges as the most important factor, consistent with results from Asia as a whole. However, commitments to intellectual property protection for e-commerce transactions, clear direction in resolution of conflicts across chapters on e-commerce, services and investment have negative impact with marginal significance. Source code related protection has no significant influence, nor does consumer protection for e-commerce transactions. The number of articles dedicated to e-commerce shows up with a negative impact post-2018.

Table 11. Estimation results of e-commerce depth indicators influencing insurance and pension services exports from ASEAN

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	ASEAN exports	ASEAN exports	ASEAN exports	ASEAN exports post-2018	ASEAN exports post-2018	ASEAN exports post-2018
EC3_sum	-0.15*			-0.10*		
Dig. trade facilitation	113.96***			87.75***		
Source code protection	10.25			5.19		
# articles std		-3.74			-3.72*	
Consumer protection			-0.11			-0.02
Constant	4.84***	4.89***	4.89***	4.78***	4.84***	4.82***
N	2954	2954	2954	897	897	897
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Pseudo	0.93	0.93	0.93	0.95	0.95	0.95

Source: Author's computation.

In sum, it appears ASEAN may be less mature as an exporter of insurance and pension services than East Asia. For the latter, clarity in importance of e-commerce in conflicts with other chapters, intellectual property rights and consumer protection come out as most important, but for ASEAN, digital trade facilitation (paperless trading) is most important, especially post-2018. This the opposite of what was observed for East Asia, where the same may have been facilitated by all constituent countries quite some time back. This section synthesizes the results and points to relevant policy implications discussed in the next section.

V. CONCLUSION

Digital tradability of services has resulted in increasing provisions under free trade agreements to facilitate cross-border trade in services through mode 1, especially post-COVID-19. The study examines the influence of e-commerce facilitating provisions contained in trade agreements to understand the differential impact of each provision on financial services and insurance and pension services. Available statistics indicate that these services are traded through mode 1 (cross-border) only.

Analysing basic trends, financial services exports from East and Southeast Asia grew steadily up to 2021 and subsequently declined. South Asia (with a lower base) has not seen a similar fall in value of exports. Incidentally, most of the digital trade enabling provisions came into force between 2020 and 2021.

For financial services, trade agreements are revealed to be important for exports from ASEAN and the Asian region as a whole but not for East Asia. Total e-commerce depth does not seem to impact financial services exports from Asia, but individual depth attributes are found to be important. Commitments on data protection in trade agreements tend to drive financial exports from the region. However, countries with commitments on cross-border data transfers or with a higher number of articles promoting digital e-commerce show a reduced value of exports of financial services. Data protection emerges as hugely important for financial services exports from Asia. A close examination of e-commerce specific provisions yields the following conclusions.

First, East Asia's exports of financial services remain relatively unresponsive to e-commerce related commitments in FTAs (FTAs have had an insignificant impact on East Asia's exports, as mentioned earlier). Second, Asia as a whole and ASEAN in particular, have seen financial exports grow in response to committing to deeper e-commerce facilitation clauses including protection of intellectual property rights in e-commerce transactions, presence of e-commerce in services chapters, providing clarity on which chapter takes precedence in conflicts arising between services, investments and e-commerce chapters, etc. Third, commitments to guarantee consumer protection in e-commerce transactions and protection against requirements to share source code or algorithms of software from exporters promote financial services

exports from ASEAN and Asia in general but not from East Asia.

Insurance and pension services exports from Asia have slightly different trends compared to financial services. First, exports from East Asia mostly stagnated after 2018 and from PRC dipped significantly from 2020. Singapore and Malaysia saw steep growth of insurance and pension services exports in 2022. ASEAN thus comes out as a region guiding the growth of exports of these services in Asia. Second, from the estimation results, free trade agreements are important for promoting exports of insurance and pensions services exports from Asia. Total e-commerce depth of the agreements has a weak effect on exports. However, specific attributes are found to be of importance.

Higher scope of data protection does not impact exports of insurance services, but facilitation of cross-border data flows has a positive effect. This is in contrast to the results for financial services. A more detailed structure with higher number of chapters for different kinds of services trade modes have a favourable impact on exports from East Asia. Digital trade facilitation which promotes paperless trade has a positive influence on insurance services exports from Asia, and ASEAN in particular, but not as much from East Asia. Commitments on consumer protection for e-commerce transactions and non-requirement of sharing of source code in trade agreements (post-2018) is particularly helpful for promoting exports of insurance services from East Asia but not so much for ASEAN and Asia. Results suggest that exports of insurance services may be linked to goods trade and hence e-commerce factors which are typically associated with goods trade facilitation also help promote exports of insurance services.

In summary, the digital trade facilitation aspects that come out as thrust areas for promoting financial and insurance and pension services exports would be:

- provisions for data protection,
- consumer protection in case of e-commerce transactions,
- non-requirement for sharing source code of software,
- intellectual property rights protection,
- targeted depth in e-commerce facilitation, including clear communication for dispute resolution in case of conflicting clauses across sectors and provisions of e-commerce in services liberalization chapters in trade agreements.

This does not preclude other e-commerce facilitating measures. The above provisions are highlighted because, while many trade agreements facilitate e commerce to varying degrees of depth, they do not necessarily address these specific attributes, which emerge as key distinguishing factors in enhancing the effectiveness of trade agreements in promoting exports of financial services and insurance and pension

services from Asia.

One may additionally note that the above listed attributes actively promote SDGs 9 and 12. Data protection, intellectual property protection and non-requirements for sharing source code of software, facilitate growth of industry, innovation and sustainable infrastructure growth (SDG 9). Consumer protection in e-commerce transactions promote SDG 12 i.e. responsible consumption and production.

The analysis leads to possible areas of focus for policy makers and trade negotiators seeking to broaden trade possibilities through digital channels, especially e-commerce. It was noted that, in all cases, COVID-19 did not dampen exports of either of the two services from Asia. In fact, exports increased for most countries. This is possible primarily because these services are exported through digital channels via mode 1. This is also in line with the enforcement of multiple digital trade provisions at the time as revealed from the study. Digital trade of the services are thus sustainable in the face of pandemic risks helping build sustainable communities (SDG 11).

To improve the export potential of either of the services, digital trade and e-commerce in both finance and insurance services may be promoted through FTAs promoting e-commerce market access, non-taxation of e-commerce transactions, including e-commerce transactions in dispute settlement chapters as noted by the literature. Inking such agreements would help foster sustainable inclusive growth for Asia through formation of partnerships which together may work towards attaining the SDG goals (SDG 17).

In addition, the findings point to an increasing role for (a) clarity in trade agreements on which chapters take precedence in case of conflicts between services, investment and e-commerce in line with dispute resolution; (b) data protection; (c) consumer protection for e-commerce transactions; and finally (d) non-requirement of source code/algorithm sharing of software from exporter to importer. While these stand out as most important, other provisions like cooperation on ICT and cyber security would supplement the strength of the listed factors.

Commitments on new issues like “cross-border data flows” may also benefit trade in these services but the evidence remains mixed and needs appropriate nuanced negotiations. This is important for countries in South Asia and others which currently have low volumes in exports in both of these services and may have the potential to grow much more by adopting appropriate provisions and commitments in negotiations of services trade agreements. Adoption of common standards across agreements in Asia on the above discussed attributes have the potential for facilitating achievements of multiple SDG goals and finally and create the base for an inclusive growth in Asia.

Note on Author

Deeparghya Mukherjee is a faculty member at the Indian Institute of Management Nagpur. His research interests are in international trade and investment agreements, services trade, and digital and sustainable trade. He previously served as a Visiting Research Fellow at the National University of Singapore (NUS) and a Research Fellow at the Indian Council for Research on International Economics Relations (ICRIER), India. He holds a PhD from the Indian Institute of Management Bangalore, India and a master's degree in economics from the Delhi School of Economics.

REFERENCES

Anukoonwattaka, W., Romão, P., Shahu, N., & Duval, Y. (2024). Harnessing Digital Trade to advance the Sustainable Development Goals: An Empirical Study. ESCAP. Bangkok: ARTNeT Working Paper Series No. 237. Retrieved from https://repository.unescap.org/server/api/core/bitstreams/af0c6b1e-ad7a-4465-a6d2-3336b8919b25/content

Baier, S., & Bergstrand, J. (2007). Do Free Trade Agreements actually increase members' international trade? Journal of International Economics, 71(1), pp. 72-95.

Baker, P., & Le, L. (2023). Promoting Sustainable Development Through Digital Trade and Digital Trade Policies. Bangkok: ARTNeT Working Paper Series No. 229, ESCAP. Retrieved from https://artnet.unescap.org/index.php/publications/working-papers/promoting-sustainable-development-through-digital-trade-and-digital

Batshur, G., Jonetzko, G., Magdeleine, J., Marchetti, J., & Mattoo, A. (2024). Services . In A. Mattoo, N. Rocha, & M. Ruta, Handbook of Deep trade Agreements (pp. 111-142). Washington D.C.: The World Bank.

Burri, M., & Lazo Polanko, R. (2020). Digital Provisions in Preferential Trade Agreements: Introducing a new Dataset. Journal of International Economic Law, 23(1), pp. 1-34. doi:https://doi.org/10.1093/jiel/jgz044

Burri, M., Callo-Müller, M., & Kugler, K. (Nov 2024). TAPED: Trade Agreements Provisions on Electronic Commerce and Data Codebook. Retrieved from https://unilu.ch/taped

Chen, Q., & Shen, Y. (2024). Deep trade agreements and services trade: An analysis based on service trade provisions. The World Economy, 47(7), pp. 2909-2946. doi: https://doi.org/10.1111/twec.13563

Duval, Y., & Hardy, S. (2021). Climate Change and Trade Facilitation: Estimating Greenhouse Gas Emission Savings from Implementation of Cross-Border Paperless Trade in Asia and the Pacific. Journal of Asian Economic Integration, 3(2), pp. 190-210. doi:https://doi.org/10.1177/26316846211035567

Freund, C., & Weinhold, D. (2002). The internet and international trade in services. The American Economic Review, 92(2), pp. 236-240.

Hoffmann, C., Osnago, A., & Ruta, M. (2017). Horizontal Depth: A New Database on the Content of Preferential Trade Agreements. Policy Research Working Paper;No. 7981, World Bank. doi:http://hdl.handle.net/10986/26148

Jafari, Y., & Tarr, D. (2017). Estimates od ad valorem equivalents of barriers against foreign suppliers of services in eleven services sectors and 103 countries. World Economy, 40(3), pp. 544-573.

Kofler, G., & Sinig, J. (2019). Equalization taxes and the EU's digital service tax. Intertax, 47(2), pp. 176-200.

Lee, W. (2019). Services liberalization and global value chain participation: New evidence for heterogenous effects by income level and provisions. Review of International Economics, 27, pp. 888-915.

Margherion, L. (1998). The Emerging Digital Economy. US Department of Commerce. Retrieved from http://www.ecommerce.gov/

Nasir, S., & Kalirajan, K. (2016). Information and Communication Technology-Enabled Modern Services Export Performances of Asian Economies. Asian Development Review, 33(1),

pp. 1-27. doi: https://doi.org/10.1162/ADEV_a_00059

OECD. (1998). The Economic and Social Impact of Electronic Commerce. Paris: OECD. Retrieved from http://www.oecd.org/subject/e-commerce/ebooks/009-026.pdf

OECD. (2025). The OECD-WTO Balanced Trade in Services Database (BATiS). Paris: OECD Publishing. doi:https://doi.org/10.1787/c321a7a7-en

Roy, M. (2011). Services Commitments in preferential trade agreements: An empirical dataset. WTO Staff Working Paper.

Santos Silva, J., & Tenreyro, S. (2006). The log of Gravity. Review of Economics and Statistics, 94(1), 641-658.

UNESCAP. (2023). Asia-Pacific Trade and Investment Report 2023-24: Unleashing Digital Trade and Investment for sustainable Development. United Nations. Retrieved from https://repository.unescap.org/server/api/core/bitstreams/60761b38-a3d8-46a6-9b96-2514c102251e/content

Urata, S., & Kiyota, K. (2003). Services Trade in East Asia. In T. Ito, & A. Krueger, Trade in Services in the Asia Pacific Region, NBER East Asia Seminar on Economics (EASE), Volume 11, pp. 379-427. Univeristy of Chicago Press. Retrieved from http://www.nber.org/chapters/c10165

Wajda-Lichy, M., Fijorek, K., Denkowska, S., & Kawa, P. (2022). The impact of information and communication technology on services exports: Evidence from developed and developing economies. International Entrepreneurship Review, 8(3), pp. 69-80. doi:https://doi.org/10.15678/IER.2022.0803.05

Wang, Y., & Liu, B. (2025). The impact of digital trade rules on services trade: An mpirical Investigation from the DVA perspective. Review of International Economics, pp. 1-16.

Watson, R., Berton, P., P. L., & Zinklan, G. (2000). Electronic Commerce: The Strategic Perspective. New York, NY.: The Dryden Press.

Wu, J., Luo, Z., & Wood, J. (2023). How do digital trade rules affect global value chain trade in services?—Analysis of preferential trade agreements. The World Economy, 46(10), pp. 3026-3047. doi: https://doi.org/10.1111/twec.13412

Wymbs, C. (2000). How e-commerce is transforming and internationalizing service industries. Journal of Services Marketing, pp. 463-477. doi:https://doi.org/10.1108/08876040010347598

Xing, Z. (2018). The impacts of Information and Communications Technology (ICT) and E-commerce on bilateral trade flows. International Economics and Economic Policy, 15, pp. 565–586. doi:https://doi.org/10.1007/s10368-017-0375-5

Yin, Z., & Choi, C. H. (2023). The effects of China's cross-border e-commerce on its exports: a comparative analysis of goods and services trade. Electroic Commerce Research, 23, pp. 443–474. doi:https://doi.org/10.1007/s10660-021-09483-y

APPENDIX

Table A1.1 Financial services exports to the world by key Asian countries ($ millions) as reported in the TISMOS and BATIS datasets

Country	BATIS Data			TISMOS		
	2005	2015	2022	2005	2015	2022
Afghanistan	8	54	14	8	54	0
Australia	1,289	3,052	2,649	1,289	3,052	2,585
Bangladesh	18	71	194	18	71	194
Bhutan	0	0	13	0	0	13
Brunei Darussalam	0	1	0	0	1	0
Cambodia	11	34	39	11	34	39
China, People's Republic of	145	2,338	5,082	145	2,334	5,172
Taipei,China	1,517	2,422	3,920	1,517	2,422	3,967
Democratic People's Republic of Korea	0	0	0	0	0	0
Hong Kong, China	6,269	19,179	25,782	6,269	19,179	26,539
India	1,143	5,488	7,560	1,143	5,344	7,337
Indonesia	367	248	873	367	248	873
Japan	5,071	10,322	11,897	5,071	10,299	11,897
Republic of Korea	773	1,639	3,533	773	1,639	3,533
Lao People's Democratic Republic	0	1	2	0	1	2
Malaysia	60	336	572	60	336	572
Myanmar	0	6	3	0	6	3
Nepal	0	0	0	0	0	0
New Zealand	273	483	340	273	474	318
Pakistan	47	108	251	47	108	249
Philippines	67	414	244	67	414	249
Singapore	4,604	21,006	40,600	4,604	21,006	40,587
Sri Lanka	0	254	92	0	254	92
Thailand	72	580	748	72	580	748
Viet Nam	220	180	178	220	180	286

Source: Author's compilation using WTO-OECD BATIS and TiSMOS database.

Table A1.2. Insurance and pension services exports to the world by key Asian countries($ millions) as reported in the TISMOS and BATIS datasets

Country	BATIS			TISMOS		
	2005	2015	2022	2005	2015	2022
Afghanistan	0	6	0	0	6	0
Australia	269	414	762	269	414	784
Bangladesh	5	1	4	5	1	4
Bhutan	17	3	2	17	3	2
Brunei Darussalam	7	2	1	7	2	1
Cambodia	1	0	12	1	0	12
People's Republic of China	549	4,985	4,459	549	4976	4544
Taipei,China	365	255	318	365	255	318
Democratic People's Republic of Korea	0	0	0	0	0	0
Hong Kong, China	512	1,308	1,376	512	1308	1343
India	941	2,039	3,460	941	1985	3358
Indonesia	15	54	253	15	54	253
Japan	868	1,583	2,115	868	1579	2115
Republic of Korea	169	737	265	169	737	265
Lao People's Democratic Republic	3	11	10	3	11	10
Malaysia	278	372	610	278	372	609
Myanmar	0	0	0	0	0	0
Nepal	4	18	10	4	18	10
New Zealand	28	61	27	28	60	25
Pakistan	32	54	52	32	54	52
Philippines	40	119	100	40	119	100
Singapore	684	3,864	8,302	684	3864	8299
Sri Lanka	73	119	19	73	119	19
Thailand	40	58	215	40	58	215
Viet Nam	45	55	78	45	55	119

Source: Author's compilation using WTO-OECD BATIS and TiSMOS database.

ACKNOWLEDGEMENTS

This special theme issue of the Asia-Pacific Sustainable Development Journal (APSDJ), titled Enabling Accessibility and Inclusion through Digital Trade and E-Commerce, has been developed by the special issue editors, Jong Woo Kang (Director, ADB), Rupa Chanda (Director, ESCAP) and Sanchita Basu Das (Senior Economist, ADB).

The special issue has been made possible through the support of the Regional Cooperation and Integration Division (ERCI) of the Economic Research and Development Impact Department (ERDI) at the Asian Development Bank (ADB), as well as the Trade, Investment and Innovation Division (TIID) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The preparation of this issue was supported by ADB's Technical Assistance (TA) 10419 REG: Enhancing Research Capacity of Think Tanks in Asia and the Pacific on Issues of Regional Cooperation and Integration, which funded the ADB-led initiative Asia Think Tank Network (ATTN). Under this initiative, contributing authors collaborated closely in developing their papers over the period June 2025 to February 2026.

The papers in this issue were presented at the ATTN Forum held in October 2025, jointly organized by ADB, the Asian Development Bank Institute (ADBI), and ESCAP. The forum provided a valuable platform for the authors to engage directly with experts and policy practitioners, fostering meaningful exchange and collaboration. These interactions not only bridged research and practice but also generated insights that significantly strengthened the final versions of their papers.

The papers incorporated here underwent several rounds of revisions. The authors refined their manuscripts under the guidance of subject experts prior to the ATTN Forum. Subsequently, they incorporated further revisions based on feedback from the special issue editors to ensure the quality and policy relevance of the final contributions.

The issue has also benefitted from the guidance and contributions of several individuals. Dr. Jong Woo Kang, Director of ERCI, provided overall supervision; Dr. Sanchita Basu Das, Senior Economist at ERCI, led the project and ensured its progression, working closely with Dr. Rupa Chanda, Director of the Trade, Investment and Innovation Division at ESCAP, whose support was instrumental in bringing this volume to completion. The contributions of the ADB team—Angel Love Roque, Carol Ongchangco, Mara Tayag, Nanette Lozano, Katherine Firmeza, and Eric van Zant— are likewise recognized, with appreciation for their valuable support and assistance throughout the preparation of this issue.

Special appreciation is extended to the authors, experts, and policy practitioners whose valuable insights and expertise greatly contributed to the development of this volume:

Abdul Abiad, Deputy Chief Economist, Economic Research and Development Impact Department (ERDI), ADB

Agnes Surry, Deputy Head and Senior Capacity Building Specialist, ADBI

Aladdin D. Rillo, Managing Director for Policy Design and Operation, Economic Research Institute for ASEAN and East Asia

Andri Yudhi Supriadi, Senior Statistician, Badan Pusat Statistik Indonesia

Arief Ramayandi, Senior Research Economist, ADBI

Avik Ghosh, Assistant General Manager, Reserve Bank of India

Bambang Brodjonegoro, Dean ADBI

Cassey Lee, Senior Fellow and Coordinator, Regional Economic Studies Programme, ISEAS–Yusof Ishak Institute, Singapore

Deeparghya Mukherjee, Assistant Professor, Indian Institute of Management, Nagpur

Devi Asiati, Researcher, Center for Public Policy, National Research and Innovation Agency (BRIN)

Dil Rahut, Vice Chair of Research and Senior Research Economist, ADBI

Dina Azhgaliyeva, Senior Economist, ERDI, ADB

Dina Chhorn, Centre Director, Centre for Development Economics and Trade, Cambodia Development Resource Institute (CDRI)

Fukunari Kimura, President, Institute of Developing Economies-Japan External Trade Organization

Hadi Kardoyo, Researcher, BRIN

Homer Pagkalinawan, Officer, Climate Change and Sustainable Development Department, ADB

Ivan Cenon Bernardo, Economist, Bangko Sentral ng Pilipina

James Correia, Policy Analyst, ADB

James Villafuerte, Regional Lead Economist (Southeast Asia), ERDI, ADB

John Paolo R. Rivera, Senior Research Fellow, Philippine Institute for Development Studies

Kean Muny Nhim, CDE Trade, CDRI

Kennith G.C. Dillena, Assistant Professorial Lecturer 2, De Salle University, Philippines

Kijin Kim, Senior Economist, ERDI, ADB

Kiyoshi Taniguchi, Regional Lead Economist (Central and West Asia), ERDI, ADB

Loan Le, Chairman of the International Economics Consulting Group, (Viet Nam),

Manisha Pradhananga, Senior Economist, ERDI, ADB

Ma. Kristina P. Ortiz, Supervising Legislative Staff Officer II, House of Representatives, Philippines

Mark Carmelo Manguera, House of Representatives, Philippines

Masahiro Kawai, Professor Emeritus, University of Tokyo; Senior Fellow, Policy Research Institute, Japan Ministry of Finance; Distinguished Research Fellow, Japan Forum on International Relations; and Fellow, ADBI

Mengyuan Cai, PhD Candidate, Nanyang Technological University

Muhammad Sabil Farooq, Associate Professor and Senior Researcher, Qilu Institute of Technology

Naoyuki Yoshino, Professor Emeritus, Keio University; and Fellow, ADBI

Paul R. Baker, Chairman, International Economics Consulting Group, Rachita Gulati, Research Economist, ADBI

Ramil Huseyn, Deputy Executive Director, Center for Analysis of Economic Reforms and Communication, Republic of Azerbaijan

Rifki Weno, Executive Director, ASEAN Business Advisory Council

Roosganda Elizabeth, Senior Researcher, BRIN

Sayuri Shirai, Fellow, ADBI

Shandre Mugan Thangavelu, Head, Jeffrey Cheah Institute on Southeast Asia, Sunway University

Shu Tian, Principal Economist, ERDI, ADB

Shujiro Urata, Distinguished Senior Fellow and Professor Emeritus, Waseda University, Chairman Emeritus, Research Institute of Economy, Trade, and Industry

Sivly Houy, Research Asssistant, Centre for Development Economics and Trade, CDRI

Sri H. Rachmad, Researcher, BRIN

Suborna Barua, Professor and Chairman, Department of International Business, University of Dhaka

Sunil Kumar, Professor, South Asian University

Tasnimussaad Abdullah, University of Dhaka

Tetsushi Sonobe, Professor, National Graduate Institute for Policy Studies; and Fellow, ADBI

Thiam Hee Ng, Regional Head, Regional Cooperation and Integration, ADB

Tshilidz Marwala, Rector of the United Nations University and UNderSecretary General of the United Nations i

Wakana Asano, Asia Pacific Initiative (API) Takano Fellow, IISS-Asia

Zalina Enikeeva, Research Fellow, University of Central Asia

We also extend our appreciation to the following esteemed referees who have reviewed papers for the special issue, “Resilient Prosperity: A Multi-dimensional Pathway for Sustainable Development in Pakistan” (Vol. 33, No. 1, April 2026) and papers submitted following APSDJ’s usual submission guidelines

Faisal Abbas, Professor and the Head of the Department, Department of Economics School of Social Sciences and Humanities National University of Sciences and Technology Islamabad, Pakistan

Girijasankar Mallik, School of Business, Western Sydney University, Australia

Irmeli Mustalahti, Professor of Natural Resources Governance, Chair of Responsive Natural Resources Governance (RNRG) - Research Group, Department of Geographical and Historical Studies, University of Eastern Finland, Finland

M.A. Jabbar, Professor and Head of the Department of CSE(AI&ML) Vardhaman College of Engg. Hyderabad, India

MD Anisuzzaman, Energy division, ESCAP

Sergey Kolchin, PhD, Animal Ecology Laboratory, Institute of Water and Ecology Problems, Far Eastern Branch, Russian Academy of Sciences, Khabarovsk, Russia

Surender Kumar, Senior Professor, Department of Economics Delhi School of Economics, University of Delhi, India

Tamás Köpeczi-Bócz, Head of Department at Corvinus University of Budapest, Hungary.

Tim Adair, Professorial Fellow ARC Future Fellow, Nossal Institute for Global Health, Melbourne School of Population and Global Health, The University of Melbourne,

Vipin Joshi, Senior Technical Officer, CSIR-IIP, Dehradun, India

United Nations publications may be obtained from bookstores and distributors throughout the world.

Please consult your bookstore or write to any of the following:

Customers in: America, Asia and the Pacific

Email: order@un.org
Web: shop.un.org
Tel: +1 703 661 1571
Fax: + 1 703 996 1010

Mail orders to:
United Nations Publications
PO Box 960
Herndon, Virginia 20172
United States of America

Customers in: Europe, Africa and the Middle East

United Nations Publications
c/o Eurospan Group
Email: info@eurospangroup.com
Web: https://eurospan.co.uk/
Tel: +44 (0) 1767 604972
Fax: +44(0) 1767 601640

Mail orders to:
United Nations Publications
Unit 2 Lancaster Way
Biggleswade Bedfordshire SG18 8YL
United Kingdom

For further information on this publication, please address your enquiries to:

Managing Editor
Asia-Pacific Sustainable Development Journal

Office of the Executive Secretary
United Nations Economic and Social Commission for Asia and the Pacific

United Nations Building, Rajadamnern Nok Avenue
Bangkok 10200, Thailand
Email: escap-apsdj@un.org

For more details, please visit www.unescap.org/publication-series/APSDJ.

The *Asia-Pacific Sustainable Development Journal (APSDJ)* is published twice a year by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). It is the continuation of ESCAP's Asia Pacific Development Journal (APDJ) with an explicit recognition of sustainable development in line with the United Nations 2030 Agenda for Sustainable Development.

APSDJ provides a platform for policymakers to share their experiences. It also offers opportunities to academics and researchers in their early careers to develop their capacity for policy-oriented and applied research.

ISBN 978-92-1-157945-1