Studies in Trade, Investment and Innovation No. 99

Navigating digital trade towards sustainable development: Empirical insights and policy implications

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Economic and Social Commission for Asia and the Pacific

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Executive summary

This report explores the intersection of digital trade and the Sustainable Development Goals (SDGs),[1] offering empirical insights and actionable recommendations for policymakers. While digital trade holds immense potential to drive economic growth, reduce inequalities, and foster innovation, its benefits are neither guaranteed nor equitably distributed. Without coordinated policies, digital trade risks exacerbating existing inequities, straining environmental systems, and deepening the digital divide.

Over the past decade, digital trade has expanded rapidly, driven by technological advancements and increasing internet penetration. Exports of digitally delivered services (DDS) now constitute over 60% of global services trade, growing at an annual rate of 7%. This growth reflects not only technological progress but also the rising demand for seamless, cost-effective cross-border transactions.

For developing countries, digital trade reduces market-entry barriers, enabling micro, small, and medium-sized enterprises (MSMEs) to integrate into global value chains. E-commerce platforms and digitally enabled services equip these businesses with tools to expand their reach, diversify markets, and compete globally. On the consumer side, digital trade democratizes access to essential services like telemedicine and online education, promoting social inclusion and advancing SDGs such as Quality Education (SDG 4) and Reduced Inequalities (SDG 10).

Empirical evidence presented in the report underscores these linkages:

- **Economic Growth**: A 10% increase in the value of DDS is associated with a 1% improvement in GDP per capita, highlighting its role in boosting productivity and income growth.
- **Export Diversification**: Digital trade provisions (DTPs) in trade agreements enable developing countries and LDCs to increase their global export share, reducing dependence on traditional commodities and fostering economic resilience.
- **Social Inclusion**: Digital trade broadens access to affordable healthcare, education, and financial services, enhancing social equity and inclusion.

Challenges and risks

Digital trade offers significant opportunities for economic growth and sustainable development, but its potential is limited by a range of interconnected challenges and risks. These barriers stem from structural inequities, fragmented governance, and emerging externalities. Key issues include:

- **Digital exclusion and inequities:** The digital divide remains a critical barrier, particularly in least-developed countries (LDCs) and among marginalized groups such as rural populations and women. Nearly 75% of people in LDCs lack internet access, and even when connected, affordability and poor service quality persist. A widespread lack of digital skills and literacy further compounds this exclusion, disproportionately affecting MSMEs, rural communities, and women. Without access to affordable infrastructure and adequate training, these groups cannot fully engage in digital trade, perpetuating existing inequalities.
- **Regulatory fragmentation and trust deficits:** Fragmented, inconsistent, and outdated regulatory frameworks in areas such as data governance, cybersecurity, and cross-border transactions hinder digital trade. Conflicting rules across jurisdictions increase compliance costs and create significant barriers for MSMEs. The absence of harmonized standards also erodes trust in digital systems, exacerbated by cybersecurity threats, data breaches, and weak consumer protections. Without robust and coordinated frameworks, both businesses and consumers face uncertainty, limiting cross-border trade and collaboration.

[1] https://sdgs.un.org/goals.

- **Market concentration:** The dominance of a few multinational corporations creates "winner-takes-all" dynamics, where economies of scale and control over global platforms leave smaller economies, MSMEs, and local players struggling to compete. This market concentration skews the benefits of digital trade toward a few dominant players, exacerbating global economic inequalities and marginalizing smaller businesses, particularly in developing countries.

- **Environmental sustainability challenges:** Digital trade poses significant environmental challenges, including increased carbon emissions from e-commerce logistics and high energy demands from technologies like blockchain and cryptocurrency. The generation of e-waste from digital devices and infrastructure adds to these concerns. Without sustainability-focused policies, the environmental costs of digital trade could offset its economic benefits, hindering progress toward global sustainability goals.

Policy Recommendations

To harness the transformative potential of digital trade while addressing its challenges, this report outlines the following targeted policy actions grounded in its findings:

1. Bridging the digital divide

To ensure inclusive participation in digital trade, policymakers must prioritize:

- Expand access to reliable and affordable internet in underserved rural areas, addressing the significant disparities in connectivity.
- Launch targeted digital literacy and skills development programs to empower marginalized groups, particularly women and youth, to engage effectively in digital trade.
- Support initiatives that reduce the cost of digital tools and services, making them accessible to low-income populations).

2. Enhancing trust in digital ecosystems

Building trust is essential for fostering widespread adoption of digital trade. Key measures include:

- Strengthening cybersecurity frameworks to protect businesses and consumers from threats and breaches.
- Establishing robust data governance policies to ensure privacy and secure data exchanges, particularly in cross-border contexts.
- Enhancing consumer protection laws to address grievances and build confidence in digital transactions.

3. Harmonizing regulatory frameworks

Fragmented and inconsistent regulations create significant barriers to cross-border digital trade. To address these issues, governments should:

- Develop and adopt harmonized standards for data privacy, cybersecurity, and consumer protection, reducing compliance costs and fostering trust.
- Align domestic regulations with international best practices and frameworks, such as those discussed in the WTO Joint Statement Initiative on E-Commerce.
- Establish regional agreements that provide consistency across jurisdictions, particularly for cross-border data flows and e-commerce transactions.

4. Promoting multilateral and regional cooperation

The report emphasizes the critical role of multilateral and regional platforms in shaping cohesive and inclusive digital trade policies. Policymakers should:

- Actively participate in global initiatives such as the WTO Joint Statement Initiative on E-Commerce to align domestic policies with international standards.
- Foster collaboration through regional and global agreements to harmonize digital trade rules, reduce fragmentation, and ensure inclusive participation.
- Support South-South cooperation to share knowledge and best practices, enabling developing countries to benefit collectively from digital trade.

3. Empowering MSMEs and marginalized groups

MSMEs and women-led enterprises face unique challenges in digital markets. To unlock their potential, policies must:

- Provide targeted financial support, such as grants, loans, and subsidies, to enable MSMEs to adopt digital tools and enter global markets.
- Facilitate access to capacity-building programs that improve technical and business skills, tailored to the needs of small businesses and women entrepreneurs.
- Include MSMEs and gender-focused provisions in trade agreements, ensuring their representation and benefits from digital trade.

4. Embedding environmental sustainability into digital transformation policy

Digital trade must align with environmental sustainability goals to minimize its ecological footprint. Recommended actions include:

- Promoting green technologies and innovations, such as paperless trade and energy-efficient logistics, to reduce emissions.
- Enforcing regulations for e-waste management, ensuring the safe disposal and recycling of digital devices and infrastructure.
- Encouraging sustainable practices in e-commerce, including eco-friendly packaging and distribution systems.

In conclusion, to address these challenges and unlock the full potential of digital trade, policymakers must adopt a holistic approach that combines inclusivity, sustainability, and international cooperation.

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Abbreviations

AfT	Aid for Trade
ASYCUDA	Automated System for Customs Data
BaTiS	Balanced Trade Statistics
B2C	business to consumer
CAGR	compound annual growth rate
CPTA	Cross-border Paperless Trade Agreement
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
DCs	developing countries
DFQF	duty-free quota-free
DDS	digitally-deliverable services
DEAs	digital economy agreements
DEPA	Digital Economy Partnership Agreement
DIPs	Digital intermediation platforms
DPVs	digital provision variables
DTA	Digital Trade Agreements
DT.PC	digital trade per capita
DTPs	digital trade provisions
DTRI	Digital Trade Restrictiveness Index
DTVs	Digital trade variables
ECIPE	European Centre for International Political Economy
EDI	electronic data interchange
EIF	Enhanced Integrated Framework
ESCAP	Economic and Social Commission for Asia and the Pacific
FDI	foreign direct investment
FTAs	free trade agreements
GPA	Government Procurement Agreement
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GHG	greenhouse gas
GMV	gross merchandise volume
GNI	gross national income
GTMI	GovTech Maturity Index
IAEG	Inter-Agency and Expert Group
ICT	information and communications technologies
IMF	International Monetary Fund
IoT	Internet of things
ITA	Information Technology Agreement
ITU	International Telecommunication Union
JSI	Joint Statement Initiative
LAC	Latin America and the Caribbean
LDCs	least developed countries
MFN	most-favoured nation
MOOC	massive open online courses
MSMEs	micro, small and medium-sized enterprises
NTMs	non-tariff measures
OECD	Organisation for Economic Co-operation and Development
PPP	purchasing power parity

PTAs	preferential trade agreements
R&D	research and development
RCEP	Regional Comprehensive Economic Partnership
RDTII	Regional Digital Trade Integration Index
RTAs	regional trade agreements
SDT	Special and differential treatment
SMEs	small and medium-sized enterprises
SDGs	Sustainable Development Goals
SPS	sanitary and phytosanitary
STRI	Services Trade Restrictiveness Index
TAPED	Trade Agreements Provisions on Electronic-commerce and Data
TBT	Technical Barriers to Trade
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UNCITRAL	United Nations Commission on International Trade Law
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USDOC	United States Department of Commerce
USMCA	United States-Mexico-Canada Agreement
WCED	World Commission on Environment and Development
WDI	World Development Indicators
WTO	World Trade Organization

Introduction

Digital trade is transforming the global economy, creating opportunities to advance sustainable development and drive inclusive growth. This report examines the relationship between digital trade and the Sustainable Development Goals (SDGs), exploring how digital trade contributes to and interacts with these goals. It provides a detailed analysis of key challenges and risks while offering actionable recommendations to address barriers and align digital trade with sustainable development objectives.

The report is organized into six key chapters:

1. **Promoting Sustainable Development Through Digital Trade and Policies**: This chapter provides a conceptual overview of the links between digital trade and the SDGs, highlighting the role of digital policies in achieving inclusive and sustainable outcomes.
2. **Harnessing Digital Trade for Sustainable Development Goals**: Using empirical evidence, this chapter quantifies the contributions of digital trade to economic growth, export diversification, and social inclusion.
3. **Digital Trade and Wealth Inequality in the Asia-Pacific Region**: Focusing on the Asia-Pacific region, this chapter explores the relationship between digital trade and wealth inequality, highlighting disparities and potential corrective measures.
4. **Digital Trade Provisions in Trade Agreements**: This chapter evaluates how digital provisions in trade agreements, including digital economy agreements, influence sustainable development and foster innovation.
5. **Policy Environment for Digital Connectivity in the Asia-Pacific**: Assessing the state of digital infrastructure and policies, this chapter examines trade and investment policies, market structures, and barriers to digital connectivity in the region.
6. **Regulatory Barriers to Digital Health Interventions**: This chapter identifies key regulatory challenges that hinder the implementation of digital health initiatives, emphasizing their implications for SDG progress.

This report aims to inform policymaking by:

- It examines the empirical relationship between digital trade and development outcome.
- The report identifies critical challenges that need to be addressed to fully realize the benefits of digital trade.
- The report proposes targeted actions for governments and stakeholders to enhance digital trade participation, improve regulatory coherence, and foster sustainability.

The findings and recommendations in this report are intended to support policymakers in designing digital trade strategies that contribute to equitable growth, economic resilience, and sustainable development.

CHAPTER 1

Promoting sustainable development through digital trade and digital trade policies

Chapter 1

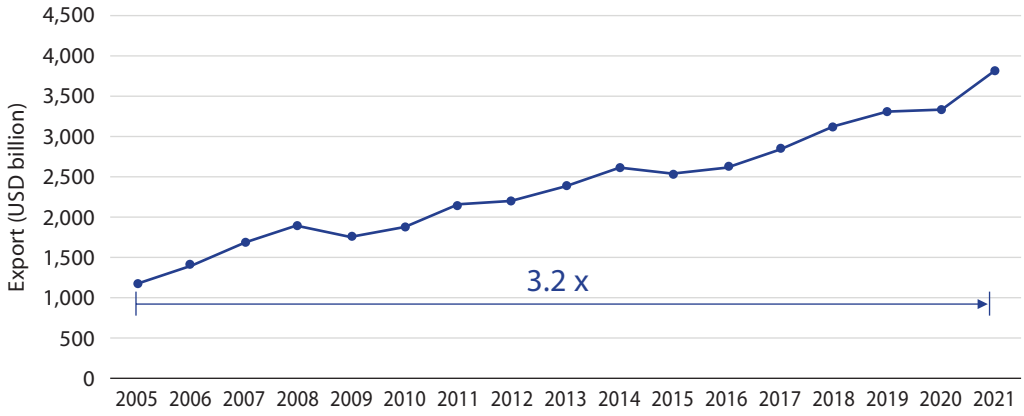
Promoting sustainable development through digital trade and digital trade policies[2]

1.1. Introduction

Digital trade has become a dynamic driver in the global economy as evidenced by its growth and the role it has played in supporting trade resilience during the recent COVID-19 pandemic. Measuring digital trade remains a daunting task for any international organization as well as national statistical agency. However, available data can be used as a proxy to indicate the size, or a portion thereof, of digital trade and the larger digital economy. In terms of e-commerce merchandise volume (the digitally-ordered trade portion of digital trade), UNCTAD estimated that global e-commerce sales amounted to $26.7 trillion globally in 2019, with B2B e-commerce representing 82 per cent of all e-commerce (UNCTAD, 2021c). The COVID-19 pandemic has undoubtedly altered shopping behaviour from offline to online (UNCTAD, 2021a). While the data for e-commerce gross merchandise volume (GMV) for 2020 onward is not yet available, it is estimated that online retail sales as a share of total retail sales jumped by 3 percentage points during the period 2019-2020 (UNCTAD, 2021b).

Trade in digitally-delivered services has also been increasing over the years, with a compound annual growth rate (CAGR) of about 7 per cent (figure 1.1). In 2021, exports of digitally-delivered services amounted to $3.8 trillion, accounting for approximately 63 per cent of global trade in services, according to UNCTADStat. The export of digitally-deliverable services[3] experienced strong growth during the period 2020-2021, demonstrating the resilience of digitally-deliverable trade during the COVID-19 pandemic.

Figure 1.1
Global exports of digitally-deliverable services, 2005-2021



Source: Data from UNCTADStat.

[2] The initial version of this paper was published as: Paul R. Baker and Loan Le (2023). "Promoting Sustainable Development Through Digital Trade and Digital Trade Policies", ARTNeT Working Paper Series No. 229, December 2023, Bangkok, ESCAP.

[3] According to UNCTAD (2022), digitally-deliverable services (DDS), or services that can be delivered over information and communications technology (ICT) networks, include ICT services themselves, sales and marketing services, insurance and financial services, professional services, back-office services, research and development (R&D), and education and training services, among others.

Digital trade is expected to bring abundant benefits to socioeconomic improvement. E-commerce provides consumers with access to online markets with a wide range of products and the ability to compare prices. On the supply side, e-commerce provides firms with easier entry and market diversification, even to markets abroad. Digital trade is expected to reduce trade costs, through digitalization and paperless trade process which can be especially beneficial for micro, small and medium-sized enterprises (MSMEs) and firms in developing countries (DCs) (see section 3).

While digital trade can bring about several benefits, there can be unintended consequences on the social side and the environment in a "no-action" scenario (see section 5). This points to the need to have a proper policy framework at both the domestic and regional levels to ensure distributive outcomes of digital trade and the larger digital transformation.

This chapter explores the linkages between the Sustainable Development Goals (SDGs), especially indicators of performance of the Goals through the contribution of digital trade. We employ proxies for measuring both digital trade (section 2) and the Goals (section 3). We then explore the linkages between digital trade and the Goals using statistical and econometric analysis (section 4). Potential undesired consequences which can arise from digital trade are also examined to give a balanced view on digital trade (section 5). With the link between digital trade and the Goals established, the chapter then explores the policies, including provisions in free trade agreements (FTAs) (section 6) and recommendations (section 7), to promote just and equitable outcomes of digital trade for all.

1.2. Digital trade – a theoretical framework

While the concepts of e-commerce and digital trade have been used widely in business as in trade policy, there is no single recognized definition of the two terms. Understanding the composition of digital trade is important for identifying the policy framework governing digital trade. To look at the scope of regulation of e-commerce, we examine the different use of the terms in existing frameworks and literature.

The UNCITRAL Model Law on Electronic Commerce (1996) does not provide a definition for the term "e-commerce", leaving it to the broad interpretation of transactions based on "electronic data interchange (EDI)" – that is, computer-to-computer communication using pre-defined standards.[4]

OECD (2011) defines electronic commerce, or e-commerce, as "*the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders*". This definition of e-commerce covers orders made in web pages, extranet or EDI, while excluding orders made by telephone calls, facsimiles, or manually typed emails (OECD, 2011).

At the multilateral level, e-commerce was introduced into the work programme of the World Trade Organization (WTO) in 1998. This led to the announcement in 2019 of a joint statement on future negotiations on electronic commerce, with the participation of 91 WTO members (as of June 2024) (WTO, 2024). The consolidated negotiating text as of September 2021 proposed that "[*Digital trade/e-commerce] means the production, distribution, marketing, sale or delivery of goods and services by electronic means*". This provides a broader definition compared with that of OECD, as it covers all transactions whereby at least one stage of commerce is done using electronic means. For example, physical sale concluded following an online marketing campaign will also be counted as digital trade/e-commerce under the definition of the WTO Joint Statement Initiative (JSI) on E-commerce. JSI, however, has not been able to make a clear-cut division of digital trade and e-commerce under the current negotiating draft text, and the two terms are often, but not always, used interchangeably (Ismail, 2020).

In an effort to build a general conceptual framework to measure digital trade, OECD, WTO and IMF (2020) define digital trade as "*all trade that is digitally ordered and/or digitally delivered*". This definition arguably has a broader coverage than the OECD (2011) definition (which is focused only on the sale), but a narrower scope than the proposed definition of WTO (2021), which covers any phase

[4] Article 2 (b) of the Model Law defines "electronic data interchange (EDI)" as the electronic transfer from computer to computer of information using an agreed standard to structure the information. See UNCITRAL (1999).

from making to selling of products. OECD further clarifies that digital trade "*encompasses digitally enabled transactions of trade in goods and services that can either be digitally or physically delivered, and that involve consumers, firms, and governments*" (OECD, n.d.). In this sense, digital trade comprises digitally ordered trade and digitally delivered trade, whereby:

- *Digitally ordered trade* is the international sale or purchase of a good or service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders. This is equivalent to the coverage of the OECD (2011) definition of e-commerce.
- *Digitally delivered trade* covers international transactions that are delivered remotely in an electronic format, using computer networks specifically designed for the purpose.

This definition, however, excludes non-monetary transactions with regard to "data" despite its undeniable role in the digital economy.[5] The movement of data, especially across borders, has becoming crucial, especially with the increasing use of new technology, such as cloud computing, Internet of things (IoT), big data analytics, or 3D printing. The use of data – without a proper regulatory framework – can act as a double-edged sword: it can help address development challenges, but also raises various concerns related to data privacy and security, competition, taxation, etc. (UNCTAD, 2019). This chapter, however, will explore only the role of digital trade as means to achieving the SDGs, while a more thorough inquiry into the impact of data flow on SDGs is suggested for future research.

1.3. The nexus between digital trade policy and sustainable development

In exploring the linkage between digital trade and sustainable development, we first consider the connection between trade and digitalization vis-à-vis sustainable development. The concept of sustainable development was first introduced by the Brundtland Commission (formerly, the World Commission on Environment and Development, or WCED) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In other words, sustainable development requires a balanced approach to achieve equitable distribution and access to resources, without locking anyone out of the opportunities. Today, it has morphed into a catch-all term that cuts across three interdependent and mutually reinforcing pillars of economic growth, social inclusion and environmental protection.

The Sustainable Development Goals, adopted by the United Nations in 2015 comprise 17 integrated objectives to serve as a "shared blueprint for peace and prosperity for people and the planet, now and into the future" (United Nations, n.d.). These 17 goals can be divided into three major pillars of sustainable development, as shown below:

[5] Data provide multiple functions in digital trade flows: a means of production, a medium for digital commercial transaction, an enabling factor for trade facilitation and a "traded" asset. "Traded" is used generally to describe the cross-border flow of data for commercial purposes, while the exchanged data do not necessarily generate payments. See OECD (n.d.); Ciuriak and Ptashkina (2018); and Ciuriak and Ptashkina (2020).

The linkage between trade and digitalization, considered separately, with sustainable development has been widely discussed. Trade is considered a means to achieve the SDGs if it is inclusive and sustainable, as recognized in the 2030 Agenda and several targets under SDG 17, Partnerships for the Goals (box 1.1). Indirectly, trade also contributes to many SDGs in one way or another (box 1.2). Equally, digitalization also, through various pathways, contributes to the realization of SDGs under all three pillars of economic, social and environmental sustainability (box 1.3). WTO (2018) estimated that technological changes are expected to increase trade growth by 2 per cent overall and up to 25 per cent for services trade, with developing countries likely to gain an increasing share of global trade subject to their ability to catch up on the adoption of digital technologies.

Box 1.1

Trade-related SDG targets

Goal 17: Partnerships for the Goals

Target 17.10: Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations within its Doha Development Agenda;

Target 17.11: Significantly increase the exports of developing countries, in particular with a view to doubling the share of least developed countries (LDCs)' global exports by 2020;

Target 17.12: Realize timely implementation of duty-free quota-free (DFQF) market access on a lasting basis for all LDCs consistent with WTO decisions, including by ensuring that preferential rules of origin applicable to imports from LDCs are transparent and simple, and contribute to facilitating market access.

Box 1.2

Evidence of trade's contribution to the Sustainable Development Goals

Goal 2: Zero Hunger. Correct and prevent trade restrictions and distortions in global agricultural markets that deny poor countries much-needed export revenue and allow for better food security; eliminate export prohibitions or restrictions on foodstuffs purchased for non-commercial humanitarian purposes.

Goal 5: Gender Equality. Trade creates opportunities for the employment and economic development of women.

Goal 8: Decent Work and Economic Growth. Aid for Trade (AfT) for LDCs via the Enhanced Integrated Framework (EIF) targeting improved regional infrastructure to improve connectivity for both the formal and informal sectors.

Goal 9: Industry, Innovation and Infrastructure. Cross-border connectivity and infrastructure, which allows for increased integration of small and medium-sized enterprises (SMEs) into global markets and value chains.

Goal 10: Reduced Inequalities. Special and differential treatment (SDT) for developing countries, according to WTO agreements.

Goal 13: Climate Action. Trade measures in environmental goods and services.

Goal 14: Life Below Water. Disciplines to eliminate harmful fishery subsidies, particularly in more developed countries.

Source: Based on Baker (2021).

Several empirical studies point to the positive connections between digitalization and sustainable development. Relevant to trade and economic growth, the literature commonly utilizes Internet connectivity as a proxy to examine the linkage between digitalization and trade. Caselli and Coleman (2001) found that computer adoption is associated with higher levels of human capital and manufacturing trade openness. Czernich and others (2011) estimated that a 10-percentage point increase in broadband penetration raises annual per capita growth by up to 1.5 percentage points. Using firm-level export performance, Clarke (2008) found that enterprises with Internet connections in low and middle-income countries export more as part of their total sales. López-González and Ferencz (2018) also pointed to the correlation between Internet use and higher market and product diversification as digital connectivity facilitate more sectors to find more customers in foreign markets. This will in turn contribute to reducing the independence and vulnerability of the economy. Andrenelli and Lopez-Gonzalez (2019) further argued that digital technologies increase export propensities of firms, especially SMEs, in developing countries. Digitalization also strengthens firms' resilience to supply shocks during the COVID-19 pandemic. Using firm-level data in the Middle East and the Central Asian subregion, Abidi, El Herradi and Sakha (2022) found that digitally-enabled firms experienced a lower decline of their sales in 2020 compared with digitally-constrained firms.

Box 1.3

Evidence of digitalization's contribution to the Sustainable Development Goals

Goal 3: Good Health and Well-being. The provisions of digital health services to allow access to health care and medicines.

Goal 4: Quality Education. The provision of online education services to allow access to education at affordable costs.

Goal 5: Gender Equality. Digitalization can be leveraged to promote the empowerment of women as entrepreneurs and traders, job creation and productive activities.

Goal 8: Decent Work and Economic Growth. Digitalization can support productive activities and decent job creation and can encourage the growth of MSMEs.

Goal 9: Industry, Innovation and Infrastructure. Digitalization can foster innovation and create new opportunities, for example smart cities, smart logistics systems and smart agriculture.

Goal 13: Climate Action. Digitalization can be leveraged to lower carbon footprints with regard to economic transactions, logistics and service delivery.

Goal 17: Partnerships for the Goals. Digital trade can boost the exports of developing countries, enabling business to expand, reach more potential customers in domestic as well as foreign markets, in a more targeted way, and often at lower cost than through traditional channels.

On the above-analysed basis of the connection between trade and digitalization with SDGs, we now consider the impacts of digital trade in contributing towards the three sustainable development pillars.

E-commerce and digital trade can support production activities, job creation, entrepreneurship and innovation (Target 8.3). This includes through the formalization of MSMEs in developing countries, as well as increasing access to ICT-enabled financial services, such as online and mobile payments, especially for the unbanked and underbanked population (OECD and WTO, 2017). The rise of e-commerce also provides employment opportunities across job categories, from website developers, sales administrators, digital marketeers, couriers, etc., thus promoting employment and decent work for all (Target 8.5). E-commerce, with the power of allowing digitally ordered goods and

services, will make trade more accessible, especially for MSMEs, to provide more goods and services and integrate better into global value chains (Target 9.3). In generalizing at the country level, digital trade offers the opportunity to diversify export products and markets, especially for less developed countries (Target 8.2).

The contributions to economic development resulting from digital channels may also have impacts on certain social and environmental aspects, either directly or indirectly. The ability to support job creation and promotion of trade opportunities for all leads to other knock-on effects, especially in social areas. For example, digital trade can contribute to Goal 1 (No Poverty) through job opportunities and raising household income; however, participation in e-commerce requires costs to access (Internet connectivity and communication devices) as well as digital skills,[6] which are related to the possible digital divide as will be further discussed in section 5. Furthermore, digital trade can be leveraged to promote women's roles as employees, entrepreneurs and traders, thus contributing to women's economic empowerment (Target 5.b). Online markets also provide information on food markets and food prices equally for businesses and consumers (Target 2.c). The bundling of services into "smart" products (such as smart watches or "smart wears") allows users to better monitor health quality (Target 3.d). Technological advancement allowing the provision of telemedicine and telehealth services contributes to access to health-care services and medicines (Target 3.8). Online education tools and platforms provide people living in remote areas access to training courses on several skills necessary for employment, decent jobs and entrepreneurship (Target 4.4) (also see box 1.4).

Box 1.4

Digital trade promoting access to education, job creation and health in developing economies

According to the UNCTAD *Digital Economy Report 2021*, overall, developed economies have a larger share of their population undertaking such activities as Internet banking, procuring information on goods and services and purchasing goods and services online. For professional development purposes, again developed economies scored a higher level of use of the Internet, except for Asian developing economies when it comes to job application.

However, when it comes to services, such as formal online courses (education) and streaming services (entertainment), other regions show greater levels of activity. For instance, 28.5 per cent of people in the Latin American and Caribbean (LAC) region take classes online. A large number of individuals in developing economies in Asia download or stream content online. These figures illustrate how digitalization of trade in goods and services can contribute to different Sustainable Development Goals concerning access to education, job creation and health care.

[6] The International Telecommunication Union (ITU) divides the digital skill sets required in current and future digital environments into three levels: (a) basic digital skills – the ability to participate in a digital ecosystem at a minimum level to access and use digital technologies to perform basic tasks; (b) intermediate digital skills – the ability to use ICT tools to perform work related tasks required for professional growth of a society and applicable to a wide range of job profiles; and (c) advanced digital skills – the knowledge to perform specialist tasks in the ICT industry to develop, manage and maintain the world of digital innovation. See ITU (2021a).

Box 1.4 (*continued*)

Table 1.1
Internet activities undertaken by individuals, by level of development and region
(Percentage)

Internet Activity	Developed Economies	Transition Economies	Developing Economies – Africa	Developing Economies – Asia	Developing Economies – LAC
Internet Banking	62.3	14.9	9.8	34.8	11.6
Getting information on goods and services	83.9	50.9	30.6	68	51.8
Purchasing or ordering goods or services	53.9	18.2	14.6	29.1	13.1
Selling goods or services	16.8	7	3.5	6.4	9.3
Interacting with government	54.5	5.7	12.1	25.6	10.7
Seeking health information	62.4	37.5	24.3	47.1	41.1
Doing a formal online course	8.1	4.5	17.5	15.9	28.5
Seeking job or submitting a job application	17.4	9.8	14.3	19.9	16.6
Participating in professional networks	21	3.6	5.9	6.4	0.7
Streaming or downloading image, movies, videos or music playing or games	57.4	52.9	64.2	66.4	50.8

Source: UNCTAD (2021).

Digital trade can lead to more traditional trade across all sectors due to the lower trade costs involved (López-González and Sorescu, 2022), and therefore increase exports of developing countries (Target 17.11). Digitalized trade processes enable more streamlined cross-border flows of goods. The adoption of e-signatures, e-contracts, e-communications and e-transferrable records can save time and costs for businesses conducting business across borders (see box 1.5). This can also arguably contribute to potential resource savings due to the paperless movement of trade (Target 15.2).

Based on the above pathway analysis, we created a map illustrating the linkage between digital trade and SDGs to the level of specific Goals, targets, and indicators, while the next section will test some of these pathways and relationships empirically. We focused the analysis of those goals with the most direct effect,[7] based on the literature presented above, and drawing on the indicators established by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) (United Nations, n.d.). The targets of the Goals and their indicators are divided according to their respective economic, social, or environmental pillars (figure 1.2). On the other hand, negative and indirect consequences of digital trade will be considered in section 5, which leads to a discussion on the possible policy measures to encounter those unintended impacts.

In order to further examine the linkages between digital trade and sustainable development, we looked into the empirical evidence for a nexus the between one digital trade index and SDG indicator.

An examination of the digitally deliverable services (DDS) trade (as a proxy for digital trade) and the share of DCs and LDCs in global exports as well as GDP per capita (as proxies for SDGs) shows a strong correlation (figures 1.3 and 1.4). The relationship between DDS and the global share of exports can be two-way. On one hand, increasing DDS through digital channels contributes to increasing the share of exports by DCs and LDCs. On the other, as noted in the existing body of literature, exports of goods increased the demand

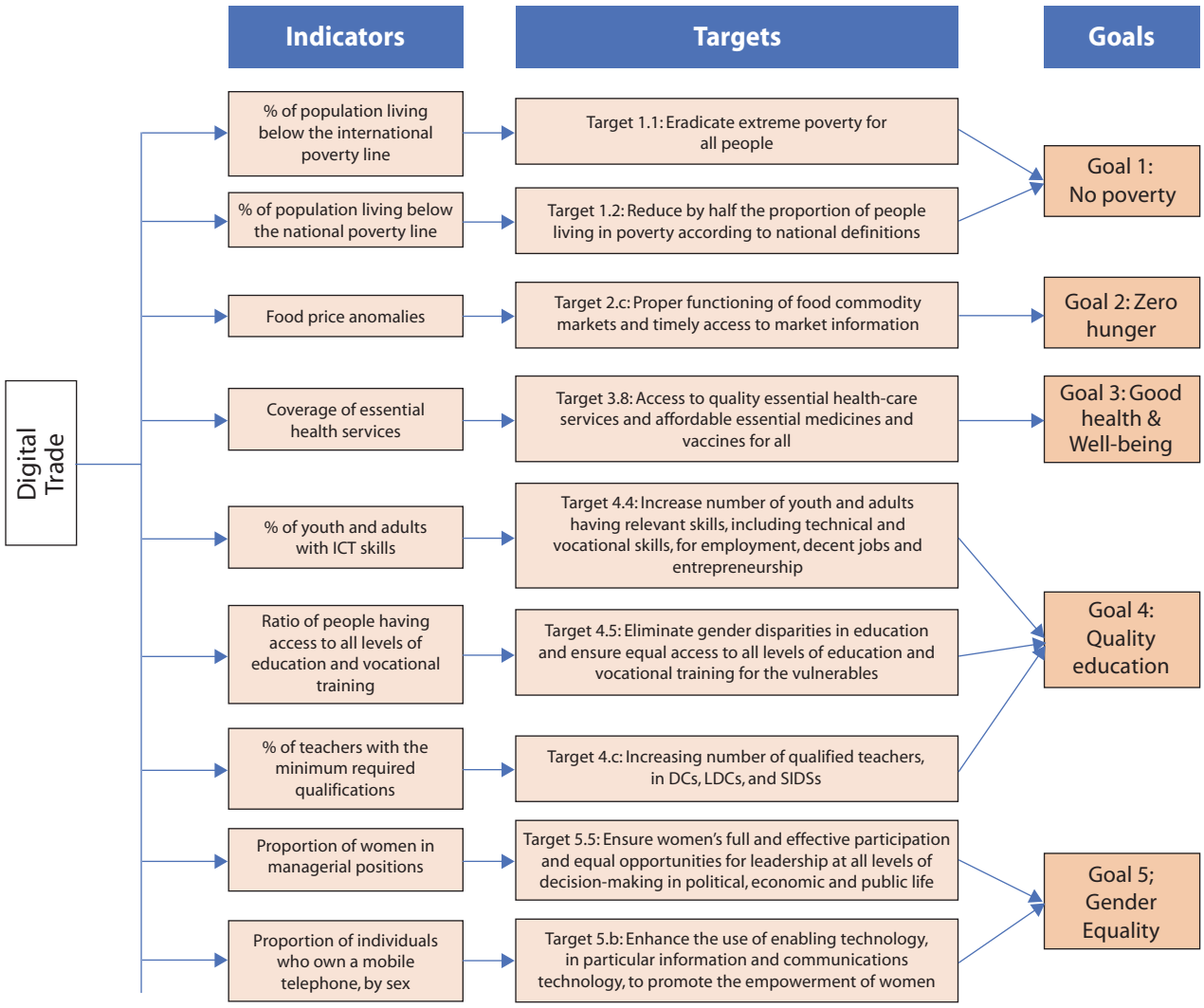
[7] For more information on other SDG indicators, please refer to United Nations (n.d.), SDG Indicators: Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development, which is available at https://unstats.un.org/sdgs/indicators/indicators-list/.

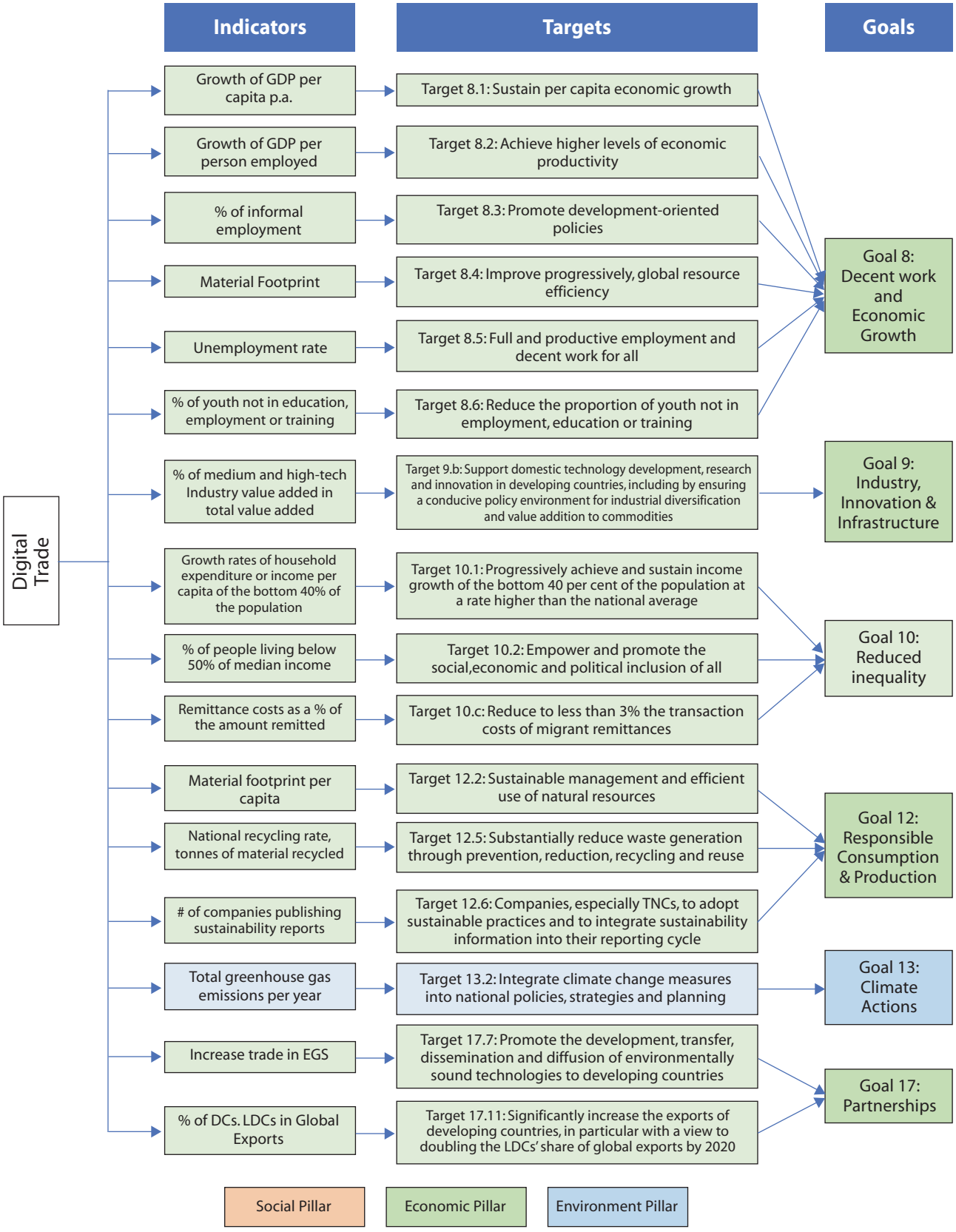
Box 1.5

Illustration of nuances involved in traditional trade flows

In 2014, Maersk found that just a simple shipment of refrigerated goods from East Africa to Europe can go through nearly 30 people and organizations, including more than 200 different interactions and communications among them. Consequently, the cost of time spent waiting for paper stamps and email replies is equal to the cost of the actual shipment (Groenfeld, 2017). On trade finance, Boston Consulting Group estimated that there are more than 20 players involved in each trade finance transaction, interacting with data fields captured in various documents (10–20 documents with more than 100 pages altogether), and generating approximately 5,000 data field interactions throughout an end-to-end process. Among those 5,000 data field interactions, there are only about 60-80 unique data fields (dates, amounts, reference numbers and others) being repeated throughout all documents. These duplications might result in discrepancies and thus errors, and inefficiency (BCG, 2017). To make the situation more complicated, each country has its own requirements regarding trade documents and the data elements they contained, as prescribed in national and relevant international regulations in such fields as health, consumer protection, safety, tax, trade policy, environment and security.

Figure 1.2
Digital trade and potential pathways to reach the Sustainable Development Goals

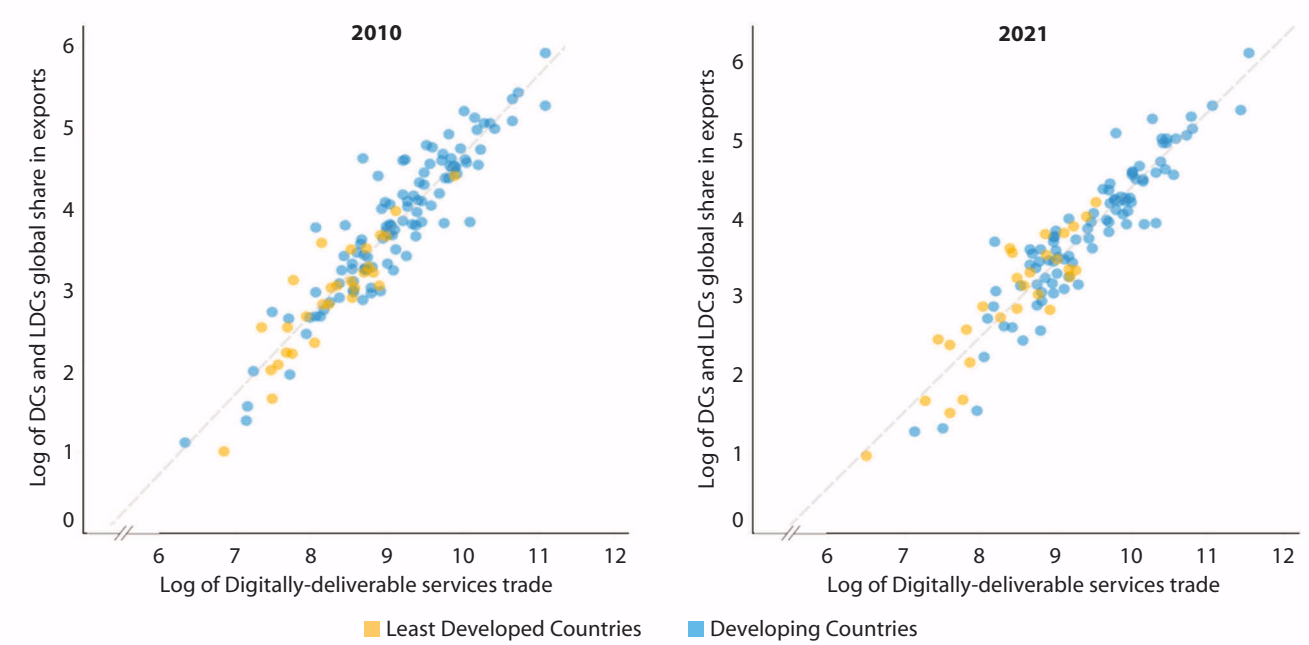




Source: ESCAP compilation.
Note: The indicators are from the official list of Global Sustainable Development Goal indicators developed by the Inter-Agency and Expert Group on SDG Indicators, which were agreed at the 48th session of the United Nations Statistical Commission held in March 2017. See (United Nations, n.d.).

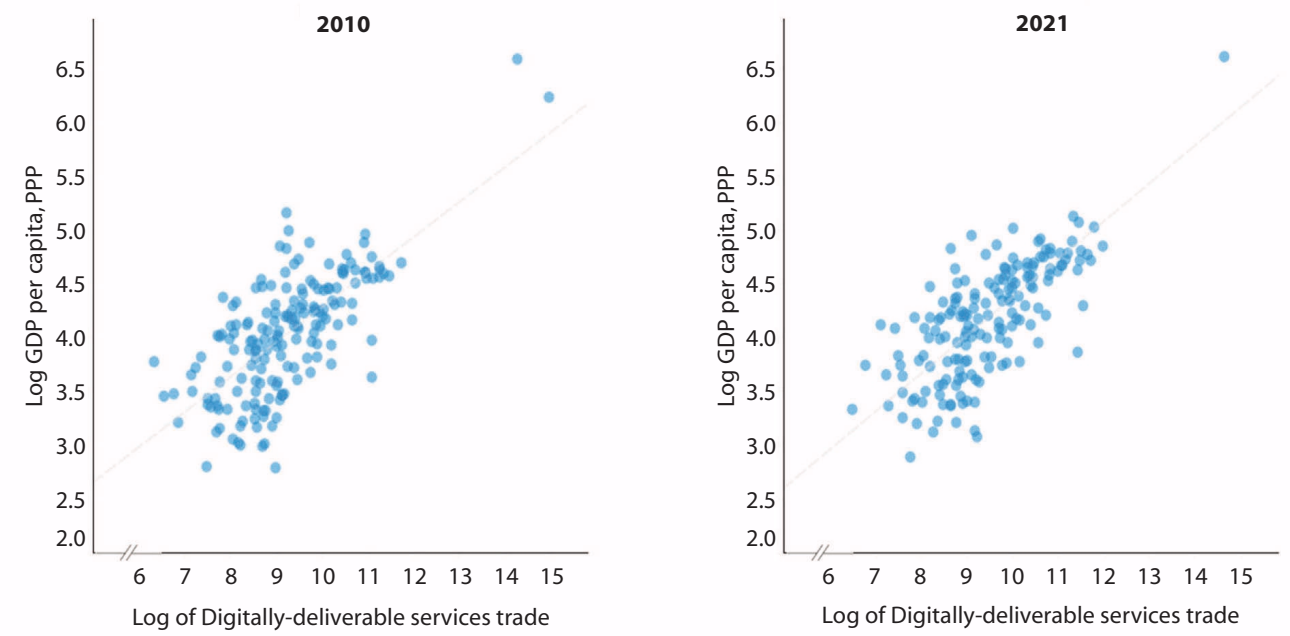
for services exports through the "network effect", especially with the use of knowledge-intensive services in manufacturing production (Hoekman and Mattoo, 2008; François and Hoekman, 2010; Eichengreen and Gupta, 2013; Sahoo and Dash, 2017). The data also show a positive correlation between digital trade and GDP per capita, which can be explained by the job creation and income generation effect of digital trade (figure 1.4).

Figure 1.3
Digitally-deliverable services trade vs. export share, by DCs and LDCs



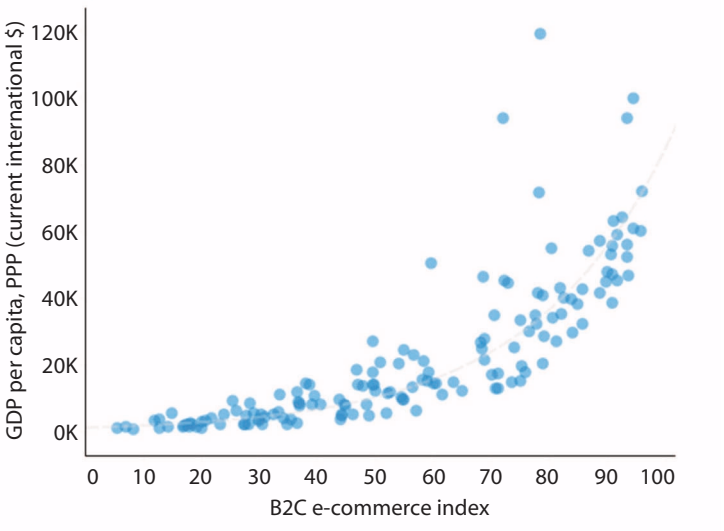
Source: ESCAP, based on data from UNCTADstats; and World Bank, World Development Indicators.
Note: Digitally-deliverable services trade = import + export flows. Global share in exports covers both exports of goods and services.

Figure 1.4
Digitally-deliverable services trade vs. GDP per capita



Source: ESCAP; UNCTADstats; and World Bank, World Development Indicators (WDI)
Note: "PPP" in the vertical axes means "purchasing power parity".

Figure 1.5
B2C e-commerce index vs. GDP per capita (PPP) (2020)



Source: ESCAP; UNCTAD stats; and World Bank, World Development Indicators.
Note: B2C stands for "business to consumer".

Based on the observed positive relationship between selected SDG indicators and some digital indicators, we proceeded to use an econometric approach to estimate the parameters of digital trade indicators on SDG indicators.

The first equation takes GDP per capita on the left-hand side of the equation, and a host of other explanatory variables on the right-hand side. Explanatory variables refer to such factors as life expectancy (as a proxy for health), literacy levels (as a proxy for skills), digital services (as a proxy of technological progress) and government efficiency (as a proxy for institutions, political, regulatory systems and administrative systems). Indicators were chosen from a search (Acemoglu, 2009).

The results indicate that a 10 per cent increase in the value of digitally-delivered services trade is associated with a 1 per cent improvement in GDP per capita of a country. This finding complements the findings in the existing body of literature, whereas services export performance contributes to increasing productivity at both the economy and firm levels, as well as to overall economic growth (François and Hoekman, 2010; Hoekman and Mattoo, 2008).[8]

1.4. Unintended externalities of digital trade

Despite all the benefits conferred on trade fuelled by digital technologies, there are also several concerns arising from a digitalization process, including market concentration, loss of privacy and security threats, the digital divide, etc. In addition to the traditional trade barriers, regulations on intellectual property rights, data flows, and privacy are likely to emerge as new sources of comparative advantage as well as trade barriers in the digital space. The distributive impact will also be likely to arise with the new business model with "winner-takes-all" dynamics and new forms of barriers, such as those that block data flows (WTO, 2018). These are even more challenging in countries where the domestic regulatory framework on digital trade has not been developed. As noted by Haddad (2022), developing countries, especially LDCs, have rarely been involved in rule-making on digital trade, and therefore specific concerns related to their development needs might not be fully reflected in digital trade talks.

[8] The analysis is provided in annex 1 in the original working paper: Paul R. Baker and Loan Le (2023). Promoting sustainable development through digital trade and digital trade policies, ARTNeT Working Paper Series No. 229, December 2023, Bangkok, ESCAP, available at http://artnet.unescap.org.

Among the most discussed concerns of digital transformation is the issue of the digital divide, which is defined as "*the unequal access and utility of internet communications technologies and explores how it has the potential to replicate existing social inequalities*" (Ragnedda and Muschert, 2013). A World Bank (2016) study on the implications of the digital economy for inclusive growth noted: "*In many instances digital technologies have boosted growth, expanded opportunities, and improved service delivery. Yet their aggregate impact has fallen short and is unevenly distributed [....] [L]abor markets have become more polarized and inequality is rising—particularly in the wealthier countries, but increasingly in developing countries*".

The World Bank GovTech Maturity Index (GTMI)[9] shows that digital inequality in the world is on the rise due to the different paces at which developed versus developing countries are implementing digital transformation (Gutierrez, 2022). The lack of inadequate infrastructure remains the main impediment to connectivity (World Bank, 2020), and thus the capability to capture the benefits of the digital transformation and digital trade. For example, ITU (2021b) found that almost three quarters of people in LDCs have never connected to the Internet, with women being particularly marginalized. Disparities in access and connectivity will amplify existing divides among, as well as within, economies and groups of society (Portulans Institute, 2022; UNESCO, 2023; ITU, 2021b; ITU, 2022). Inclusive growth will become harder as the digital transformation becomes more pervasive, thus barring the ability to connect and entry for lower-income groups. In addition to an adequate infrastructure, a stable investment and business environment created by an enabling regulatory framework will be crucial.

Lack of awareness and skills to use and benefit from e-commerce is another specific challenge. As noted by Ciurak and Ptashkina (2018), "the economics of the digital economy also promotes skewing of distributional gains, with skilled workers and connected individuals moving ahead, while others fall behind". ITU (2021a) pointed to the divide that exists between countries: while in developed countries: 65 per cent of all individuals have basic digital skills and 49 per cent have standard skills; these numbers in developing countries are much lower, at 46 and 20 per cent, respectively. This gap risks further dividing the developed and developing countries, as well as the skilled and unskilled workforce in the context of increasing digital trade and the digital economy. For bridging skill gaps, education and training therefore play a key role in equipping the workforce with the right set of skills and ensuring that everyone enjoys the benefits of the digital transformation (ILO, 2021).

Especially for women, several barriers affecting their participation in offline trade are also at play when considering e-commerce. These include lower levels of access to the Internet and technology, lower access to education and digital skills development, as well as lower capital and access to finance (Zarrilli, 2022). OECD (2018) further emphasized the inherent gender biases and sociocultural norms as the root cause of gender-based digital exclusion. These factors, in combination, lead to the disadvantaging of women and limit the accessibility of women-led businesses to benefit from digital trade.

The resulting stratification of the digital transformation also gives rise to other social concerns. For example, as a result of the ability to virtually deliver services (including through Mode 1 – cross-border provision of services), there has been a revolution of the so-called gig economy, which has changed the nature of work arrangements by providing flexible employment opportunities. However, on the downside, it also creates a gap in access to social benefits, such as unemployment insurance and health benefits (Ciuriak and Ptashkina, 2018).

Digitalization, including that used for trade-related purposes, also triggers various environmental concerns. Distribution, packaging and return of goods are the primary sources of carbon emissions directly linked to e-commerce activities. Weideli (2013) calculated that one online shopping process may leave a carbon footprint of 1.5 kg of carbon dioxide, which is much lower than that of traditional shopping. However, shopping consumer behaviours that include online shopping steps, such as conducting both online searches and store visits before making purchasing decisions, are not always

[9] The GovTech Maturity Index introduces a measure of GovTech maturity in four focus areas — supporting core government systems, enhancing service delivery, mainstreaming citizen engagement, and fostering GovTech enablers — to assist in the design of new digital transformation initiatives. See World Bank (2022).

environmentally better. Additionally, while several use cases of digital trade supporting environmental sustainability can be cited (TechUK, 2023), the use of technology infrastructure to support digitalization can also put pressure on the ecosystem. For example, blockchain has been closely associated with high energy consumption. According to the Cambridge Center for Alternative Finance (CCAF) (2023), bitcoin consumed about 107 terawatt hours of electricity in 2022, which is equal to the consumption level of the Netherlands in an entire year (World Population Review, 2023). The United States White House (2022) estimated that crypto-asset activities in that country emit approximately 25 to 50 metric tons of carbon dioxide per year, which is similar to emissions from diesel fuel used by railroads in the United States of America.

Another issue concerns greenhouse gas (GHG) emissions related to the production and use of electronic devices that are supporting the expansion of e-commerce. For example, according to Cook and Jaedim (2017), up to 80 per cent of GHG emissions emanating from smartphones can be traced back to their production, 16 per cent to customer usage throughout their life cycle. The production of a single smartphone uses as much energy as the amount needed to charge it for a decade. Furthermore, as the demand for electronic devices increases, concerns have been raised over electric waste (e-waste). According to the United Nations Global E-waste Monitor report, in 2019, about 53.6 million metric tons of e-waste were generated globally. The rates of recycling e-waste, however, differ greatly, from 11.7 per cent in Asia to 42.5 per cent in the Europe (Forti and others, 2020). The amount of e-waste is rising at an alarming pace having reached more than 74 million metric tons in 2023 and is projected to reach nearly 110 million metric tons in 2050, with the majority coming out of Asia (Parajuly and others, 2019).

Once again, these potential externalities of digital trade point to the need for a proper policy framework, at both the domestic and regional levels to further the positive outcomes while at the same time, containing the unintended impacts to ensure distributive outcomes of digital trade and the larger digital transformation.

1.5. Towards an inclusive and sustainable digital trade policy framework

With the uptake of the digital transformation and the resulting flows of data, digital trade now consists of not just four but five flows: goods, services, capital, natural persons and data. For the cross-border flows of goods and services (and trade-related aspects of capital and natural person movement), the regulatory framework was established at the multilateral level with the conclusion of the General Agreement on Tariffs and Trade (GATT) 1947 and WTO Agreements in 1994 (including, among others, the General Agreement on Trade in Services (GATS). Under the Interim Report to the General Council regarding the Work Programme on Electronic Commerce (S/C/8), the Council for Trade in Services noted that there is a common understanding that "*[t]he electronic delivery of services falls within the scope of the GATS, since the Agreement applies to all services regardless of the means by which they are delivered, and electronic delivery can take place under any of the four modes of supply*". The report also highlights the "technological neutrality" rule, whereby electronic supply of services are permitted by [GATS]-specific commitments unless the schedule states otherwise. The report, however, contains many uncertainties regarding the adoption of other specific rules related to e-commerce. Among these, one of the key unsettled issues is whether certain products delivered electronically (such as e-books, or 3D-printing) might be classified as goods, and therefore be subject to GATT disciplines, rather than as services. Adding to the complexity, rules on trade-related aspects of data, however, are still at the exploratory phases, whereby a single set of rules is missing but different regulatory approaches have been established through unilateral, bilateral, or regional initiatives (Kuner, 2013; Gao, 2021).

For domestic e-commerce legislation, the United Nations Conference on Trade and Development (UNCTAD) identifies four key areas: electronic transaction laws, data protection/data privacy laws, cybercrime laws, and consumer protection laws (UNCTAD, 2023). While these four areas cover the core legislations, they leave out many other areas affecting e-commerce, such as on content regulation, domain names, cloud computing, as

well as other areas affecting cross-border e-commerce. Daza Jaller, Gaillard and Molinuevo (2020), however, noted that having an "e-commerce law" of similarly titled instruments is not necessarily indicative of the soundness of the country's regulation on digital trade. To assess the e-commerce readiness of a country, UNCTAD provides a more holistic framework by looking at seven policy areas. In addition to the e-commerce policies and strategies (policy level) and legal and regulatory frameworks (regulatory level), the UNCTAD framework also suggests an assessment of the ICT infrastructure and e-commerce support services; trade facilitation and logistics; payment solutions; access to financing; and skills development.[10] These provide broader coverage involving also certain aspects of cross-border e-commerce (i.e. trade facilitation) and inclusion (access to financing and skills development).

Given the broad coverage and the cross-cutting nature of this area, an e-commerce regulatory framework might cover several aspects under the four broad regulatory areas identified by UNCTAD. Daza Jaller, Gaillard and Molinuevo (2020) looked at the regulatory framework for digital markets from two perspectives: facilitative and restrictive measures. Measures that seek to facilitate electronic transactions and promote trust in digital markets cover regulations on e-documents and e-signatures, consumer protection, intermediary liability, privacy and data protection, and cybersecurity. Regulatory restrictions in digital markets include such measures as domain name restrictions, bans of online sales and regulations on cross-border data flows. There are also many other policy areas relevant to digital trade, such as regulations on competition policy, taxation, intellectual property and business licence requirements.

By looking into policy measures that can potentially hinder digital trade, the European Centre for International Political Economy (ECIPE) suggested a framework for the categorization of measures affecting digital trade under its Digital Trade Restrictiveness Index (DTRI) methodology (Ferracane, Lee-Makiyama and van der Mard, 2018) which, however, is focused more on regulatory aspects that might hinder digital trade. Some areas that are not explicitly covered include licences for e-commerce activities, online consumer protection and channels for effective dispute settlements, or redress mechanisms against anti-competitive practices online. Areas affecting inclusion and sustainable development issues related to digital trade are not explicitly included.

In the same vein, ESCAP also developed a regulatory framework for the Regional Digital Trade Integration Index (RDTII) (ESCAP and OECD, 2022). ESCAP RDTII considers its digital trade regulatory framework as a composition of three policy cluster: traditional trade policy (which corresponds to market access measures); domestic regulations; and digital governance (which addresses the newly arising issues related to the online provision of products and data-related issues). However, within this framework, sustainable development elements are seemingly missing.

While the WTO plurilateral negotiations on e-commerce remain unsettled 25 years after their introduction, e-commerce has been introduced on the agenda of trade policymakers, in developed and developing countries alike, through regional trade agreements. E-commerce rules have been incorporated into more than a quarter of all FTAs notified to WTO (Monteiro and Teh, 2017). While e-commerce provisions are still heterogeneous across all FTAs, the most common types of e-commerce provisions refer to such issues as electronic authentication, consumer protection, personal information protection and paperless trading, as well as general rules on e-commerce promotion, cooperation and a moratorium on customs duties. An increasing number of FTAs also cover such areas as personal information protection, unsolicited commercial electronic messages, Internet interconnection charge sharing, code source and cybersecurity (Monteiro and Teh, 2017). Darsinouei and Kaukab (2017) suggested the division of e-commerce-related provisions in trade agreements into three main categories: (a) market access provisions covering customs duties, treatment of digital products, cross-border information flows and electronic supply of services; (b) specific rules and regulations covering consumer protection, privacy and data protection, unsolicited commercial emails and domestic electronic transactions frameworks; and (c) trade facilitation provisions covering paperless trade administration, cooperation, transparency and electronic authentication. Among these areas, some have reached certain levels of agreement globally, such as the moratorium on applying duties to

[10] For further information on the seven policy areas, see https://etradeforall.org/about/policy-areas/.

electronic transmissions. Other issues are dealt with under different levels of commitments and approaches.

Furthermore, a new class of so-called digital-only or digital economy agreements (DEAs) have been rising, starting with the Digital Economy Partnership Agreement (DEPA) signed in June 2020 between Chile, New Zealand and Singapore.[11] The agreement builds upon the e-commerce chapters of existing FTAs while at the same time adding enhanced commitments addressing a range of emerging digital economy issues, such as artificial intelligence, fintech, open government data and digital identities. SMEs' cooperation and digital inclusion are also included, however, mainly at the "best endeavour" level of commitment. Table 1.2 below provides a mapping of sustainability-related provisions in digital trade agreements or other frameworks that can promote trade and remedy the unintended externalities of trade digitalization.

Table 1.2
Sustainability-related provisions in digital trade agreements/chapters

Small and medium-sized enterprises	**Information-sharing**: Provision to ensure publicly accessible information that can be relevant or beneficial to SMEs.
	SME cooperation: Provision to establish a cooperation framework to enhance trade and investment opportunities for SMEs in the digital economy through information exchange, SMEs' participation in government procurements, and SMES trade and investment platforms.
	Digital SME dialogue: Provision to establish a digital SME dialogue, including private sector, non-governmental organizations, academic experts and other stakeholders, to promote relevant collaboration efforts and initiatives supporting SMEs and digitalization.
Digital inclusion	**Digital inclusion**: Provision to address barriers in accessing digital economy opportunities and promote digital inclusion, including through promoting access to digital infrastructure, and participation of women, rural populations, low-level socioeconomic groups and indigenous peoples in the digital economy.
	Women's participation in digital trade: Provision to facilitate participation by women and women-led enterprises in digital trade through cooperation, information-sharing and technical assistance.
	Digital skills development: Provisions to address digital skill gaps and provide capacity-building to improve digital literacy skills training.
Innovation	**Public domain**: Provision to recognize the importance of accessible public domain and publicly accessible databases for the development of the digital and knowledge-based economy.
	Open government data: Provision to facilitate public access to and use of open government information to foster economic and social development, competitiveness and innovation.
Transparency	**Publication**: Provision to ensure that laws, regulations, procedures and administrative rulings related to digital trade and digital economy are promptly published or otherwise made available for interested persons to access.
	Administrative proceedings: Provision to ensure that related persons are provided with prior notice and a reasonable opportunity to present facts and arguments in support of their positions in an administrative proceeding ("right to be heard").
	Review and appeal: Provision to establish or maintain independent judicial, quasi-judicial, or administrative tribunals, or procedures for the purpose of prompt review and correction of final administrative actions regarding matters related to digital trade or the digital economy.

Source: ESCAP compilation.

[11] Canada submitted a formal request to launch negotiations for its accession to DEPA on 22 May 2022. On 24 August 2022, the DEPA parties established a working group for Canada to begin DEPA accession negotiations. See Canada (Government of) (2022).

1.6. Conclusion and policy implications

Digital technologies are unlocking new pathways for rapid economic growth, innovation and job creation, as well as access to goods and services. However, there are still challenges in implementing the digital transformation in the trade arena. These include strengthening coordination frameworks, aligning policies and sector regulation, and the need for a massive scaling-up of investment and dedication of resources. To reap the benefits of digital transformation, affordable and accessible connectivity is the first and foremost condition to give people access to digital platforms, goods and services.

The mapping provided in section 3 points out anecdotal accounts of possible linkages between digital trade and SDGs. The unintended externalities, as pointed out in section 5, are imminent unless a balanced policy framework is in place to promote positive outcomes and eliminate negative outcomes. In examining the linkages between digital trade and sustainability, it is hoped that this chapter will contribute to the theoretical framework integrating the sustainability aspects into national and regional digital trade policy for better monitoring and promoting of sustainable development and digital trade policy.

Sustainable development should be an explicit goal in the digital policymaking process. For example, to guide a common approach in digital trade and sustainable development, an international framework such as RDTII could be considered to expand to a cross-cutting pillar covering the sustainability aspects of digital trade, such as provision on digital inclusion, digital innovation and provisions supporting SMEs and women.

Digital infrastructure investments will be a crucial factor in bridging the gap between developed and less developed countries. Furthermore, bridging the digital divide will also involve making digital technologies more affordable to all, including for women and populations located in remote areas. For the gender-based divide, policy actions should be aimed at fostering women's full participation and inclusion in the digital economy, while awareness-raising efforts should be targeted at altering the ingrained social norms that lead to discrimination against women. Digital data collection, including disaggregated data by gender, will also be crucial to support the evidenced-based policymaking process. The current most extended effort in measuring the digital economy potentially has been done by OECD, WTO and IMF (2020) The WTO *Handbook on Measuring Digital Trade*, however, does not include gender-disaggregated data; therefore, a combination of use with existing data sets maintained by ITU, the World Bank and national statistical offices will be needed.

The potential externalities of digital trade, as discussed in section 5, point to the need for a proper policy framework at both the domestic and regional levels to further the positive outcomes while, at the same time, containing the unintended impacts to ensure distributive outcomes of digital trade and the larger digital transformation. There is a need to balance regulation with facilitation to avoid locking out of the digital market vulnerable groups, such as women, the informal workforce and MSMEs. Policies appealing to increase investments in digital infrastructure should be designed under a sustainable development microscope to ensure healthy competition as well as environmental and social consciousness. It is important to consider the impact on jobs, the environment and society to avoid a "race to the bottom". In this sense, digital skills strengthening will be key to ensure the organic and sustained growth of the digital economy. Finally, considering the patchwork of current FTA provisions on digital trade and e-commerce, global efforts should be strengthened to finalize a common model framework for regulating digital trade.

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CHAPTER 2

Harnessing digital trade to advance the Sustainable Development Goals: An Empirical Study

Chapter 2

Harnessing digital trade to advance the Sustainable Development Goals: An Empirical Study[12]

2.1. Introduction

The dynamic interplay between digital technology and trade has swiftly transformed traditional trade practices and spurred a new era of digital trade, which IMF and others (2023) define as: "All international trade that is digitally ordered and/or digitally delivered". According to an ESCAP, UNCTAD and UNIDO (2023) report, in 2022, digitally-deliverable services (a common proxy for total digital trade) already represented the majority of services traded globally, with this trend expected to intensify in going forward. As such, digital trade has become the centrepiece of a host of new policy challenges and understanding its relationship with sustainable development has become key in promoting a successful digital transition. Yet, owing to digital trade's relatively recent and ever-changing nature, this is a topic that is still largely unexamined.

In this context, this chapter adds to the existing literature by offering a wide-ranging empirical exercise investigating how digital trade, digital trade provisions and Internet penetration might have impacts on the SDGs. We built regression models utilizing OECD-WTO BATIS statistics on digital deliverable services (DDSs) and ESCAP data on digital trade provisions (DTPs) in regional trade agreements to link digital trade and related provisions to 32 SDG targets spread across four areas of intervention: economic; social; environmental; and governance and global partnerships. Our models leverage large country-year panel data across SDG targets and employ a country fixed-effects identification strategy to ensure the derivation of robust estimations. We complement this empirical exercise with an extensive literature review that provides a rich framework to interpret our results and distil policy recommendations.

While some limitations naturally arise from the wide scope of the chapter, we hope to lay the groundwork covering the intricate relationship between digital trade and sustainable development and shed some light on future research. Key findings from this chapter were included in an ESCAP, UNCTAD and UNIDO flagship report entitled *Asia-Pacific Trade and Investment Report 2023: Unleashing Digital Trade and Investment for Sustainable Development* (2023). All technical and methodological support for the findings published therein can be found below.

The rest of this chapter is organized as follows. In section 2, we start by exploring the nature and potential measurements of digital trade, digital trade provisions and the SDGs. We then exhaustively analyse the existing literature linking digital technologies, digitalization and sustainable development, covering all SDGs. In section 3, we deep dive into the chapter's empirical approach, laying down the fundamentals of our models, the underlying assumptions and core limitations. In section 4, we examine the results of all significant regressions, bridging them with the existing literature. Section 5 concludes the chapter, providing suggestions for future research.

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2.2. Literature review

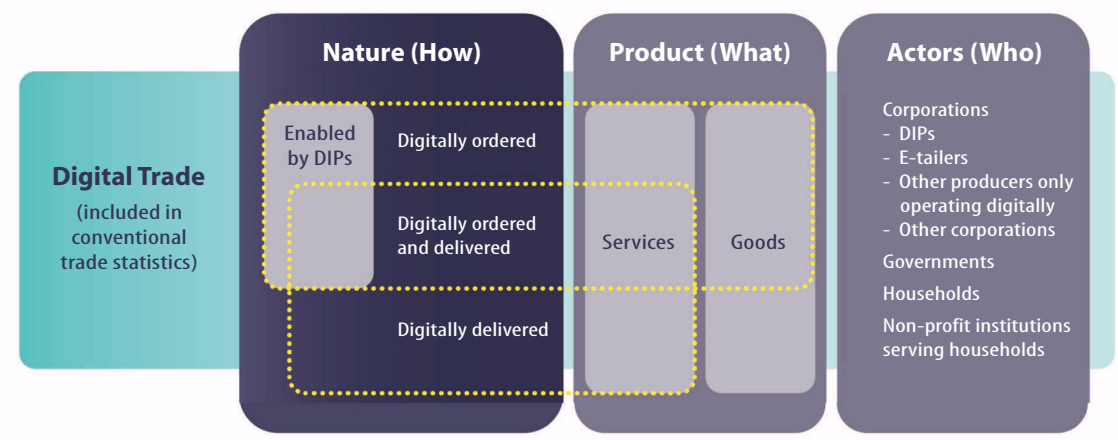
What is digital trade?

While the definition of digital trade is constantly evolving, IMF and others, in the second edition of the *Handbook on Measuring Digital Trade* (2023), have harnessed widespread consensus in understanding digital trade as: "All international trade that is digitally ordered and/or digitally delivered".

This is such that, digitally ordered trade encompasses all international transactions in goods and services conducted over computer networks specifically designed to place and receive orders (i.e. international e-commerce); digitally-delivered trade denotes all international transactions in services that are remotely delivered over computer networks (i.e. ICT-enabled services); and digitally ordered and delivered trade corresponds to all international transactions meeting at the intersection of all above-mentioned criteria. Conceptually, figure 2.1 summarizes this definition.

As figure 2.1 illustrates, the concept of digital trade is centred around the nature of transactions (the "How") rather than on the nature of the products transacted (the "What"). This reflects the understanding that the same product might fall under the scope of digital trade depending on how it has been ordered or delivered. In contrast, readily available trade statistics disaggregate trade according to sector and product categories, such as HS codes and ISIC codes, seldomly recording transactions' delivery or ordering modes. In essence, this indicates that existing statistics have yet to effectively capture digital trade flows. As a result, identifying useful proxies to represent digital trade trends is crucial at this early stage of digital trade statistical measurement. Below we deepen the discussion on how to adequately proxy digital trade.

Figure 2.1
The conceptual framework for digital trade



Source: Based on IMF and others (2023).
Note: Digital intermediation platforms (DIPs), which are defined as: "Online interfaces that facilitate, for a fee, the direct interaction between multiple buyers and multiple sellers, without the platform taking economic ownership of the goods or rendering the services that are being sold (intermediated)".

How can digital trade be measured?

While such indirect proxies as the use of ICT goods and services (also called ICT-enablers) or Internet penetration have been widely used to mirror digital trade variations in the past (OECD, 2018; 2021), their usage has been in gradual decline. Indeed, as more direct proxies of digital trade have become available, albeit with varying coverage, these have become preferred variables for mirroring digital trade. In this regard, IMF and others (2023) have compiled the many different potential sources for proxying digital trade and, more specifically, its subcomponents: digitally-delivered and digitally-ordered trade.

Measuring digitally-ordered trade, both in goods and services, has proven to be problematic. While, in principle, estimates can be derived from a variety of sources, such as business or household surveys,

VAT reports, card payment data or customs declarations, the lack of a common reporting framework has made it highly challenging to achieve comparability across sources and economies. Furthermore, as IMF and others (2023) noted, these methods can provide only rough estimates of total digitally-ordered trade volume. They state that "no single [available] source can offer a holistic measure for digitally ordered [trade] at the economy level." For those reasons, the use of digitally-ordered trade measurements has been limited and other proxies are more commonly preferred.

Indeed, most digital trade literature has instead turned to measuring digitally-delivered trade or, equivalently, digitally-delivered services. In particular, digitally-deliverable services – a subset of total services already recorded in national statistics – serve as the most common proxy for digital trade (ADB, 2022; Fu and others, 2022; Di and others, 2022).

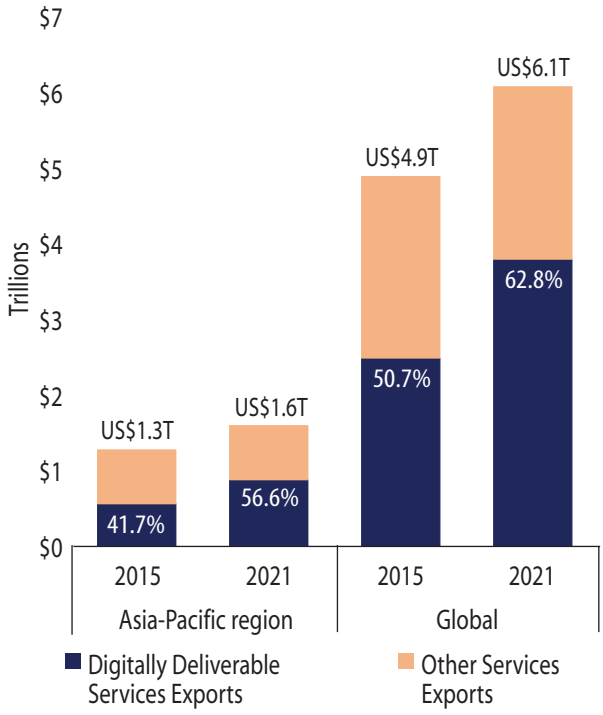
Digitally-deliverable services are a set of service categories, such as financial services or telecommunications, that were identified to be potentially digitally-delivered (that can be delivered remotely via an ICT network) (IMF and others, 2023). As several studies have shown, upward of 80 per cent of digitally-deliverable services are, in fact, digitally delivered, meaning that DDSs serve as an upper-bound on total digitally-delivered trade (UNCTAD, 2015; Borga, 2012). Moreover, IMF and others (2023) noted that most digitally-delivered services are also likely to be digitally ordered. As a result, changes in DDSs are expected to reflect wider trends in digitally-ordered services – i.e. international e-commerce in services.

While DDSs do not directly include digitally-ordered goods – i.e. international e-commerce in goods – their growing importance in various aspects, such as Internet services, e-marketplace services, online payment and finance services, and e-logistics significantly aids the processes of ordering, paying and tracking in digital transactions. This suggests that the growth and expansion of DDSs can provide valuable insights into broader trends in international e-commerce involving goods. Therefore, while not a direct measure, the proliferation and use of DDSs can act as an indicative measure of general trends in the digital trade sector. As such, in this chapter, DDSs are used as a proxy for total digital trade. Disaggregated data on DDSs are available from multiple sources and databases, such as UNCTAD, the United States Department of Commerce (USDOC) and OECD-WTO Balanced Trade Statistics (BaTiS) — the dataset used in this chapter.

How has digital trade evolved from 2015 to 2021?

Over past decades, digital trade has grown considerably. In particular, during the period 2015-2021 alone, global digitally-delivered services – the suggested proxy for total digital trade – grew by an annualized rate of 6.3 per cent. In Asia and the Pacific, these services grew even faster at an annualized rate of 7.5 per cent. This can be compared with the 3.1 and 2.9 per cent annualized global and regional growth rates registered in total services exports, respectively. As a result of these trends, DDSs' prominence in global and regional services exports has risen substantially. In 2021, well over half of global (62.85 per cent) and regional (56.6 per cent) services exports were attributed to it (figure 2.2).

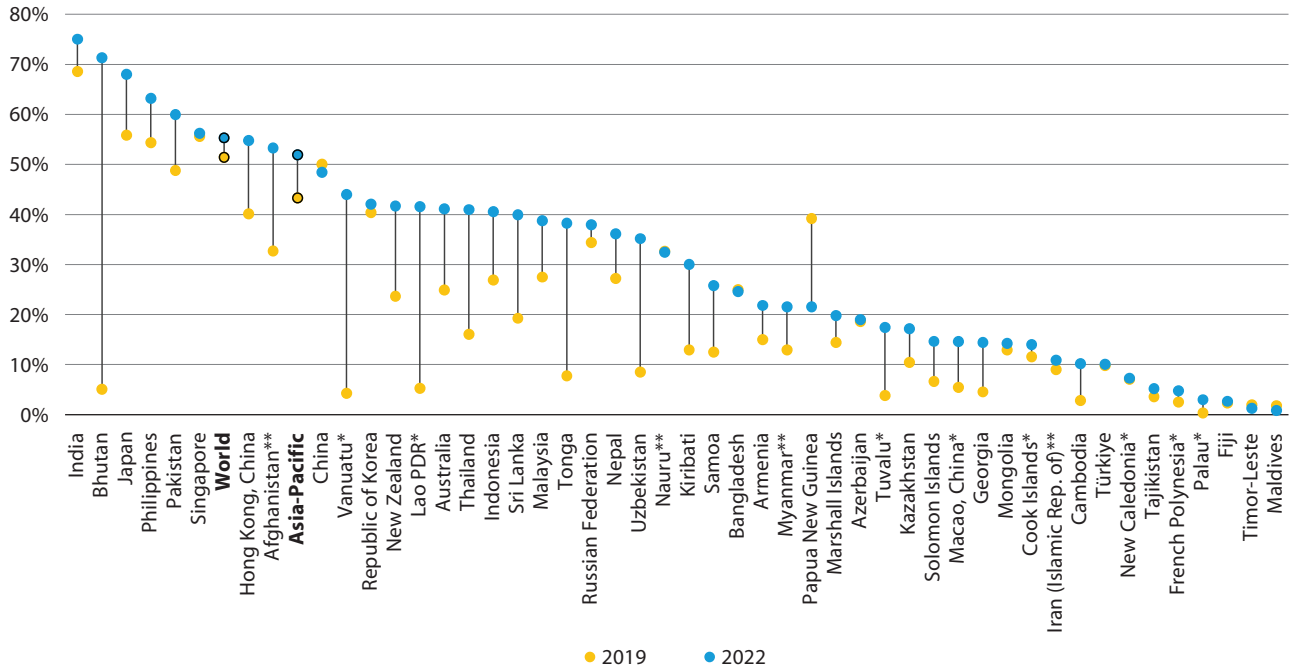
Figure 2.2
Growing trend of digitally-deliverable services in total services trade: 2015-2022



Source: ESCAP, based on BATIS Services Trade data and WTO Commercial Services Trade between 2015 and 2021.
Note: To maintain data consistency across years, only economies with both digital trade and total exports data for all years were used. As a result, the world aggregated consisted of 182 economies, while the Asia-Pacific region aggregated consisted of 46 economies.

The Asia-Pacific region's dynamic digital growth over the several past years has translated into an increase in the region's prominence in global digital trade. Between 2015 and 2021, Asia and the Pacific's share of digital trade grew from 22 to 24 per cent. However, digital trade's prominence at the economy level remain extremely heterogenous. Indeed, such countries as Bhutan, India, Japan, Pakistan and the Philippines, where digitally-deliverable services represent more than 60 per cent of their total services exports, starkly contrast with such economies as Fiji, Maldives, Palau and Timor-Leste, where such services represented less than 5 per cent of the total (figure 2.3). This substantial variability in digital trade participation highlights the accentuated digital divide felt across the region. While digital trade is booming and becoming a central piece in most economic activities, many small developing economies are falling behind.

Figure 2.3
Percentage of digitally-deliverable services in total services exports for Asia-Pacific economies, 2019 and 2022



Source: ESCAP, UNCTAD and UNIDO (2023), chap. 2, figure 2.3, p. 30.
Note: * Data are for 2021 instead of 2022; ** data are for 2020 instead of 2022.

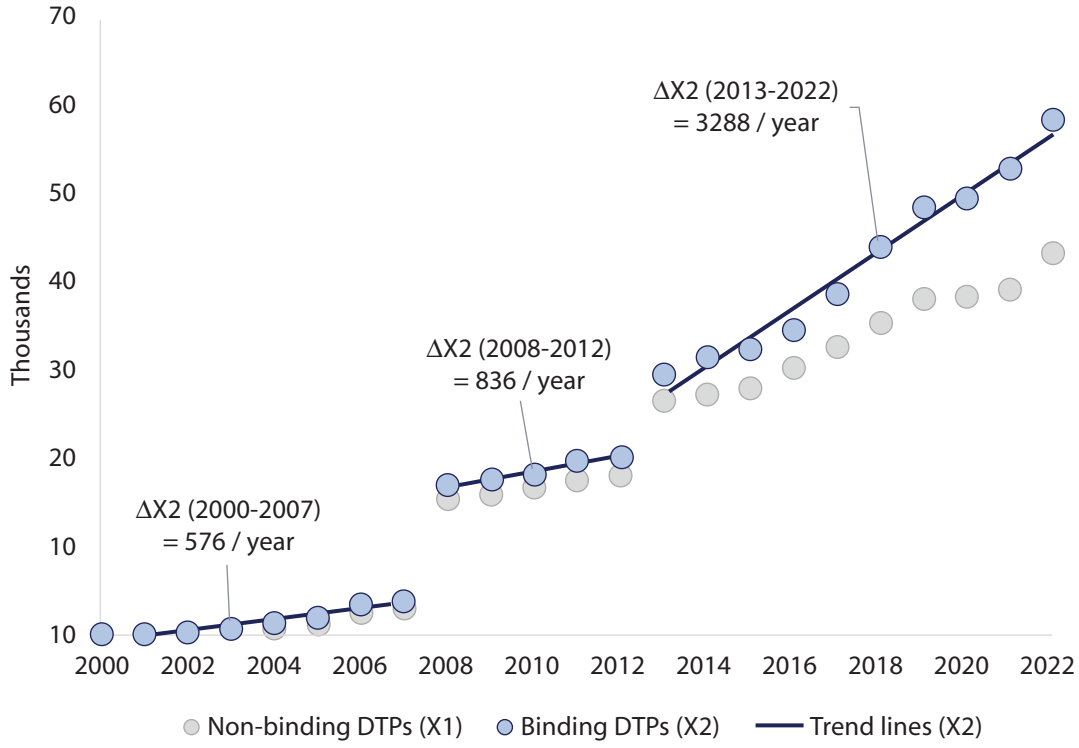
Digital trade provisions in international trade agreements

While the first record of a digital trade provision (DTPs) in an international trade agreement dates back to the Agreement between the United States of America and the Hashemite Kingdom of Jordan on the Establishment of a Free Trade Area signed in 2000 (Köhler-Suzuki, 2023), its adoption was relatively slow until the 2010s (figure 2.4). Then, mirroring the rise in digital trade's prominence, the number of new DTPs rapidly accelerated. Indeed, since 2013, 3,288 new binding DTPs have come into force every year, compared with just 836 in the period between 2008 to 2012.

In addition, digital trade provisions have also quickly expanded both in terms of scope and in terms of commitment. As figure 2.4 highlights, the difference between the number of binding and non-binding DTPs has been increasing ever since 2000. Evidence of this shift can be seen in recent PTAs, such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the United States-Mexico-Canada Agreement (USMCA), where the digital economy and trade have become the centrepiece. Several digital trade agreements, such as the Digital Economy Partnership Agreement (DEPA) and the Australia-Singapore Digital Economy Agreement have also emerged as comprehensive "digital-only" trade

agreements. The comprehensive nature of DTPs has been observed in the texts of recent digital trade agreements. For instance, the USMCA trade agreement recognizes the importance of "frameworks that promote consumer confidence in digital trade and of avoiding unnecessary barriers to its use and development". The Australia-Singapore Digital Economy agreement compels parties to "recognize the need to create an environment that enables and supports, and is conducive to, experimentation and innovation".

Figure 2.4
Growing trend of digital trade provisions (DTPs) in preferential trade agreements (PTAs), 2000-2022



Source: ESCAP, based on TAPED (Burri, Callo-Müller and Kugler, 2022).
Note: In the figure, ΔX2 denotes the slope of the trend line for each of the periods indicated. This can thus be understood as that period's average yearly variation of binding provisions (X2).

While understanding the effects of digital trade provisions on the Sustainable Development Goals is still in its early stages, there is increasing research interest in exploring how specific policy areas related to digital trade intersect with various aspects of development. Generally, the findings from these studies have been encouraging. For instance, research by Duval & Hardy (2021b) estimated that implementing cross-border paperless trade — a provision in the Cross-border Paperless Trade Agreement (CPTA) — has contributed to a reduction in carbon dioxide emissions of between 8.9 million and 23.4 million tons. Durkin (2017) suggested that trade facilitation agreements with such measures as electronic document processing and customs can reduce delays and mishandling of perishable goods and increase food safety and quality. Lastly, research by OECD (2021) and CITES (2022) highlighted the use of trade facilitation measures, such as e-certification, in creating efficiencies in sanitary and phytosanitary (SPS) systems and e-permits to curb the illicit trade in endangered animal species. In this context, this chapter is aimed at adding to the existing literature by offering a wider-ranging empirical exercise that can understand the role of digital trade cooperation, regulatory readiness and coherence – proxied by DTPs – in sustainable development.

To measure DTPs in PTAs, several databases provide timely updates on this rapidly evolving regulatory space. For instance, the St. Gallen Endowment for Prosperity through Trade's (SGEPT) Digital Policy Alert provides a "record of policy changes that affect cross-border digital

commerce". Nemoto and Lopez-Gonzalez (2021) created the OECD digital trade inventory to provide greater transparency and visibility of existing digital trade standards, while Burri, Callo-Müller and Polanco (2022) created the above-mentioned Trade Agreements Provisions on Electronic-commerce and Data (TAPED) database, providing a comprehensive data set on provisions and articles affecting digital trade in trade agreements across five policy areas in preferential trade agreements. Similarly, ESCAP in Semenova, Utoktham and Duval (2023) used a powerful text algorithm to comprehensively extract the appropriate provisions and articles based on specific key words. This database provides the flexibility to calculate customized data sets that can fit our panel data structure. For that, data from Semenova, Utoktham and Duval (2023) have been utilized in this chapter.

The Sustainable Development Goals

The SDG framework consists of 17 Goals (figure 2.5), spanning 4 areas of development: social, economic, environmental and partnerships. These Goals have been translated into 169 targets and 241 indicators for which data are regularly collected and made available via the United Nations Sustainable Development Goal Data Portal (UNSDG Portal). These data enable researchers and institutions to closely track SDG developments across all areas of intervention globally.

Figure 2.5
The 17 Sustainable Development Goals

Source: Adapted from https://sdgs.un.org/goals.

Linking the SDGs, digitalization and digital trade

While digital trade has been the subject of immense research over past decades, its connection with the SDGs has yet to be explored. Indeed, most of the existing research is focused more broadly on the impact of digitalization and digital technologies on the Goals. Our understanding of the relationships between digital trade and digitalization will help us bridge this gap and build a rich backdrop to understand the potential influence paths of digital trade on the Goals. Below we review the existing literature for each Goal area: economic, social, environmental, governance and global partnerships.

Economic Goals (1, 2, 8 and 9)

Economic Goals comprise Goals 1 (No Poverty), 2 (Zero Hunger), 8 (Decent Work and Economic Growth) and 9 (Industry, Innovation and Infrastructure). Overall, digital technologies and digitalization are considered to promote economic Goals. These are often linked with increased productivity, a shift towards higher value addition activities and an overall expansion of job opportunities. Moreover, economic Goals are heavily influenced through many of the beneficial social, environmental and institutional impacts that will be approached in further detail below. In

contrast, the digital divide is identified as the main threat to digitalization's contribution to economic advancement. In an environment where digital access is largely drawn along income lines, the benefits accruing from digitalization might be poorly distributed and accentuate existing inequalities. Below we deepen this discussion for each individual economic Goal.

As explored above, digitalization has a promising role in promoting Goals in a wide array of areas, such as health, education, inequality, institutions and the environment. Naturally, these are all key areas of intervention to successfully tackle structural poverty (Goal 1). As such, the literature reviewed throughout this section is as relevant for each individual target as it is herein.

Nevertheless, another avenue for poverty eradication is the promotion of decent work and economic growth (Goal 8). In this regard, several studies have shown a promising role for digitalization. Indeed, Baker and Le (n.d.) found that a 1 per cent increase in digital services trade value corresponds to a 3 per cent rise in a country's GDP per capita. Kohnert (2021) and Lyons, Kass-Hanna and Greenle (2020) found that access to web-based platforms and e-commerce contribute to economic growth and poverty alleviation. In effect, digital platforms provide exposure to new entrepreneurship and job opportunities as well as easing access to a wider range of goods and services. Lopez-Cordova (2020) also highlighted that digital platforms reduce information asymmetries, which improves market functioning and reduces transaction costs. According to that author, this directly translates into lower costs of travel and higher demand for tourism services in countries where digital platforms exist.

International e-commerce and social media platforms are also a crucial part of any business strategy, enabling firms to connect with wider audiences. These can be particularly important for MSMEs in smaller developing economies, as Chen (2019) investigated. For these businesses, the author said, local growth opportunities are particularly scarce, making it vital to be able to reach oversea opportunities via digital platforms of goods and services. Likewise, during the COVID-19 pandemic, As'ad and others (2021) found that many MSMEs managed to survive by leveraging social media and e-commerce.

Digitalization is also an important tool to leverage an economy's industry, innovation and infrastructure (Goal 9). Ezell and Koester (2023) stated that cost-effective and accessible digital services influence productivity and innovation. In fact, Hajishirzi, Costa and Aparicio (2022) insisted that the impact of data on productivity and expansion is higher than traditional innovation.

Apart from the poverty alleviation and economic growth channels through which digitalization is contributing to end global hunger (Goal 2), the literature has also highlighted its potential role in revolutionizing agricultural supply chains. Indeed, digital initiatives, such as EarthOptics, Apollo Agriculture, Ulula, FoodLogiq, Algramo and Buy-From-Women, offer farmers support throughout the whole production process, promoting higher efficiency and sustainability (Bain and Company, n.d.; UN-Women, 2020). At early stages, these projects offer intelligence on the soil and the weather, along with credit and financing options, especially for small stakeholders. In later stages, interventions are focused on promoting food traceability and efficiency, as well as on implementing smart packaging and waste management solutions. Jouanjean (2019) also found evidence for digitalization's role in improving transparency, traceability and data reliance in agri-food value chains, supporting these initiatives' work.

Notably, the positive impacts of digitalization examined in previous studies are ubiquitously reliant on a strong Internet connectivity and ICT infrastructure. Indeed, as ITU (2022) highlighted, affordable access to devices and broadband Internet, together with appropriate digital skills, are required to navigate the digital landscape safely, as well as to recognize opportunities presented by digitalization.

Nevertheless, ITU (2022) reported that 30 per cent of the global population (i.e. 2.9 billion people) are not connected to the Internet. Furthermore, many among the online population are not "connected meaningfully", owing to persistent gaps in digital skills and Internet connections. Moreover, one in three people who can connect to the Internet choose not to do so, due to lack of devices, skills and awareness of the benefits and opportunities. UNCTAD (2021) also found that many MSMEs, especially in developing countries, lacked

proficiency to take advantage of e-commerce opportunities and realize growing online sales during the pandemic. This is mostly attributed to the lack of internal capabilities, high costs of adoption, poor infrastructure and lack of information affecting ICT adoption among MSMEs. The digital divide is thus a key issue to address in order to effectively reap the benefits of digitalization.

Social Goals (3, 4, 5, 10)

Social Goals comprise Goals 3 (Good Health and Well-being), 4 (Quality Education), 5 (Gender Equality) and 10 (Reduced Inequality). In general, digitalization and digital technologies are largely recognized as engines for social development, widening access to health and education and promoting economic opportunities. Nevertheless, the literature also points towards the dangerous role of the growing digital divide, which – as with economic development – threatens to accentuate existing divergences. Below we deepen this discussion, reviewing each social Goal individually.

Several studies have linked higher digitalization levels with better health-care outcomes (Goal 3). This relationship materializes both through digitalization's potential to catalyse access to urgent and affordable care via "telemedicine", as well as to improve diagnossis and treatment through access to better information and web-based tools.

Indeed, UNCTAD (2022) reported that access to health care increased with higher e-commerce and other digital tools usage. Zhang and others (2022) found that higher digitalization contributed to a reduced infant mortality rate and increase life expectancy. Moreover, several institutional initiatives have showcased digitalization's potential in advancing health outcomes. WHO launched "Be He@lthy, Be Mobile", using messaging services to spread awareness about non-communicable diseases; DYNAMIC is an AI-based solution that provides health-care workers in Tanzania with devices and clinical algorithms-based software – ever improving as more data become available – to support their medical decision-making.

Notably, AI in health care needs diverse and exhaustive data. ITU (2021) highlighted the lack of capacity to collect and store these data, especially in developing countries. This is a key obstacle to the broader adoption of health-care technologies. Additionally, the report stated that missing information about health among members of marginalized communities reduces the accuracy of AI solutions and increases inequality in access to health care.

Stronger educational outcomes (Goal 4) have also been linked with higher digital penetration. Indeed, Tay (2015) and UNCTAD (2022) provided evidence that digital tools and Internet platforms, such as online universities and MOOC (massive open online courses) services, have a strong positive impact on access to education. For instance, international certifications from such platforms as Edx, Coursera or university websites are widely recognized and available, providing students with a flexible learning environment and education at lower cost.

However, ITU (2022) highlighted that the share of Internet users is higher in high-income countries, urban areas and among younger and more educated people. Specifically, Chamberlin and Parish (2011) showed that this disparity in digital access translates into unequal opportunities in access to online education across all demographic groups. In fact, Christensen and others (2013) and Emanuel (2013) confirmed that individuals who engage in MOOCs often share specific traits, such as being well educated and young.

On the other hand, ITU (2022) and Chu and Li (2022) demonstrated that considerable amounts of time spent online by students and youth has negative impacts on their health and well-being due to lack of physical activity and increased stress.

Mixed evidence regarding digitalization's role in promoting gender equality (Goal 5) has emerged. On one hand, Sorgner and others (2017) found that digitalization can lower entry barriers for female participation in the work force – either via regular employment or self-employment – and thus become an engine for financial independence.

Additionally, several studies have highlighted a persistent digital gender divide that threatens to heighten existing inequalities. Indeed, ITU (2022) found that only 57 per cent of women compared with 62 per cent of men use the Internet. Zhou (2014) showcased that women exhibit comparatively lower performance and interest in ICT-related skills compared with men. As OECD (2018) highlighted, this can result in displacement in the workforce, unless appropriate adult ICT upskilling is undertaken. The same report also warned against

online security and privacy threats, which are especially relevant for women. Indeed, studies by EIGE (2017) and Duggan (2017) stated that 1 in 10 women from the age of 15 have experienced cyber harassment and are more likely than men to experience online sexual harassment.

Lastly, higher digital trade and digitalization have been mostly linked with reducing inequality (Goal 10). In particular, Graham, Hjorth and Lehdonvirta (2017) highlighted the role of such digital platforms as Uber and Grab (ridesharing and delivery services) and Fiverr and Upwork (freelance services) in granting individuals access to more distant, lucrative, or otherwise unavailable markets in the so-called gig-economy. However, studies by Rani and Furrer (2020) and Kaine and Josserand (2019) also highlighted the labour market challenges associated with the digital gig-economy. In most countries, these platforms usually offer ambiguous self-employment service agreements that leave workers without social and labour protections, such as a set minimum wage, paid holidays and sick leave, or the ability to collectively bargain for better working conditions.

Another important channel for inequality alleviation relies on individual remittance flows, which are extremely important for developing countries that depend on earnings from abroad. Notably, a World Bank (2021) report used the remittance prices worldwide database to demonstrate that the average cost of sending and receiving cross-border remittances is lowest through mobile money (i.e. digital wallets and payment platforms).

Environmental Goals (6, 7, 11, 12, 13, 14, 15)

Environmental Goals comprise Goals 6 (Clean Water and Sanitation), 7 (Affordable Clean Energy), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water) and 15 (Life on Land). Overall, the literature points towards the facilitating role of digital technologies in transitioning towards carbon neutrality and sustainable modes of living. However, heavy energy consumption, e-waste and the use of non-renewable commodities are among the key drawbacks to be considered. Below we deepen the discussion for each individual environmental Goal.

Digital technologies have been at the heart of improving resource management. In particular, Jozefowicz and Michniewicz-Ankiersztajn (2023) demonstrated that the use of digital web-based applications, social media and IoT reduced water wastage through better user awareness and sewage management (Goal 6). Likewise, Puskás-Tompos (2020) reported that Web platforms, smart grids, AI and blockchain enable more energy trading, promoting efficiency in commercial energy usage (Goal 7). Similarly, a World Bank (2022) report indicated that energy as a service (EaaS) and smart water management are effective in promoting sustainable consumption of both resources.

In its comprehensive report entitled *Enhancing the Contribution of Digitalisation to the Smart Cities of the Future* (2019), OECD exhaustively explored the role of digital tools in building sustainable and resilient communities (Goal 11). The report highlights that transformative technologies tackling existing issues on everything from health, education, mobility and security to Governments and the environment are rapidly emerging around the world. While the authors identified potential privacy concerns and consumer protection risks to be aware of in highly digitized cities, they see digitalization as a key factor in achieving Goal 11.

When it comes to responsible consumption and production (Goal 12), Chauhan, Parida and Dhir (2022) proposed that a circular economy goes hand in hand with digitalization. Indeed, IoT sensors and other technologies provide data for predictive analysis for efficient resource utilization. Furthermore, Wilts and others (2021) showed that using robots with AI in municipal waste management to automate waste sorting improves recycling rates.

Regarding Goal 13, digitalization in trade potentially minimizes the environmental footprint associated with conventional trade. Fu and others (2022) found that increases in trade in digital deliverables services lowers carbon emissions. The authors also highlighted how the fintech sector uses climate data to allocate credit to projects targeted towards reducing carbon emissions. Lazarević and others (2020) confirmed that providing night-time deliveries for e-commerce platforms dramatically reduces fuel consumption and carbon dioxide emissions. Duval and Hardy (2021a), ESCAP, UNCTAD and UNEP (2021) found that promoting paperless trade – i.e. using e-contracts, digital records and electronic document transfers – is a tangible way of reducing trade's environmental footprint.

Finally, environment and climate monitoring systems using satellite imagery, big data analytics and AI have provided key tools to identify and reduce the depletion of natural resources and wildlife both below water (Goal 14) and on land (Goal 15). For instance, Leslie & Lugo-Mulligan (2021) reported that Earth observation is used to track wildlife migration and human-wildlife conflict/interaction. In addition, it can distinguish where human interference should be limited. The report also stated that eCDT (electronic catch, documentation and traceability) systems use digital tools and services to ensure legal fishing and, ultimately, prevent depletion of the oceans via overfishing.

In contrast, some evidence regarding digitalization's potentially harmful impacts to environmental Goals has also emerged. On one hand, the production and consumption of ICT goods is characterized for being especially damaging in terms global greenhouse gas emissions. In fact, Freitag and others (2022) suggested that a sizable 2.1-3.9 per cent of total GHG emissions can be attributed directly to the production and consumption of ICT products. This is due both to the large amount of energy they consume and to the specific materials necessary for their production. Interestingly, De Vries and others (2022) provided evidence that bitcoin mining alone is responsible for an annual footprint of 65.4 megatons of carbon dioxide. Furthermore, as the Global E-waste Monitor 2020 (Forti and others, 2020) highlighted, ICT products generate a considerable amount of e-waste. Current estimates put this figure at 53.6 million tons of e-waste produced annually with as much as 83 per cent of it currently not being recycled. Finally, e-commerce logistics have a notable carbon footprint on the environment. For instance, Muñoz-Villamizar and others (2021) warned that parcel trade requires packaging and transportation that contribute to harmful emissions and the consumption of non-recyclable materials.

Governance and Global Partnerships (Goal 16, 17)

Global Governance and Partnerships Goals comprise Goals 16 (Peace, Justice and Strong Institutions) and 17 (Partnerships for the Goals). The impact of digitalization and digital technologies on these Goals is largely thought to be ambivalent. On one hand, digital technologies have brought Governments closer to the public, widening access and efficiency. Multilateral engagement has also been fostered as digital economy issues require international coordination. On the other hand, cyber security issues have raised significant challenges for institutions. The rapid spread and weaponization of misinformation are among the leading challenges. Below we deepen this discussion for each individual governance and global partnerships Goal.

The potential impact of higher Internet penetration and digitalization on the strength of Governments and institutions (Goal 16) remains unclear. On one hand, the use of digital tools enables Governments to implement e-governance and e-government solutions that can raise accountability and inexpensively democratize access to many institutional services. In fact, Ouedraogo and Sy (2022) observed that digital adoption is positively correlated with a reduction in corruption, increase in tax compliance and a significant increase in trust in government officials.

On the other hand, the rise of social media platforms has accelerated the spread of disinformation with potentially far-reaching political and social consequences (ITU, 2022). In fact, Amorin, Lima and Sampaio (2022) identified that for each new Internet service provider that becomes available in a location – a proxy for broadband penetration – the probability of protests occurring is 1-3 percentage points higher. Moreover, as Reuters (2021) reported, blocking Internet access has increasingly become a tool to suppress social unrest and curb freedom of speech and association.

Lastly, booming digital trade and digitalization have been an effective engine in promoting international engagement for stronger partnership for the Goals (Goal 17). Indeed, there is widespread evidence of trade facilitation initiatives relying on the digitalization of customs procedures and regulations. For instance, the United Nations ASYCUDA (Automated System for Customs Data) or the "E-bill of lading" smoothens trade flows and reduces cross-border costs. In Thailand, Customs Connect enables traders to pay customs duties and related fees online. In the Netherlands port of Rotterdam, smart infrastructure automatically determines if a ship is allowed to enter the port, while in Australia robots and AI automate boat-to-quay operations – thus increasing handling capacity. Such initiatives as the eTrade Alliance and Nextrade support private public partnerships to promote digital trade and enable small businesses in developing economies to access global e-commerce. Notably, these initiatives

encourage developing countries and least developed countries to become involved in global trade. Furthermore, Wirjo and Calizo (2022) reported that e-payment solutions, blockchain-enabled platforms coupled with technologies such as AI and sensors ensure better business connectivity and resilience. Overall, those authors pointed to these technologies' role in strengthening cross-border connections, enhancing data ecosystems and reducing corruption and sabotage.

Additionally, the rise in digital trade has played a significant role in reviving international engagement over international regulations that can fairly and safely process this type of trade. OECD (2018) indicated that in recent years, the number of RTAs, including specific provisions on digital trade, have sharply increased. The scope of these provisions is diverse covering data security, taxation, privacy and promotion of paperless trade.

2.3. Empirical approach

To understand the intricate relationship between digital trade and the SDGs, a series of country fixed-effects regression models were built. In these models, several digital trade variables (DTVs), digital provision variables (DPVs) and controls were interacted with 32 Goal targets, spreading across the 17 Goals and grouped into 4 clusters: Economic (Goals 1, 2, 8 and 9), Environmental (Goals 6, 7, 12, 13, 14, 15), Social (Goals 3, 4, 5, 10) and Governance and Global Partnership (Goals 11, 16, 17). All data spanned from 2010 to 2021.

Digital trade variables (DTVs) and digital provision variables (DPVs)

In this chapter, digitally deliverable services data – as identified in IMF and others (2023) – was retrieved from the OECD-WTO Balanced Trade in Services Statistics (BATIS) database and further aggregated across pairs and sectors to fit our country-year panel data structure.

In addition to the digital trade variable — Log(DT) — which was log transformed for ease of interpretation and for data smoothing purposes, a digital trade per capita variable — Log(DT.pc) (also log transformed) — was built. This variable enabled us to gain a deeper understanding on how digital trade concentration – as opposed to simply its overall level – might have different impacts on SDGs.

Finally, to assess the role of DTPs in the development of Goal targets, we extracted data from the ESCAP regional trade agreement (RTA) text analyser 1.0 (Semenova, Utoktham and Duval, 2023) to build DT.CH, denoting the number of chapters in trade agreements containing digital provisions.

It was verified that the DTV coefficients remained stable – and largely unchanged – across models with and without DPVs. This means that, while digital trade provisions might have an impact on the level of digital trade itself, the studied specifications successfully isolate the impacts of digital provisions per se on SDGs developments.[13]

Sustainable Development Goals

As previously explained, each of the 17 Sustainable Development Goals has concrete targets, which are, in turn, measured via specific indicators. As such, the existing 17 Goals have been translated into 169 targets and 241 indicators, for which data are regularly collected and made available by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) via the UN-STATS portal.[14]

Drawing from our extensive literature review and guided by varying data availability, a subset of 32 indicators, spread across the 17 Goals, were selected to be regressed in our models. Several aspects were considered to arrive at the final subset of 32 indicators, where an iterative process aimed, when possible, to identify at least one significant relationship between a Goal and digital trade. After several trial regressions, 18 indicators across 13 Goals (all except Goals 2, 11, 14 and 16) yielded statistically significant results.

[13] Descriptive statistics and performed transformations for each of the DTVs and DTPs used can be found in Annex 1 in the original working paper: Anukoonwattaka and others (2024). Harnessing digital trade to advance the Sustainable Development Goals: An Empirical Study, ARTNeT Working Paper Series No. 237, February 2024, Bangkok, ESCAP, available at http://artnet.unescap.org.

[14] https://unstats.un.org/sdgs/unsdg/.

Owing to the diversity of final indicators, final Goal data were treated on a case-by-case approach, with several indicators being treated for outliers and extreme outliers. Log transformations were also applied whenever deemed beneficial. The complete list of the 17 Goals, 169 targets and 241 indicators can be found at the UN-STATS Portal.[15]

Control variables

Two control variables — Log(GDP) and Int.%, corresponding to the log of GDP and the percentage of households with Internet access in a country — were employed. These variables have been identified as major drivers of Goal development (Zhang and others, 2022; Fu and others, 2022; Khera and others, 2021). On one hand, controlling for GDP enables us to consider how the level of economic advancement and resource availability might be concomitantly correlated with both digital trade and Goal development. On the other, Internet penetration – a prerequisite for participating in digital trade – controls for the intrinsic benefits of enjoying higher digitalization levels, irrespective of the level of digital trade. These variables were applied to all models that were run.[16]

Regression model

Borrowing from Zhang and others (2022) and Fu and others (2022), we developed a series of regression models interacting with several DTVs, DPVs and controls with the 32 Goal targets selected. Our models leverage country-year panel data from the period 2010-2021 characterized by a fair number of observations and variability,[17] thereby promoting the derivation of robust estimations (Baltagi, 2008).

To enhance the precision of our estimates and identify the variation of interest, we used a country fixed-effects strategy. This is especially important owing to the impact that unobservable country-specific time-invariant characteristics, such as institutional strength, historical developments, geographic location, and cultural and social norms, have on the Goals (Greene, 2017). Finally, we adopted the ordinary least squares (OLS) inference method to compute our regression coefficients.

Thus, our basic model can be described as follows:

$$SDG_i^y = \beta_0 + \beta_1 DTV_i^y + \beta_2 DPV_i^y + \beta' A'^y_i + \beta'' FE'_i + \varepsilon_i^y \quad (1\text{-}2)$$

where DTV_i^y represents the set of digital trade variables $\{Log(DT)_i^y; Log(DT.pc)_i^y\}$ used alternatingly in equations (1) and (2); DPV_i^y represents the digital trade provision variable $DT.CH_i^y$; A'^y_i represents the vector of controls $\left[Log(GDP)_i^y, Int.\%_i^y\right]$ and β' represents the corresponding vector of coefficients. FE'_i represents the vector of country fixed-effect dummies and β'' the corresponding vector of coefficients. The superscript *y* stands for "year", and the subscript *i* stands for "individual economy". Together, these denote the country-year panel data structure present across all our models.

Furthermore, to better understand how digital trade might impact the Goals differently across different levels of digitalization, an additional model interacting with each DTV with the Internet penetration variable (Int %) was run. This model can be described as:

$$SDG_i^y = \beta_0 + \beta_1 DTV_i^y + \beta_2 DPV_i^y + \beta_3 Int.\%_i^y * DTV_i^y + \beta' A'^y_i + \beta'' FE'_i + \varepsilon_i^y \quad (3\text{-}4)$$

[15] The list of 32 indicators specifically chosen and their respective descriptive statistics and performed transformations can be found in annex 1 of the original working paper: Anukoonwattaka and others. (2024). Harnessing digital trade to advance the Sustainable Development Goals: an empirical study, ARTNeT Working Paper Series, No. 237, February 2024, Bangkok, ESCAP, available at http://artnet.unescap.org.

[16] Descriptive statistics and performed transformations for each of the control variables used can be found in annex 1 of the original working paper: Anukoonwattaka and others (2024). Harnessing digital trade to advance the Sustainable Development Goals: an empirical study, ARTNeT Working Paper Series, No. 237, February 2024, Bangkok, ESCAP, available at http://artnet.unescap.org.

[17] Please see annex 1 of the original working paper: Anukoonwattaka and others (2024). Harnessing digital trade to advance the Sustainable Development Goals: an empirical study, ARTNeT Working Paper Series, No. 237, February 2024, Bangkok, ESCAP, available at http://artnet.unescap.org.

where $Int.\%_i^y * DTV_i^y$ corresponds to the interacted variable. Similarly, equations (1-2), equations (3-4) pertain to regressions alternatingly through the DTV_i^y set.

The results of this exploratory study, complemented with the knowledge gathered throughout the whole exercise, are summarized in the next section.

Limitations

A main limitation of the models above is the absence of target-specific regression specifications, which were not built owing to chapter's wide Goal scope. Naturally, as each Goal target interacts with digital trade and other variables via differing channels, individual specifications – e.g. with target-curated control variables – should be employed to account for this heterogeneity. This would help limit the potential impacts of an omitted variable bias and thus better isolate the impact of the explanatory variable. We strongly encourage future research to build on it to further investigate each relationship of interest.

Another limitation of the current model is the understanding that a two-way interaction between the dependent and independent variables is likely. Naturally, as digital trade influences Goal improvement, higher Goals can also entice higher digital trade, as countries become more involved in high-value addition activities related to technology. While the selection – and exclusion – of specific indicators in this chapter are aimed at limiting the potential hindering impact of such interaction, an instrumental variable approach could be a powerful strategy to further strengthen the model. We encourage this exploration for future research.

2.4. Results

Among all areas of intervention, Social targets – covering Goals 3 (Good Health and Well-being), 4 (Quality Education), 5 (Gender Equality) and 10 (Reduced Inequality) – recorded the most consistently positive results, with all 6 targets measured revealing a positive linkage with digital trade.

Moreover, encouraging results on the role of digital trade on development in several Environmental Goals was observed. In particular, Goals 6 (Clean Water and Sanitation), 7 (Affordable Clean Energy), 12 (Responsible Consumption and Production), 13 (Climate Action) – for developing economies – and 15 (Life on Land) reacted positively to increasing digital trade. However, a negative connection with Goal 13 (Climate Action) – for developed economies – and no connection with Goals 11 (Sustainable Cities and Communities) and 14 (Life Below Water) was also found.

Some evidence was found regarding digital trade's enhancing role on policy-driven Governance and Partnership Goals, such as Goal 17 (Partnerships for the Goals). Yet no linkage emerged with Goal 16 (Peace, Justice and Strong Institutions), i.e. Governance.

Strong linkages between digital trade and improvements in Economic Goals, such as Goals 8 (Decent Work and Economic Growth) and 9 (Industry, Innovation and Infrastructure) could be observed. However, a negative influence on Goal 1 (No Poverty) and no significant relationship on Goal 2 (Zero Hunger) were also found.

Finally, digital trade provisions were seen to almost always be associated with an improvement in Goal progress across all areas of development.

Social Goals (3, 4, 5, 10)

Higher overall digital trade was found to be linked with an average improvement in health and well-being (Goal 3). In particular, a 1 per cent increase in digital trade was associated with a 0.01 percentage point average decline in the mortality rate from various diseases (table 2.1 and figure 2.6).

These results are in line with those of Zhang and others (2022), who presented evidence that an increase in digitally delivered health-care services reduced the mortality rate and increased life expectancy in China. Moreover, it supports the many ongoing digital health initiatives aimed at widening health-care access and improving health outcomes with digital technologies (WHO, 2021). As such, trade in digital services, digital enablers and transformative technologies are thought to be the most promising promoters of health and well-being outcomes.

Table 2.1
Impact of digital trade variables on social targets: regression coefficients across models

Variables	3 - Mortality rate (from disease)	4 - Participation rate in education	4 - Participation rate in organised learning	5 - % women in managerial positions	10 - Return on assets	10 - Remittance Costs
Digital Trade Coefficients – Simple Models (1 & 2)						
(1) Log(DT)	-0.01**	1.15*		2.06***		-1.28*
(2) Log(DT.PC)				1.63***	0.22*	
Digital Trade Coefficients – Interaction Models (3 & 4)						
(3) Log(DT)						
(3) Int % : Log(DT.PC)						
(4) Log(DT.PC)	0.01***		1.28***			
(4) Int % : Log(DT.PC)	-0.0002		-0.03***			
Policy Variable Coefficients – All Models (1-4)						
(1-4) DT.CH	Negative			Positive	Positive	Negative
Control Variables Coefficients – All Models (1-4)						
(1-4) Log(GDP)	Negative		Positive	Negative		
(1-4) Int %	Negative	Positive	Negative	Positive		

Source: ESCAP.
Note: Values shaded in green denote that the coefficients sign is consistent with our ex ante expectation. Values shaded in red denote that the coefficients sign is inconsistent with our ex ante expectation. Missing shading for cells with specific values denote that no ex ante sign expectation was defined. Blank cells denote no significant coefficient.

Nevertheless, this positive impact could be verified only for countries with moderately high levels of Internet penetration (at least above 32 per cent), as is, for instance, the case in China, which was explored in Zhang and others (2022). Naturally, shifting the provision of health-care services from modes 2, 3, 4 (physically delivered) to mode 1 (virtually delivered) relies on a strong widespread ICT infrastructure. In addition, this impact was found to be continuously enhanced as Internet penetration grows: the more digitized an economy is, the more technologies can be seamlessly integrated and synergies harnessed (figure 2.6). Thus, fostering digital trade can also boost health-care outcomes by paving the way for a better connectivity infrastructure. This insight is also supported by the positive (i.e. lower mortality rate) influence that Internet penetration alone has been found to have.

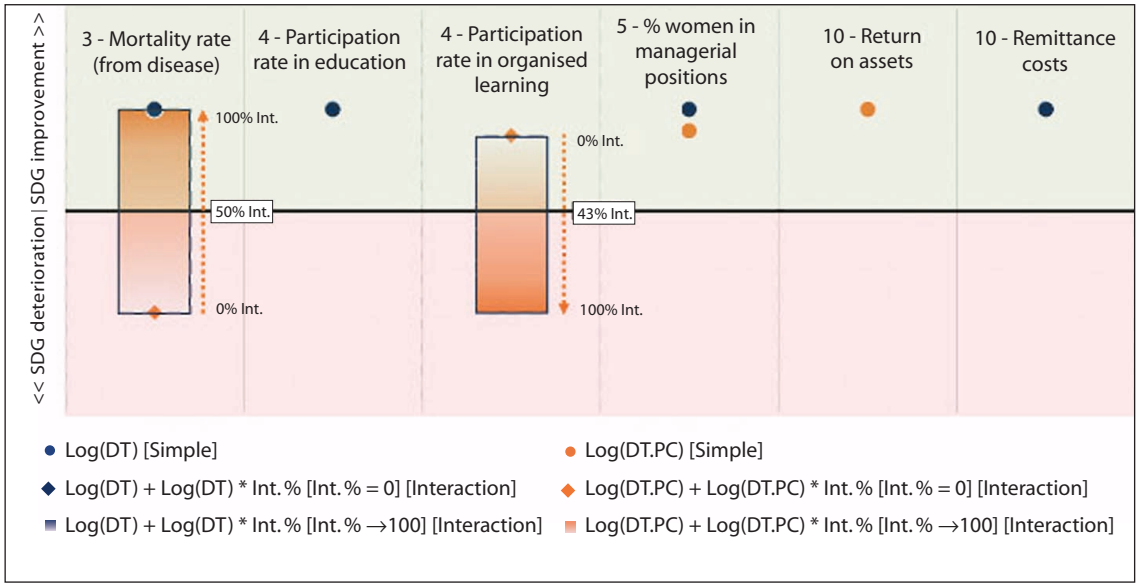
A robust relationship between higher digital trade and better education outcomes (Goal 4) was also identified. Indeed, a 1 per cent increase in digital trade is associated with an average 1.15 percentage point increase in the participation rate in both formal and non-formal education. As with health care, educational outcomes improve substantially due to wider access to educational tools. More specifically, higher digital trade facilitates the rise of e-education, online training and MOOCs – digitally ordered and delivered services – which evidence indicates can reduces costs by as much as 32 per cent (Gibbons and Fairweather, 2000).

Yet, while the overall impact of digital trade per capita was found to be positive – contributing to a 1.28 percentage point increase in the participation in organized learning – this effect seems to be diminishing as Internet penetration deepens, subsiding for moderate Internet penetration levels (above 43 per cent). This insight is in line with those of several studies that have pointed out the potential role of e-learning in exacerbating existing educational disparities in already well-digitalized environments. This aspect is mostly because remaining disadvantaged groups have significantly

more difficulties in getting all the necessary equipment to connect to and benefit from e-learning (Coleman, 2021; Schulz and Robinson, 2022). Hence, digital trade policy should be accompanied by an effective accessibility policy that can guarantee enough resources for disadvantaged groups to be able to connect.

Higher digital trade also seems to be positively contributing towards reducing inequalities. For instance, the percentage of women in managerial positions, a target of Goal 5, was associated with 2.06 and 1.63 percentage point increases for every 1 per cent rise in the level of digital trade and digital trade per capita, respectively. Apart from increased female participation in the workforce via online and remote jobs, as well as stronger economic growth, welcoming trade in digitally-delivered and ordered services, such as social media and mobile platforms, tends to expedite social awareness and corporate accountability towards social inclusion. Furthermore, digital trade can also help empower minorities through promoting financial inclusion and efficiency, for instance via cross-border online money transfers which directly reduce remittance costs. Indeed, we found that the targets of Goal 10, the return on assets and remittance costs were both 0.22 percentage points higher and 1.28 percentage points lower for every 1 per cent rise in digital trade per capita and digital trade level, respectively.

Figure 2.6
Standardized impact of digital trade variables on social targets: standardized regression coefficients across models



Source: ESCAP.
Note: The figure presents normalized coefficients for each digital trade variable – digital trade (DT), digital trade per capita (DT.PC) – across two model specifications – a simple model (no interacted variables) [Simple] and an interaction model [Interaction]. For [Interaction] models, a diamond represents the direct digital trade variable coefficient (i.e. Int % = 0); gradient bars represent the total (from both the direct and interacted coefficients) average digital trade impact for each level of Internet penetration between 0 and 100 per cent. On the X-axis next to crossing gradient bars, the precise Internet penetration level at which the total average digital trade impact switches sign is displayed.

Environmental Goals (6, 7, 11, 12, 13, 15)

A positive and consistent association between higher digital trade and better resource management was observed. Water use efficiency, a target of Goal 6, was seen to rise by $1.57 per cubic metre of water with every percentage increase in the level of digital trade (table 2.2). The tonnage of municipal waste recycled, a target of Goal 12, increased by 2.18 tons for every percentage increase in both digital trade and digital trade per capita. However, this impact saw diminishing returns with increasing Internet penetration. In fact, at very high levels of Internet penetration (upward of 73 per cent) this positive impact subsided (figure 2.7).

Table 2.2
Impact of digital trade variables on environmental targets: regression coefficients across models

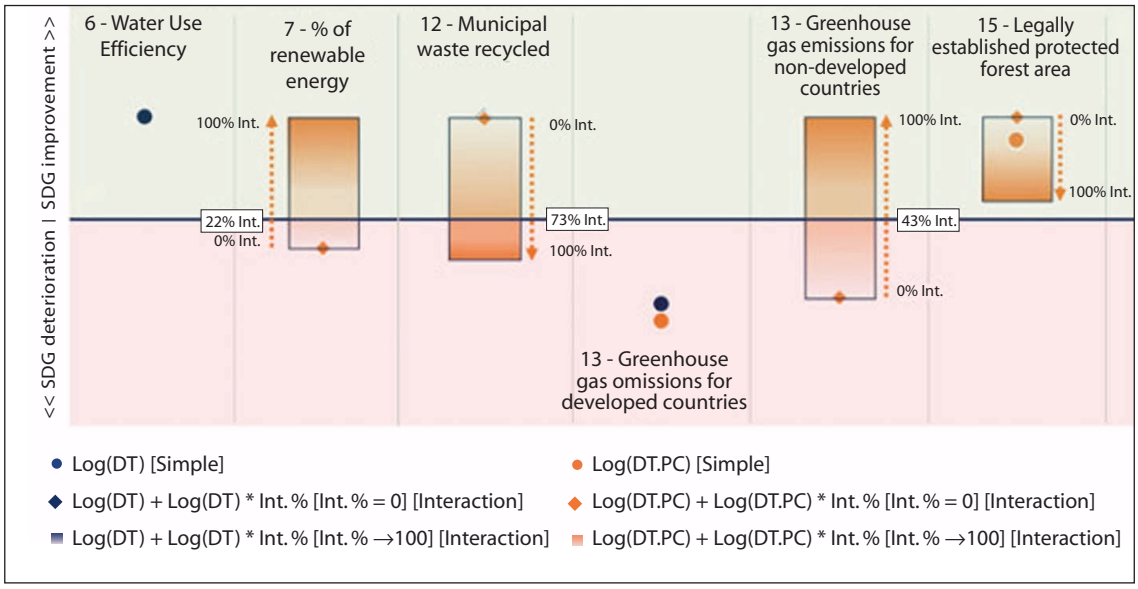
Variables	6 - Water Use Efficiency	7 - % of renewable energy	12 - Municipal waste recycled	13 - Greenhouse gas emissions for developed countries	13 - Greenhouse gas emissions for non-developed countries	15 - Legally established protected forest area
Digital Trade Coefficients – Simple Models (1 & 2)						
(1) Log(DT)	1.57**			0.1**		0.46*
(2) Log(DT.PC)				0.12**		0.47*
Digital Trade Coefficients – Interaction Models (3 & 4)						
(3) Log(DT)			2.18***			
(3) Int % : Log(DT.PC)			-0.03***			
(4) Log(DT.PC)		0.44***	2.15***		0.13***	0.64***
(4) Int % : Log(DT.PC)		0.02***	-0.03***		-0.003	-0.005
Policy Variabla Coefficients – All Models (1-4)						
(1-4) DT.CH	Positive	Positive	Positive	Negative		Positive
Control Variables Coefficients – All Models (1-4)						
(1-4) Log(GDP)	Positive	Negative	Negative		Positive	
(1-4) Int %		Positive	Unclear		Negative	Positive

Source: ESCAP.
Note: Values shaded in green denote that the coefficients sign is consistent with our ex ante expectation. Values shaded in red denote that the coefficients sign is inconsistent with our ex ante expectation. Missing shading for cells with specific values denote that no ex ante sign expectation was defined. Blank cells denote no significant coefficient.

The share of renewable energy, a target of Goal 7 and the total metric tonnage of carbon dioxide emitted by non-developed countries, a target of Goal 13, also recorded positive associations with digital trade. Indeed, for Internet penetration levels above 22 per cent digital trade per capita is associated with a higher share of renewable emissions. This impact rises steeply with higher Internet penetration, peaking at 1.56 percentage point increase in the share of renewables for every percentage increase in digital trade per capita. Similarly, digital trade per capita was found to contribute only to less carbon emissions in developing economies from moderate Internet penetration levels and above (43 per cent), with impacts ranging from an additional +0.13 to -0.17 fewer metric tons of carbon dioxide per 1 per cent increase in the level of digital trade per capita. Contrastingly, a negative connection between digital trade and carbon emissions in developed economies was found. This relationship likely translates the outsized role that developed economies have in global carbon dioxide emissions, paired with the fact that higher digital trade is also associated with higher industrial activity.

The share of legally established protected forest area, a target of Goal 15, saw a consistently positive, but slightly diminishing, association with digital trade. Indeed, higher levels of both digital trade and digital trade per capita were seen to contribute to an average increase of 0.46 and 0.47 percentage points in this target, respectively. Yet, considering digital trade per capita's impact across Internet penetration levels, it is possible to identify that this impact can be as high as 0.61 (for 0 per cent Internet penetration) or as low as 0.11 (for 100 per cent Internet penetration).

Figure 2.7
Standardized impact of digital trade variables on environmental targets: standardized regression coefficients across models



Source: ESCAP.
Note: The figure presents normalized coefficients for each digital trade variable – digital trade (DT), digital trade per capita (DT.PC) – across two model specifications – a simple model (no interacted variables) [Simple] and an interaction model [Interaction]. For [Interaction] models, a diamond represents the direct digital trade variable coefficient (i.e. Int % = 0); gradient bars represent the total (from both the direct and interacted coefficients) average digital trade impact for each level of Internet penetration between 0 and 100 per cent. On the X-axis next to crossing gradient bars, the precise Internet penetration level at which the total average digital trade impact switches sign is displayed.

Digital trade's encouraging association with environmental Goals can be understood through its role in facilitating the implementation of transformative technologies, such as in IoT, big data, robotics, among others, that can be particularly productive in tackling environmental challenges. Indeed, such initiatives as PlantSight or SIWA (working on efficient water and waste management), CoolCrop in India (supporting efficient crop cold storage efforts), DBS Solutions (for tracking products' provenance), or the many projects monitoring everything from flood risks to agricultural yields (WaPOR), overfishing, wildlife migration or the supply of renewable energies, all rely on complex digital products and infrastructure to which energetic digital trade is fundamental (Wilts and others, 2021; Leslie and Lugo-Mulligan, 2021; Jozefowicz and Michniewicz-Ankiersztajn, 2023). Exceptions to these positive impacts are Goals 11 (Sustainable Cities and Communities) and 14 (Life Below Water) for which no significant relationship was found.

Global Governance and Partnerships (Goals 16, 17)

No evidence on the impact of digital trade on Goal 16 (Peace, Justice and Strong Institutions) could be observed. Naturally, as a policy-driven Goal, the impact of digital trade can be limited in these areas and result in insignificant or inconsistent relationships.

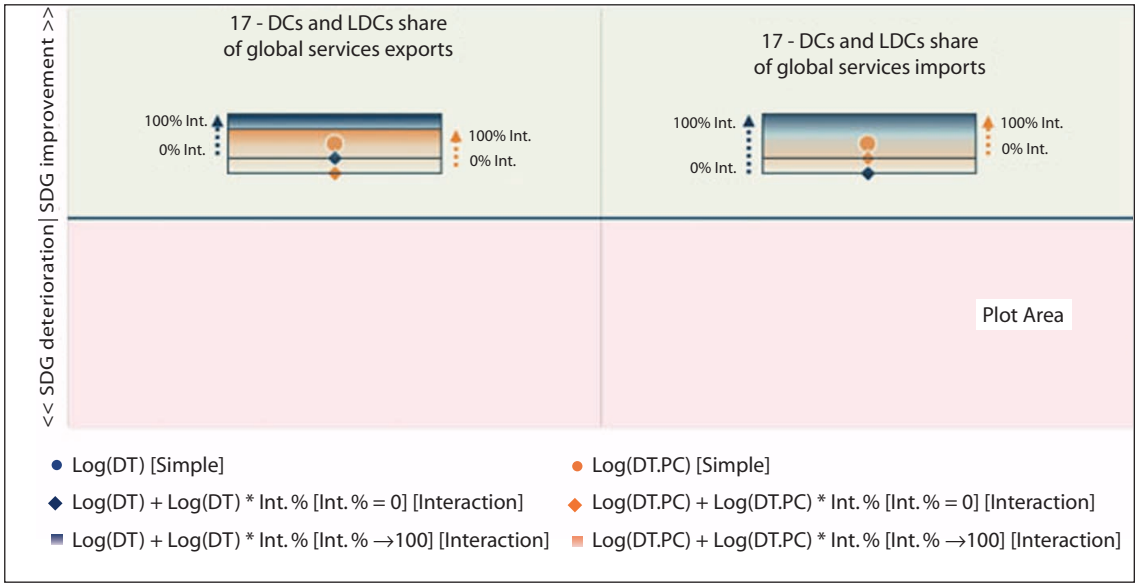
Nevertheless, convincing statistical evidence pertaining to a positive and consistent linkage between higher digital trade and an improvement in Goal 17 (Partnerships for the Goals) targets was found. Indeed, higher digital trade (both in total and per capita) was seen to consistently increase a country's share of services trade with DCs and LDCs by 0.05 percentage points (table 2.3). This impact only grew stronger as Internet penetration rose, increasing at a rate of 0.0003 percentage points per percentage point increase in Internet penetration (figure 2.8).

Table 2.3
Impact of digital trade variables on governance and global partnership targets: regression coefficients across models

Variables	17 - DC and LDCs share of global services exports	17 - DC and LDCs share of global services imports
Digital Trade Coefficients – Simple Models (1 & 2)		
(1) Log(DT)	0.05***	0.05***
(2) Log(DT.PC)	0.05***	0.05***
Digital Trade Coefficients – Interaction Models (3 & 4)		
(3) Log(DT)	0.04***	0.03***
(3) Int % : Log(DT.PC)	0.0002**	0.0004***
(4) Log(DT.PC)	0.03***	0.04**
(4) Int % : Log(DT.PC)	0.0004***	0.0003*
Policy Variable Coefficients – All Models (1-4)		
(1-4) DT.CH		Positive
Control Variables Coefficients – All Models (1-4)		
(1-4) Log(GDP)	Positive	Positive
(1-4) Int %	Negative	Negative

Source: ESCAP.
Note: Values shaded in green denote that the coefficients sign is consistent with our ex ante expectation. Values shaded in red denote that the coefficients sign is inconsistent with our ex ante expectation. Missing shading for cells with specific values denotes that no ex ante sign expectation was defined. Blank cells denote no significant coefficient.

Figure 2.8
Standardized impact of digital trade variables on governance and global partnership targets: standardized regression coefficients across models



Source: ESCAP.
Note: The figure presents normalized coefficients for each digital trade variable – digital trade (DT), digital trade per capita (DT.PC) – across two model specifications – a simple model (no interacted variables) [Simple] and an interaction model [Interaction]. For [Interaction] models, a diamond represents the direct digital trade variable coefficient (i.e. Int % = 0); gradient bars represent the total (from both the direct and interacted coefficients) average digital trade impact for each level of Internet penetration between 0 and 100 per cent. On the X-axis next to crossing gradient bars, the precise Internet penetration level at which the total average digital trade impact switches sign is displayed.

Higher digital trade in DCs and LDCs directly, via e-commerce websites, blockchain, online database services etc., or indirectly, via enabling digital products, encourage such countries to participate in trade facilitation initiatives and international trade agreements. Initiatives such as ASYCUDA, Thailand's Customs Connect or USAID Nextrade, along with the many ongoing regional digital trade-related initiatives and launched eGovernment solutions, are signs of increased prominence of DCs and LDCs engaging in multilateral partnerships and global governance programmes.

Economic Goals (1, 2, 8 and 9)

Digital trade's influence on economic Goals produces mixed evidence. While strong linkages between digital trade and improvements in Goals 8 and 9 could be observed, a negative influence on Goal 1 and no significant relationship with Goal 2 were also found.

Indeed, on one hand, a country's GDP growth rate per capita – a target of Goal 8 – was found to increase on average by 0.36 percentage points for every percentage increase in the level of digital trade per capita or 0.8 percentage points for every percentage increase in the level of digital trade (table 2.4). This is consistent with the understanding that digital trade channels are becoming a primary conduit of trade, serving as a significant engine for economic growth. Specifically, digital platforms enable firms to broaden both their source and destination markets, stimulating job creation, enhancing productivity and contributing to poverty alleviation through the various channels already discussed. Nevertheless, this positive impact was verified to be strongest for lower levels of Internet penetration, subsiding for very high penetration levels (above 70-80 per cent) (figure 2.7). This finding highlights digital trade's especially transformative impact in transitioning economies, where initial rises in Internet penetration can greatly enhance the benefits of digital trade.

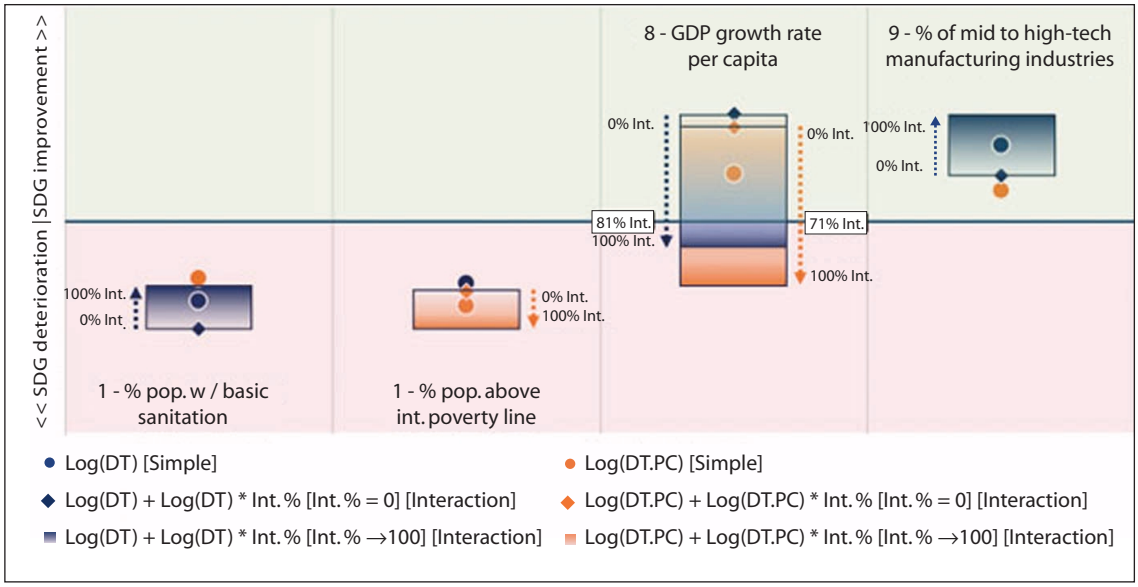
Table 2.4
Impact of digital trade variables on economic targets: regression coefficients across models

Variables	1 - % pop. w/basic sanitation	1 - % pop. above int. poverty line	8 - GDP growth rate per capita	9 - % of mid to high-tech manufacturing industries
Digital Trade Coefficients – Simple Models (1 & 2)				
(1) Log(DT)	0.49***	-1.67***		0.05***
(2) Log(DT.PC)	-0.35***	-2.29***	0.36*	0.02**
Digital Trade Coefficients – Interaction Models (3 & 4)				
(3) Log(DT)	-0.66***		0.81**	0.03**
(3) Int % : Log(DT.PC)	0.004***		-0.01**	0.0004**
(4) Log(DT.PC)		-1.89***	0.71**	
(4) Int % : Log(DT.PC)		-0.01***	-0.01**	
Policy Variable Coefficients – All Models (1-4)				
(1-4) DT.CH	Negative		Positive	Positive
Control Variables Coefficients – All Models (1-4)				
(1-4) Log(GDP)	Positive	Positive	Positive	
(1-4) Int %	Positive	Positive	Negative	Negative

Source: ESCAP.
Note: "pop. above int." means "population above interaction". Values shaded in green denote that the coefficients sign is consistent with our ex ante expectation. Values shaded in red denote that the coefficients sign is inconsistent with our ex ante expectation. Missing shading for cells with specific values denote that no ex ante sign expectation was defined. Blank cells denote no significant coefficient.

On the other hand, the two targets under Goal 1 (No Poverty) revealed a negative relationship with digital trade. A percentage increase in digital trade and digital trade per capita was associated with declines of 0.49 and 0.35 percentage points, respectively, in the share of the population with access to basic sanitation. Additionally, the share of the population above the international poverty line declined by 1.67 and 2.29 percentage points for the same variables, respectively. A possible explanation for these results is tied with digital trade's potential relationship with increased job displacement, especially in economically vulnerable demographics. Indeed, as economies transition towards more complex and productive activities, as explored above, unskilled workers in labour-intensive sectors tend to be replaced (ILO, 2016; UNIDO, 2020; Fan and others, 2018). Since exposed demographics are already the most economically vulnerable – and are most prominent in low-income countries – a situation of job displacement can quickly lead to poverty and worse sanitation conditions. Accordingly, while digital trade is seen as a positive engine for economic growth at the aggregate level, it might also contribute to worsening economic security among the most vulnerable, as digitally excluded groups face the challenges related to a changing economic landscape.

Figure 2.9
Standardized impact of digital trade variables on economic targets: standardized regression coefficients across models

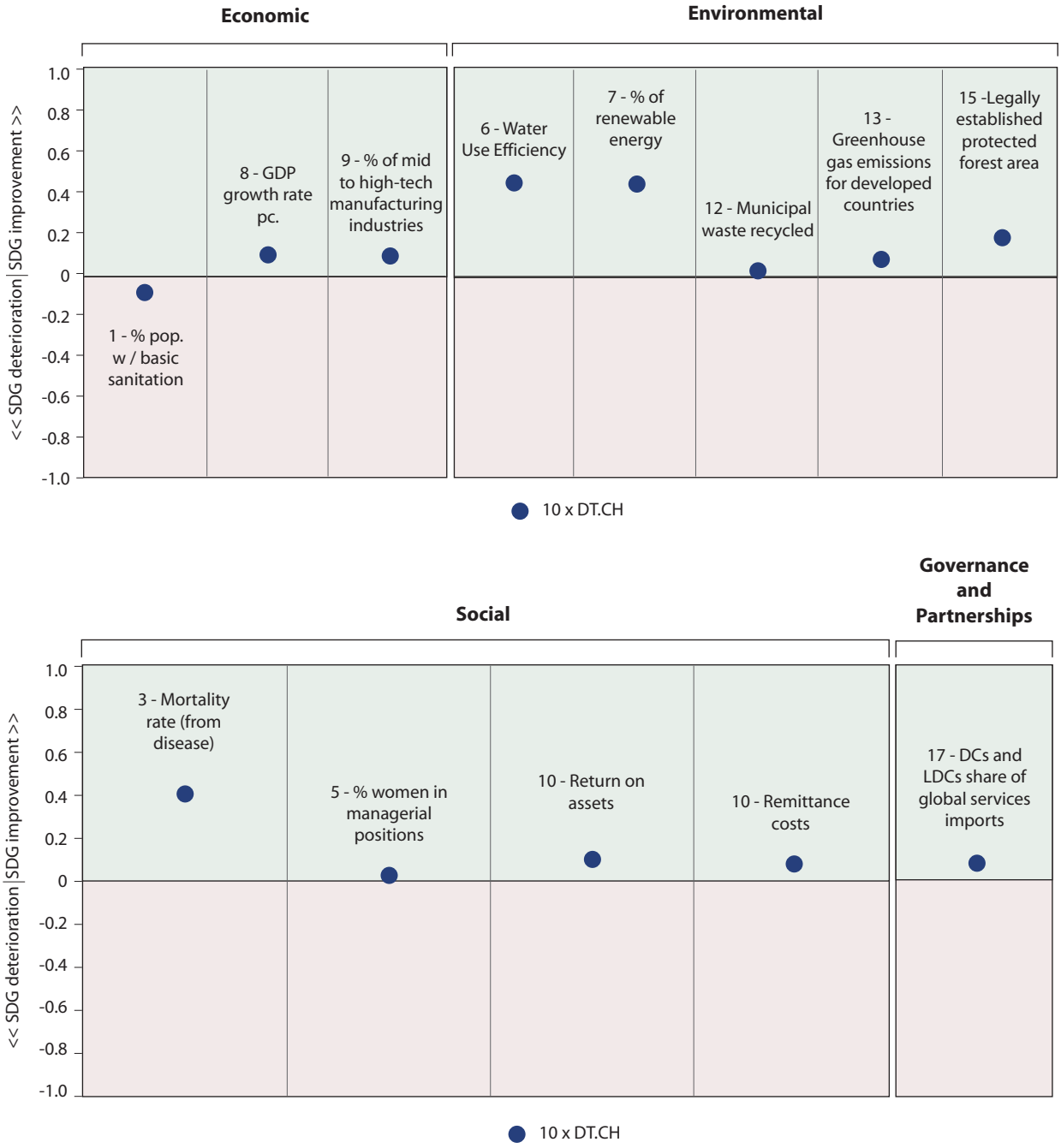


Source: ESCAP.
Note: The figure presents normalized coefficients for each digital trade variable – digital trade (DT), digital trade per capita (DT.PC) – across two model specifications – a simple model (no interacted variables) [Simple] and an interaction model [Interaction]. For [Interaction] models, a diamond represents the direct digital trade variable coefficient (i.e. Int % = 0); gradient bars represent the total (from both the direct and interacted coefficients) average digital trade impact for each level of Internet penetration between 0 and 100 per cent. On the X-axis next to crossing gradient bars, the precise Internet penetration level at which the total average digital trade impact switches sign is displayed.

Digital trade provisions – all areas of intervention

Additional digital trade provisions in international agreements, specifically measured via the number of trade chapters with digital trade provisions (DT.CH), were consistently found to have a positive impact on all areas of Goal development (figure 2.9 and tables 2.1-2.4). In particular, adding trade chapters with digital provisions to international agreements was linked with the highest positive impact on environmental targets, such as Water Use Efficiency (Goal 6) and Share of Renewable Energy (Goal 7), as well as on the social target Mortality Rate (from disease) (Goal 3). These results likely translate the positive impacts of infrastructure and regulatory readiness in harnessing the benefits from the digital revolution.

Figure 2.10
Trade chapter with digital provisions variable (DT.CH) coefficient results across Goals, normalized, by area of intervention



Source: ESCAP.
Note: The figure presents normalized coefficients for DT.CH. The coefficients range from 1 to -1, where 1 represents the highest positive impact recorded across all DTVs within a Goal and -1 is its opposite.

2.5. Conclusion

In this chapter, we empirically examined the potential impact of digital trade and digital trade provisions on the SDGs. Our exploratory findings point towards substantial links between digital trade and several Goals, particularly within the areas of social and environmental targets. All six social targets and five out of six environmental targets revealed a positive link with digital trade, at least at certain levels of digital penetration. Yet, the results related to economic development and governance and global partnerships present a more varied picture, with limited or mixed evidence emerging. Such results underscore the complexity and variety of relationships between digital trade and the SDGs, highlighting the need for further research in this area.

Crucially, our research has underscored the importance of addressing the digital divide to maximize digital trade's potential benefits. As digital trade continues to expand, it is imperative to prioritize the development of ICT infrastructure, digital skills and digital regulation that can ensure an affordable, efficient and safe digital trade environment. This will ensure that the benefits of digital trade can be widely accessed. Moreover, our findings emphasize the significant role of digital trade provisions in international agreements in enhancing sustainable development. As observed, digital trade provisions may play a crucial role in furthering sustainable development. This underlines the opportunity to leverage regional trade agreements as effective platforms for enhancing regulatory cooperation in the area of digital trade, a key factor in achieving sustainable development.

While we endeavoured to provide a comprehensive overview of the potential links between digital trade and all 17 Goals, further work in this area is strongly encouraged. Indeed, to better understand the potential causation pathways between digital trade and the SDGs, we strongly encourage more in-depth research on specific indicators – rather than on a wide range of Goals – that can more robustly model specific relationships. Different identification strategies, such as an instrumental variable approach, would also be a potential way forward to better understand the research question at hand and verify the robustness of the results.

In conclusion, this chapter serves as a steppingstone towards a deeper understanding of the potential of digital trade in advancing the SDGs. As digital trade continues to grow and evolve, policymakers have a crucial role to play in shaping its impacts. Ultimately, we hope that this exploratory study provides a useful resource for policymakers and researchers to find ways to harness digital trade to achieve the SDGs.

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CHAPTER 3

Digital trade and wealth inequality: evidence from the Asia-Pacific region

Chapter 3

Digital trade and wealth inequality: evidence from the Asia-Pacific region[18]

3.1. Introduction

The rise of the digital economy in the last few decades has significantly altered the international trade landscape globally. Digital trade is defined as digitally enabled transactions in trade in goods and services which can be delivered either digitally or physically, involving consumers, firms and Governments (Lopez-Gonzalez and Jouanjean, 2017). The growing popularity of online platforms has resulted in an increasing number of small goods packages crossing international borders, whereas new digital technologies have changed how services are produced and delivered across borders. Digital trade is based on the movement of data, with data acting both as a means of production as well as an asset which can be traded. Ensuring that digital trade is inclusive, both within and across countries, poses a formidable challenge to policymakers worldwide. Small and medium-sized firms, which were previously supplying only in domestic markets due to cost constraints, can now cater to a large and growing global customer base, by taking advantage of access to online marketplaces offered through digital technologies. Online sellers can offer products at a cheaper price due to lower capital requirements. However, there exists a wide disparity between the developed and developing world when it comes to the uptake of information and communications technology. The proportion of individuals using the Internet, an ICT Sustainable Development Goal indicator, stood at a towering figure of 87.26 per cent in North America and Europe in 2020. In contrast, only 40.53 per cent of individuals in South Asia and 57.83 per cent of individuals in South-East Asia used the Internet even during the pandemic year of 2020 (ITU, 2021).

Globalization and technological change have resulted in uneven spatial distribution of wealth and rising within-country inequality, especially in advanced economies (Iammarino, 2018). UNCTAD (2021) highlighted the increasing tendency of the world's largest digital platforms, such as Apple, Microsoft, Amazon, Alphabet (Google), Facebook, Tencent and Alibaba, to invest in all parts of the global data value chain. Interestingly, all of these companies have their headquarters in ESCAP Member States. These companies are keen on upgrading their data collection, data transmission, data storage, data analysis, data processing and final use by heavily investing in user-facing platform services, submarine cables and satellites, data centres and artificial intelligence (AI). Reaping the benefits of economies of scale, network effects and privileged access to data, these corporations have come to acquire massive financial, market and technological power and global reach in recent years. Accelerated digitalization in the wake of the COVID-19 pandemic has further enhanced their size, profits, market value and market dominance. Four of these digital platforms accounted for 67 per cent of the global revenue from cloud infrastructure services in the last quarter of 2020 (UNCTAD, 2021). In this new data-driven world order, developing countries risk being mere providers of raw data to global digital platforms, while also having to pay for the digital intelligence obtained from their data.

The net wealth of a household is defined as all the non-financial assets as well as financial assets over which the household can enforce ownership rights and which also provide economic benefits to

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their owners, net of any debt (Zucman, 2019). Non-financial assets, such as real estate, land and buildings, and financial assets, such as bank deposits, equities, bonds, life insurance and pension funds, are included in this definition of wealth. Wealth inequality is defined as the unequal distribution of wealth and assets among the countries of the world and within countries (Njangang and others, 2022). According to Chancel and others (2022), the top 1 per cent of the world's population possessed nearly 39 times the wealth of the lowest 50 per cent in 2021. However, cross-country scrutiny indicates that wealth distribution among the rich varies depending on their per capita income levels. In 2021, the top 1 per cent in the developed countries possessed 24 per cent of national wealth, whereas the comparable statistics in developing countries was 42 per cent. Besides, Piketty and Zucman (2014) highlighted that wealth inequality as a share of total national wealth has been on the rise over the last 40 years. The uneven patterns of wealth distribution and their macroeconomic consequences warrant an investigation of the major determinants of wealth inequality within and across countries.

The contributions of our chapter to the existing literature are twofold. First, this is the first empirical analysis examining the role of digital trade (accounted by digitally-deliverable services trade and ICT goods trade), focusing explicitly on within-country wealth inequality levels. Second, the sample of our study incorporates countries in the Asia-Pacific region where no specific study on the nexus between digitalization and wealth inequality has been carried out before. Our analysis provides new empirical evidence that digital trade has an inequality-enhancing effect in the Asia-Pacific region. Nevertheless, it is important to mention that the current study is limited to addressing within-country wealth inequality, and has no potential extension to address wealth inequality between countries.

The rest of the chapter is structured as follows. In section 2, we present a brief review of the theoretical and empirical literature on the effects of international trade on inequality in general, and wealth inequality in particular. We highlight the role of digitalization, hitherto neglected, in driving within-country inequality. Section 3 presents a preliminary analysis of digitalization, digital trade and wealth inequality in the Asia-Pacific region. Section 4 discusses the data, variables and empirical approach adopted in the chapter. Section 5 discusses the empirical results in detail, followed by the conclusions and policy implications in section 6.

3.2. Literature review

3.2.1. Theoretical background

The effect of international trade inequality has been studied in great detail over the years, however, without reaching a consensus. Most studies examine the nexus between international trade and inequality against the background of neoclassical theories (Zhu and others, 2022). Increased digitalization has resulted in expanded trade in both goods and services (Abeliansky and Hilbert, 2017). Baldwin (2005) adopted the heterogeneous firm model of Meltiz and proved that online markets helped in decreasing income inequality by reducing the fixed costs of exporting. Lendle and Olarreaga (2017) studied the role of online markets in making international trade more inclusive, by bringing down income inequality. Information frictions are less in online markets as there is a much smaller need to search for clients or to establish a distribution channel, compared with offline markets. In online markets, the cost incurred by the seller in finding the right customer is quite negligible. It is also much cheaper for a seller to build a reputation online due to the inbuilt mechanisms offered by e-commerce websites, wherein customers give ratings of various online vendors based on their earlier purchases.

Specifically in the context of wealth inequality, international trade, among others, is identified as a critical determinant (Foellmi and Oechslin, 2010; Chang and Wu, 2016). There are notable direct channels linking digital trade and the digitalization of trade to wealth inequality. For instance, technological progress in trade can drive wealth inequality because of its inbuilt skills bias. In contrast, digitalization provides more opportunities for lower-income groups to get market access by lowering transaction costs (Zhu and others, 2022). Besides, there are several indirect channels by which digitalization influences inequality levels in a country. The first of them is the entrepreneurship channel. It is argued that increasing digitalization has enabled expanded business opportunities

(Zhang and Li, 2018). However, there exists a parallel stream of literature which postulates that increased business opportunities can increase within-country inequality (Atems and Shand, 2018) by increasing the incomes of large businesses and leaving small and medium-sized businesses with relatively lower shares. The second indirect channel is financial development. Increased digitalization facilitates financial development in a country (Njangang and others, 2022) and the latter influences wealth inequality in two ways. On one hand, financial development coupled with digitalization reduces information asymmetry in financial transactions, thereby reducing inequality among different income classes. On the other, financial development may facilitate new business opportunities and widen wealth distribution by disproportionately favouring the rich. The third indirect channel is innovation in digitalization. It is argued that digitalization promotes innovation among large entrepreneurs, thereby reducing business opportunities for small and medium-sized businesses (Njangang and others, 2022).

3.2.2. Empirical evidence

Even though there is a large body of empirical literature on the nexus between international trade and inequality, most studies predominantly ignored the role of improvements in digitalization in international trade except Zhu and others (2022). In a recent paper, Zhu and others (2022) studied the impact of digital service trade on within-country income inequality for a panel of 100 countries. They defined income inequality in terms of the Gini index and digital service trade in terms of digitally-deliverable services trade as a share of the total services trade of a country. Using two-stage least squares-instrument variable estimation, they found that digital service trade had a negative and significant impact on income inequality in the case of high-income and middle-income countries.

Specific to wealth inequality, Islam (2018) argued that international trade and wealth inequality are inversely related in countries with lower levels of democracy. On the contrary, Tadadjeu and others (2021) showed that trade openness increased wealth inequality for a sample of 45 developed and developing countries. Njangang and others (2022) studied the impact of ICT on wealth inequality for a panel of 45 countries. They used different measures of ICT, such as Internet penetration, mobile penetration, ICT service exports, ICT index, ICT quality and quantity. They measured wealth inequality using Credit Suisse data for three proxies, namely the wealth share of the top 1 per cent, the wealth share of the top 10 per cent and the billionaire wealth-to-GDP ratio. They found that ICT increases wealth inequality, with democracy playing an important role in mitigating this impact.

While the effects of international trade and digitalization have been examined independently, whether and how digital trade affects wealth inequality remains unexplored. Our study proposes to fill this gap. The study gains more relevance in the prospect of achieving the SDG of Reduced Inequality. The Asia-Pacific region provides a suitable testing ground for our study because heightened income and wealth inequalities have accompanied rapid economic growth in this region (Zhuang, 2023). Digitally deliverable services trade in the Asia-Pacific region experienced higher growth than the rest of the world during the 15 years from 2005 to 2020 (ADB, 2022). The proliferation of digitalization in the post-COVID period further amplifies the importance of digital trade in shaping inequality levels within and across countries (Wang and Xu, 2023).

3.3. Preliminary data analysis

In subsection 3.1, we discussed the recent trends in digital trade in the Asia-Pacific region[19] for the period 2005-2021.[20] We employed digitally deliverable services trade and ICT goods trade as the broad measures of digital trade. In subsection 3.2, we show the regional evolution of wealth inequality over the period 1995-2021.[21] We use the share of wealth held by the top 1 percentile of the adult population and the top 10 percentile of the adult population as broad measures of wealth inequality.

[19] Of the 53 ESCAP Member States (listed at www.unescap.org/about/member-states), only 40 have been included in econometric analysis due to data limitations. The list of 40 countries is given in the appendix in the original working paper: Sanjeev Vasudevan and Mini P. Thomas (2024). Digital trade and wealth inequality: evidence from the Asia-Pacific region, ARTNeT Working Paper Series, No. 234, January 2024, Bangkok, ESCAP. Available at http://artnet.unescap.org.

[20] Owing to data unavailability, we limit the study period to 2005-2021.

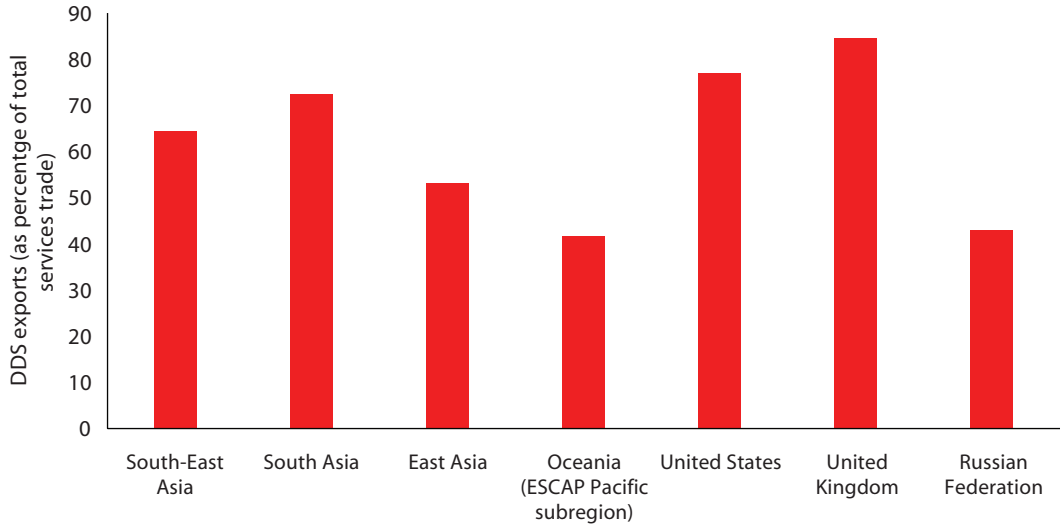
[21] Only wealth inequality analysis is carried out for such a lengthy time period. Regional evolution does not include France, Netherlands, Türkiye, the United Kingdom and the United States.

3.3.1. Digital trade in the Asia-Pacific region

Figure 3.1 throws light on the digital trade pattern unfolding within the Asia-Pacific region, and specifically among the ESCAP Member States, for the latest year for which data are available, namely 2021. Digitally-deliverable services are a superior indicator of digital trade compared with ICT services as it covers a much broader array of services exports and services imports within its ambit. Digitally deliverable services are an aggregation of insurance and pension services, financial services, charges for the use of intellectual property, telecommunications, computer and information services, other business services and audiovisual and related services (UNCTAD, 2015).

Developed countries such as the United Kingdom of Great Britain and Northern Ireland and the United States exhibited the highest share of digitally-deliverable service exports in total services trade, at 85 per cent and 77 per cent, respectively, for 2021 (figure 3.1). Among other subregions within the Asia-Pacific region, South Asia and South-East Asia emerge as leading players in the digital services export market. In South Asia, comprising such countries as India, a world leader in IT exports, DDS exports as a share of total services trade, stood at 72 per cent. For the East Asian subregion, despite containing economic powerhouses such as China, Japan and the Republic of Korea, DDS exports formed only 53 per cent of its total international trade in services. The Russian Federation is the largest country in the Asia-Pacific region and has strategic partnerships with smaller countries in the region. The Russian Federation as well as the Pacific subregion, which includes many island nations as well as the developed countries of Australia and New Zealand, were found to be lagging in the digital services export market.

Figure 3.1[22]
Export pattern of digitally-deliverable services for 2021

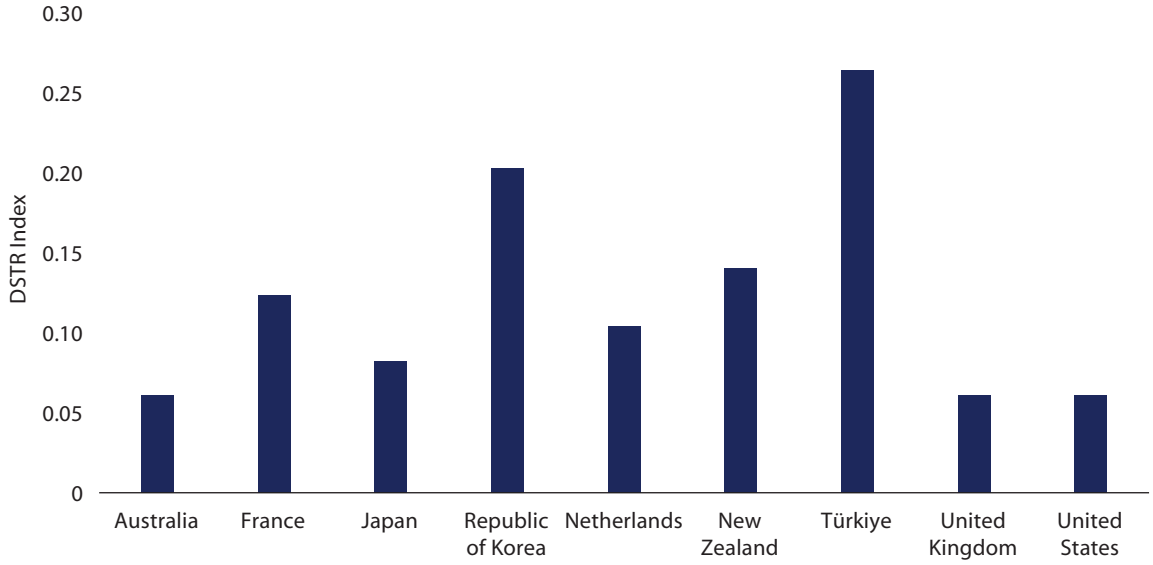


Source: ESCAP compilation from UNCTADStat data.

The regulatory regime on digital trade has important implications for the wealth inequality prevailing in a country. An open regulatory environment may reduce or accentuate the problem of wealth inequality. The Digital Services Trade Restrictiveness Index published by OECD quantifies the cross-cutting barriers that inhibit or completely prohibit the ability of firms to supply services which are traded digitally (Ferencz, 2019). This is a composite index comprising five major dimensions: infrastructure and connectivity; electronic transactions; e-payment systems; intellectual property rights; and other barriers to trade in digitally enabled services. The value of the index varies from 0 to 1, with 0 indicating an open regulatory environment and 1 indicating a completely closed regulatory environment.

[22] For figure 3.1, South Asia excludes Türkiye; South-East Asia excludes Brunei Darussalam; East Asia excludes the Democratic People's Republic of Korea; and Oceania excludes American Samoa, Guam and the Northern Mariana Islands.

Figure 3.2
Trends in digital services trade restrictiveness, 2021 (OECD countries in Asia-Pacific region)



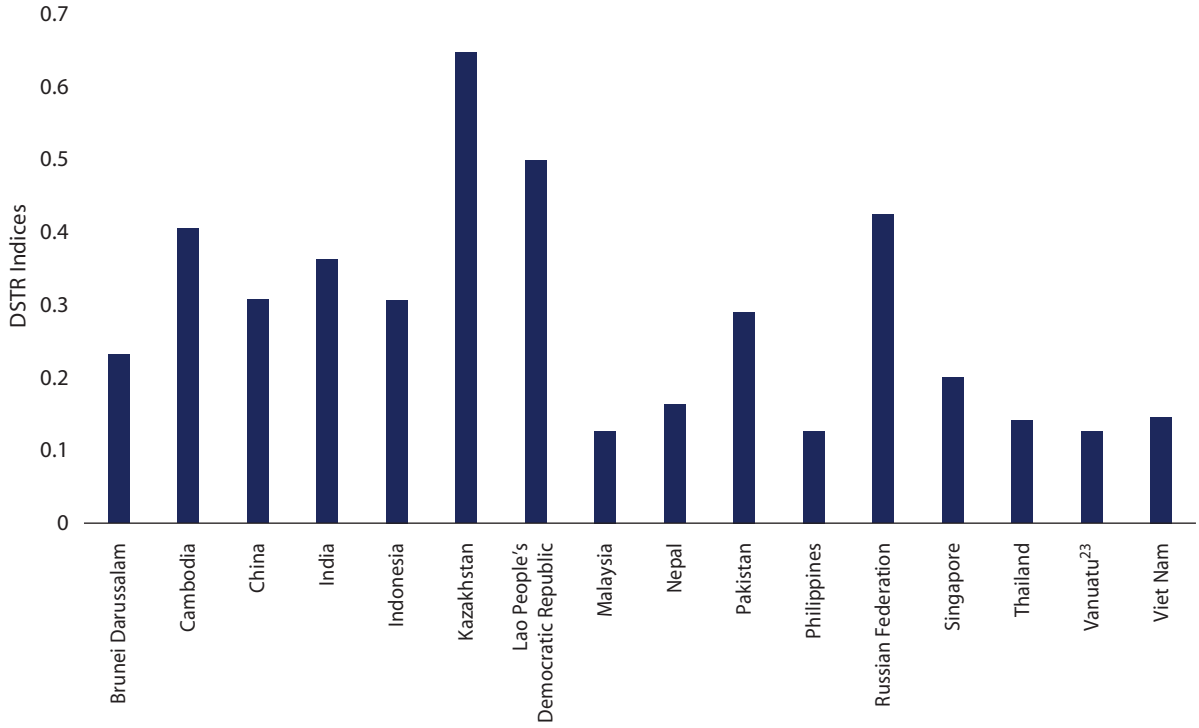
Source: ESCAP compilation from OECDStat data.

Among the ESCAP Member States, data on this index are available for 25 countries. Among the OECD countries which are in the ESCAP Asia-Pacific region, Türkiye has the maximum amount of trade restrictions, with a DSTRI of 0.264 in the year 2021, when it comes to engaging in digital trade (figure 3.2). The majority of the barriers to digital services trade for New Zealand, Republic of Korea and Türkiye can be attributed to the infrastructure and connectivity dimension of the index. The United Kingdom and the United States have the most conducive regulatory environment for firms engaging in digital services trade, with a DSTRI of 0.061. All of these nine OECD members are also developed countries.

Figure 3.3 reveals the trends in digital services trade restrictiveness for select non-OECD countries in the Asia-Pacific region for the year 2021. Cambodia, Kazakhstan, Lao People's Democratic Republic and Russian Federation have a highly unfavourable regulatory regime for engaging in digital trade. Kazakhstan has a DSTRI of 0.647 for the year 2021. Malaysia, Philippines and Vanuatu have the least amount of trade barriers on digital services trade, with a DSTRI of 0.127.

Emerging market economies, such as China, India and Indonesia, also exhibit relatively high DSTRI values of more than 0.3, the majority of which can be attributed to trade barriers in infrastructure and connectivity. India also has significant trade barriers relating to e-payment systems, which contributes to its high levels of digital services trade restrictiveness. Singapore, despite being a developed country, has a moderately high DSTRI of 0.2. Except for Singapore, all other ESCAP Member States included in figure 3.3 are developing countries.

Figure 3.3
Trends in digital services trade restrictiveness, 2021 (selected non-OECD countries in Asia-Pacific region)



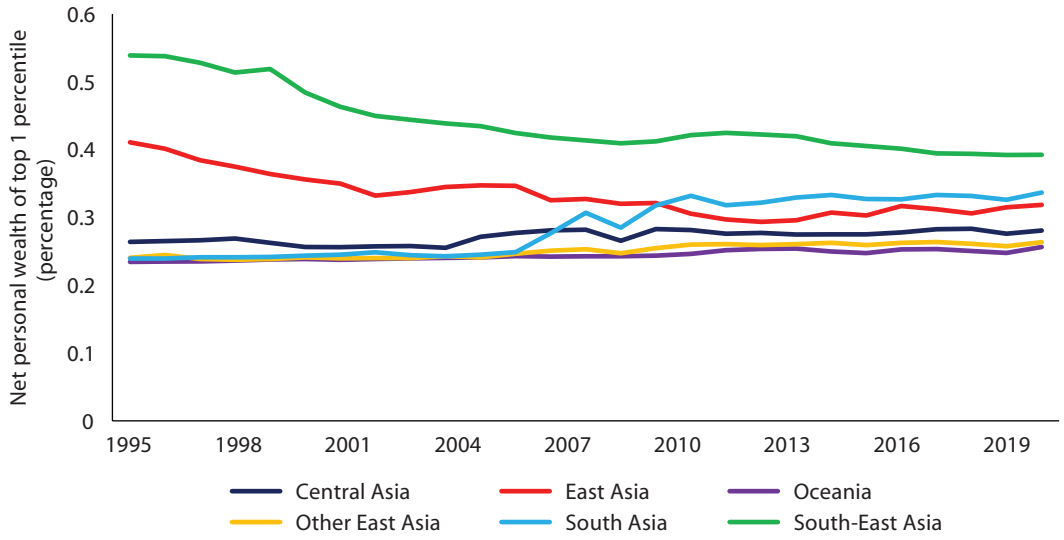
Source: ESCAP compilation from OECDStat data.

3.3.2. Regional evolution of wealth inequality, 1995-2021[24]

Figure 3.4 showcases the wealth inequality trends within the Asia-Pacific region during the period 1995-2021. While examining the share of net personal wealth held by the top 1 percentile of the adult population of different subregions within Asia and the Pacific with the help of figure 3.4, it is found that East Asia and South-East Asia have witnessed a fall in wealth inequality over time. In the East Asian subregion, the wealth inequality levels declined from 40 per cent in 1995 to 30 per cent in 2021. Corresponding numbers for the South-East Asian subregion are 54 per cent in 1995 and 39 per cent in 2021. However, South Asia has experienced a considerable increase in wealth inequality, especially after 2006. For South Asia, in 1995, the wealth inequality levels indicated that the top 1 per cent possessed 24 per cent of the wealth. However, this figure increased to 34 per cent in 2021. Central Asia, Oceania (the Pacific) and Other East Asian economies, as shown in figure 3.4, have maintained relatively stable wealth inequality levels.

[23] Vanuatu as a country in the Asia-Pacific region is not included in the econometric analysis due to data limitations.
[24] The subregional classification follows the country groupings mentioned in World Inequality Database as Central Asia (Armenia, Belarus, Georgia, Kyrgyzstan, Kazakhstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan); South Asia (Afghanistan, Bhutan, India, Islamic Republic of Iran, Maldives, Nepal, Pakistan and Sri Lanka); Oceania (Australia, New Zealand and Papua New Guinea); South-East Asia (Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste and Viet Nam); East Asia (China, Japan and Republic of Korea); and Other East Asia (Democratic People's Republic of Korea; Hong Kong, China; Macao, China; Mongolia; and Taiwan Province of China). Among the subregions, we have excluded from the econometric analysis: Belarus; Democratic People's Republic of Korea; Hong Kong, China; Macao, China; and Taiwan Province of China.

Figure 3.4
Regional evolution of wealth inequality – top 1 percentile, 1995-2021

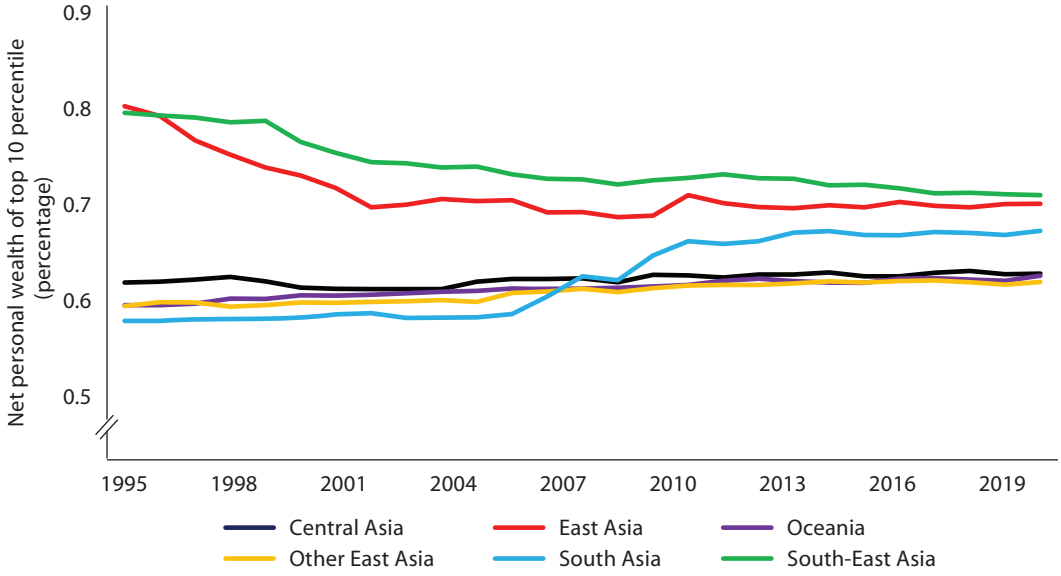


Source: ESCAP compilation from World Inequality Database.

Figure 3.5 reveals the trends in wealth inequality across subregions within Asia and the Pacific, using another indicator, namely the share of net personal wealth held by the top 10 percentile of the adult population. This indicator strengthens the observations from figure 3.4, that East Asia and South-East Asia are the subregions with declining wealth inequality trends. While the South Asian subregion experienced a notable increase in wealth inequality, the wealth inequality levels in Central Asia, Oceania and Other East Asia remained relatively stable. East Asia, South-East Asia and South Asia have nearly 70 per cent of the wealth being held by the top 10 percentile of adults. The whole of the Asia-Pacific region possesses a conducive environment for sustained growth, although the subregions indicate contending trends in wealth inequality, with a minimum of 60 per cent of wealth being held by the top 10 percentile of the adult population in the year 2021.

Figures 3.4 and 3.5 further indicate the persistence of high and stable wealth inequality levels in the Asia-Pacific region over the last one and a half decades. During the period 2005-2021, we observed that wealth inequality levels have not significantly altered in most of the subregions. An exception in this regard is South Asia. From section 2.1, we observed a significant rise in digital trade in the Asia-Pacific region. Such a trend warrants a closer examination of the association between digital trade and wealth inequality.

Figure 3.5
Regional evolution of wealth inequality – top 10 percentile, 1995-2021

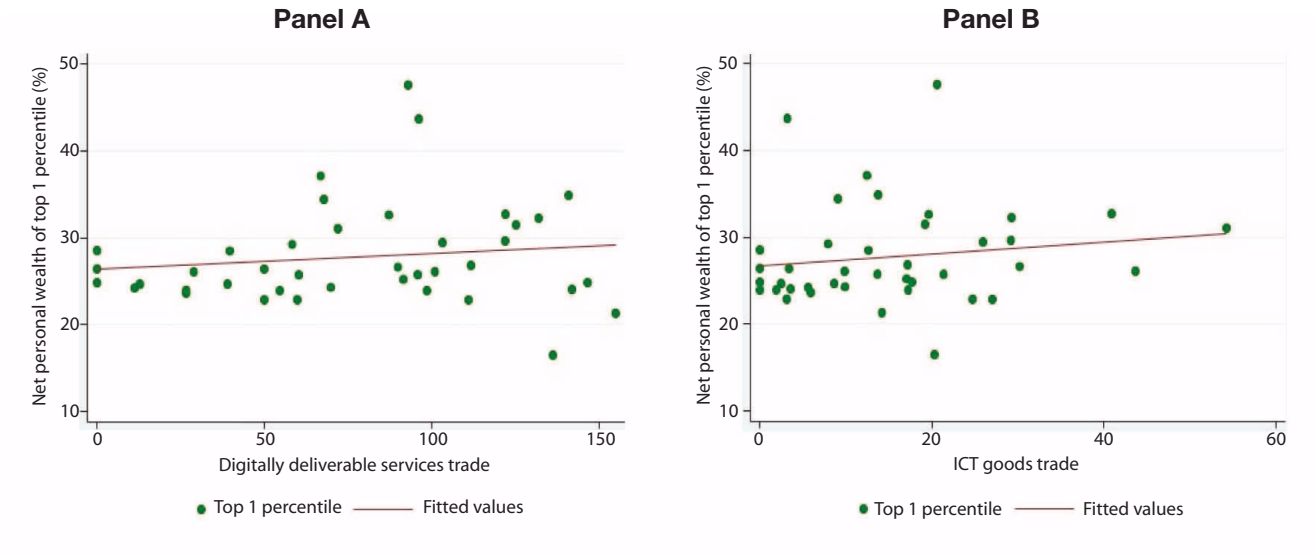


Source: ESCAP compilation from World Inequality Database.

3.3.3. Digital trade and wealth inequality

The scatter plots in figure 3.6 show the relationship of digital trade with wealth inequality (net personal wealth of the top 1 percentile) for the year 2021. Panel A refers to the relationship between digitally-deliverable services trade and wealth inequality, and Panel B refers to the relationship between ICT goods trade and wealth inequality.

Figure 3.6
Wealth inequality versus digital trade in Asia-Pacific region, 2021



3.4. Data, variable description and estimation strategy

3.4.1. Data and variable description

3.4.1.1 Data sources

Our sample covers 40 ESCAP Member States over the period 2005–2021. Data have been obtained from various sources: data on wealth inequality were obtained from the World Inequality Database, published by the Paris School of Economics. Indicators of digital trade were obtained from the UNCTAD database. We sourced the control variables of the econometric analysis from the WDI database, and Global Data Lab. Table 3.1 presents the descriptive statistics. The full description of the data is as follows.

3.4.1.2. Measures of wealth inequality

Following the literature, we consider two measures of wealth inequality, namely the top 1 per cent wealth share and the top 10 per cent wealth share. Njangang and others (2022) put forth three arguments in support of the use of these variables. First, the top wealth shares are not sensitive to wealth changes at the bottom of the wealth distribution. Second, the probability that the wealth of individuals with the highest wealth share will increase is greater than the probability that the wealth of less wealthy individuals will increase. In other words, the wealth concentration in the hands of the top 1-10 per cent in an economy is expected to increase further. Finally, these measures of wealth inequality are highly associated with the most commonly used measures of income inequality. Based on the existing literature, both of these measures were obtained as percentages from the World Inequality Database.

3.4.1.3. Measures of digital trade

The existing literature is focused largely on the production and consumption of ICT goods and services as proxies of digitalization. In the current study, we employed two measures of digitalization of international trade in goods and services. The first measure is the trade in digitally-deliverable services as a share of the total services trade (Zhu and others, 2022). We label this measure in our analysis as “digital services trade”. The second measure is trade in information and communications technology goods as a share of total merchandise trade, labelled as “ICT goods trade”. Both measures indicate the magnitude of digital trade in goods and services of a country. Data on both these measures were obtained from the UNCTAD database.

3.4.1.4. Control variables

We include the per capita real GDP to control for economic development, which is one of the major determinants of wealth inequality. However, the effect of economic development on inequality (or wealth inequality in particular) remains ambiguous. One stream of the literature found that economic development significantly reduces wealth inequality, indicating a statistically significant negative relationship (Savvides, 1998; Berisha and Meszaros, 2019; Njangang and others, 2022). Contrary to this, an alternate strand finds a significant positive or mixed effect of economic development on inequality (Nguyen, 2022; Nchofoung and Asongu, 2022; Ndoya and Asongu, 2022). These studies found that countries with higher levels of economic development have higher levels of wealth inequality.

To account for the effect of the foreign flow of capital, we define foreign direct investment as the net inflow of foreign direct investment (FDI) as a share of GDP. The existing literature postulates that the effects of foreign direct investment on wealth inequality can be negative (Tadadjeu and others, 2021; Njangang and others, 2022; Zhu and others, 2022) or positive (Herzer and Nunnenkamp, 2013; Roser and Cuaresma, 2016; Huynh, 2021; Yin and Choi, 2023).

Studies which associate education with greater wealth and faster wealth accumulation indicate a positive relationship between the two variables (Conley and Ryvicker, 2004; Zhu and others, 2022). However, another stream of the literature found that education increases the income of the bottom stratum of society and thereby reduces wealth inequality (Abdullah, Doucouliagos and Manning, 2015). We employ average years of schooling as the measure of education (Ndoya and Asongu, 2022), obtained from Global Data Lab. We label the variable as education.

Based on the resource curse hypothesis, which states that possession of higher levels of natural resources leads to increased wealth inequality, we

postulate a positive relationship for this variable (Tadadjeu and others, 2021). Further, the existing literature on income inequality also found a significant positive effect of the natural resources variable. We label the variable as natural resources and proxy it with the rent paid on natural resources as a percentage of GDP, obtained from the WDI database.

We measure urbanization as the proportion of the population living in urban areas. The literature finds a positive effect of urbanization on inequality in general and wealth inequality in particular (Yin and Choi, 2023). A higher concentration of people in urban centres seeking their livelihood is likely to result in increased unemployment and disparities in income and wealth holdings. Hence, we expect a positive relationship.

Table 3.1
Descriptive statistics

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
Wealth inequality					
Top 1 per cent wealth share	680	27.30	5.43	15.48	47.86
Top 10 per cent wealth share	680	60.47	4.68	47.69	75.78
Digital trade					
Digital services trade	680	58.03	36.50	0.00	157.17
ICT goods trade	680	9.63	8.35	0.00	54.30
Control variables					
Per capita real GDP	680	8.56	1.41	5.94	11.10
Foreign direct investment	680	4.34	7.49	-37.17	86.48
Education	675	2.10	0.45	0.53	2.62
Natural resources	680	6.36	10.00	0.00	81.91
Urbanization	680	53.59	24.19	12.98	100.00

The descriptive statistics show sufficient variability within the data. Variables such as per capita real GDP and education are reported in the natural log form. All other variables are in percentages.

3.4.2. Model specification and empirical approach

We employ a panel data econometric model of wealth inequality for our empirical analysis. The model addresses wealth inequality as a function of various macroeconomic and country-specific demographic variables. Our study is aimed at investigating the effect of digital trade on wealth inequality. We hypothesize that digital trade is positively associated with wealth inequality. Therefore, we estimate the model as specified below.

$$Wealth\ inequality_{it} = \beta_0 + \beta_1 Digital\ trade_{it} + \beta_2 X_{it} + \mu_i + \pi_t + \varepsilon_{it}, \quad (1)$$

where the $Wealth\ inequality_{it}$ is the country-specific measure of wealth inequality of country i for year t. $Digital\ trade_{it}$ stands for country-specific indicators of digital trade, as mentioned in the previous section. X_{it} is the vector of the baseline controls, including per capita real GDP, foreign direct

investment, education, natural resources and the extent of urbanization. Subscript *i* refers to the countries with *I* = 1, 2, 3,….40. Subscript *t* refers to the time in years where *t* = 1, 2, 3...17. The symbol μ_i captures the country fixed-effects and π_t captures the year fixed-effects.

We estimate various combinations of equations in the analysis, using two measures of wealth inequality and two measures of digital trade, along with different combinations of fixed-effects. The 40 countries across a period of 17 years make the total number of observations 680. We estimated the equation above using a panel data approach. The Breusch Pagan Lagrangian Multiplier Test favours the panel data framework over the ordinary least squares counterpart, confirming the presence of unobserved heterogeneity across cross-sectional units. Given the selective nature of the sample economies chosen, we employ the panel fixed-effect estimator for the benchmark analysis.

One of the potential econometric issues is the endogeneity arising from reverse causality running from wealth inequality to ICT (Njangang and others, 2022). Further, Zhu and others (2022) and Yin and Choi (2023) stated that endogeneity issues arise because of the reverse causality between digital technology and income. Specifically, growth in wealth inequality may have driven the increased use of digital technology. Further, skewed distribution of wealth may also lead to unequal access to digital infrastructure. In considering the above possibilities, the model treats indicators of digital trade as endogenous in the analysis. We corrected the endogeneity issues using the 1-period lagged values of endogenous variables as instruments for estimation (Hasan, Horvath and Mares, 2020). Given the longitudinal nature of the data, we estimated the regression equation using the panel instrumental variable fixed effects (IV-FE) method. Because we employed only one instrument for an endogenous variable, the estimation is exactly identified.

3.5. Econometric results and discussion

3.5.1. Baseline results

Tables 3.2 and 3.3 report the estimation results of equation (1) with digital services trade and ICT goods trade respectively, as proxies for digital trade. Both tables report the top 1 per cent wealth share and top 10 per cent wealth share as proxy variables for wealth inequality. In both tables, columns (1) and (4) estimate the equation without any control variables. We added the control variables subsequently along with year fixed-effects.

The results given in table 3.2 provide empirical evidence in support of a positive and highly significant impact of digital trade on wealth inequality. Specifically, the coefficient of digital services trade has a magnitude suggesting that 10 units of increase in digital services trade increases the wealth share of the ultrarich, on average, by 0.06 6 0.08 units. As digitally-deliverable services are more readily accessible and affordable for the wealthy, it provides them with more opportunities to enhance wealth accumulation. Similar results are obtained for the top 10 per cent wealth share. The empirical results indicate that a 10-unit increase in digital services trade enhances the wealth share, on average, by 0.07-0.09 units for the top decile.

Similar to table 3.2, the results of table 3.3 provide evidence of a positive and significant effect of digital trade on wealth inequality. Specifically, the coefficients of ICT goods trade suggest that a 10-unit increase in ICT digital trade increases the wealth share of the ultrarich, on average, by 0.22-0.42 units. Similar results are obtained for the top 10 per cent wealth share. The empirical results indicate that a 10-unit increase in ICT goods trade enhances wealth share, on average, by 0.23-0.41 units for the top decile. Our findings indicate a strong positive effect on wealth inequality of digital trade through services and goods. In comparing digital services trade with ICT goods trade, we observe that the effects of digital trade in the form of ICT goods have a stronger impact on wealth inequality.

Table 3.2
Effects of digitally-deliverable services trade on wealth inequality

Variables	Top 1 per cent wealth share			Top 10 per cent wealth share		
	(1)	(2)	(3)	(4)	(5)	(6)
Digital service trade	0.00855*** (0.00302)	0.00821*** (0.00314)	0.00615* (0.00333)	0.00946*** (0.00293)	0.00750** (0.00300)	0.00736** (0.00323)
Per capita real GDP		3.471*** (0.435)	2.703*** (0.531)		3.176*** (0.417)	2.933*** (0.514)
Foreign direct investment		0.0106 (0.00933)	0.0132 (0.00940)		0.0221** (0.00893)	0.0230** (0.00910)
Education		-4.287*** (0.709)	-4.909*** (0.731)		-4.776*** (0.679)	-4.971*** (0.708)
Natural resources		0.0177** (0.00888)	0.0223** (0.00925)		0.0177** (0.00849)	0.0186** (0.00895)
Urbanization		-0.0181 (0.0380)	-0.0478 (0.0392)		0.0683* (0.0364)	0.0628* (0.0380)
Constant	26.80*** (0.183)	6.874** (2.698)	16.41*** (4.318)	59.92*** (0.178)	38.94*** (2.582)	41.87*** (4.179)
Country fixed effects	No	No	Yes	No	No	Yes
Year fixed effects	No	No	Yes	No	No	Yes
Observations	680	675	675	680	675	675
R-squared	0.012	0.127	0.162	0.016	0.155	0.171
Number of cross-sections	40	40	40	40	40	40

Note: All estimations were carried out using the panel fixed effects model. Per capita real GDP and education are in natural logs. Other variables are in percentages. Wealth inequality is measured using the share of the top 1 per cent and top 10 per cent. Digital services trade is measured as a share of total services trade. Standard errors are in parentheses. The symbols ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

Table 3.3
Effects of ICT goods trade on wealth inequality

Variables	Top 1 per cent wealth share			Top 10 per cent wealth share		
	(1)	(2)	(3)	(4)	(5)	(6)
ICT goods trade	0.0421*** (0.00995)	0.0292*** (0.0102)	0.0221** (0.0109)	0.0416*** (0.00968)	0.0239** (0.00977)	0.0231** (0.0105)
Per capita real GDP		3.257*** (0.440)	2.562*** (0.526)		2.999*** (0.422)	2.766*** (0.510)
Foreign direct investment		0.00754 (0.00919)	0.0107 (0.00930)		0.0191** (0.00881)	0.0201** (0.00901)
Education		-4.142*** (0.707)	-4.779*** (0.733)		-4.644*** (0.677)	-4.834*** (0.710)
Natural resources		0.0204** (0.00891)	0.0241*** (0.00922)		0.0199** (0.00854)	0.0207** (0.00893)
Urbanization		-0.00674 (0.0373)	-0.0388 (0.0390)		0.0796** (0.0357)	0.0734* (0.0377)
Constant	26.90*** (0.110)	7.989*** (2.759)	17.02*** (4.289)	60.07*** (0.107)	39.78*** (2.643)	42.65*** (4.154)
Country fixed effects	No	No	Yes	No	No	Yes
Year fixed effects	No	No	Yes	No	No	Yes
Observations	680	675	675	680	675	675
R-squared	0.027	0.129	0.163	0.028	0.155	0.170
Number of cross-sections	40	40	40	40	40	40

Note: All estimations were carried out using the panel fixed effects model. Per capita real GDP and education are in natural logs. Other variables are in percentages. Wealth inequality is measured using the share of the top 1 per cent and top 10 per cent. ICT goods trade is measured as a share of total merchandise trade. Standard errors are in parentheses. The symbols ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

Most of the control variables exhibit statistically significant results. In both tables, we find that per capita real GDP has a positive and significant effect on wealth inequality. It indicates that unequal distribution of wealth is likely to worsen with enhanced economic development. The results are in line with the findings of Yin and Choi (2023). The coefficient of foreign direct investment indicates a significant positive effect, although it is the case only for the equations with the top 10 per cent wealth share as the dependent variable. Our findings are similar to those of Roser and Cuaresma (2016) and Yin and Choi (2023). Education has a highly significant, negative effect in all specifications, suggesting that increased education leads to reduced wealth inequality. Abdullah and others (2015) and Njangang and others (2022) obtained similar findings. Further, natural resources indicate a significant positive effect across all specifications, indicating that the possession of natural resources widens wealth inequality. Ndoya and Asongu (2022) reported similar findings for income inequality. In addition, Tadadjeu and others (2021) reported a positive effect of natural resources specifically on wealth inequality. The urbanization variable is insignificant in the equation for the top 1 per cent wealth share and weakly significant with a positive sign for the top 10 per cent wealth share. The results indicate that increased urbanization leads to a widening of wealth inequality. These results are in tandem with the findings of Yin and Choi (2023).

3.5.2. Developed versus developing countries

We split the sample into developed and developing countries based on the World Bank's income classification. There are 10 developed and 30 developing countries in the sample. All high-income countries are classified as developed countries, and all other countries are classified as developing countries. It is worth noting that our sample includes only one low-income country: Afghanistan. The other 29 countries belong to the middle-income (upper or lower) category. Table 3.4 reports the results of panel fixed effects estimation for developed and developing countries. Columns 1-4 represent developed countries, and columns 5-8 represent developing countries, respectively.

The results of table 3.4 indicate a positive and highly significant effect of digital trade on wealth inequality in developed countries. The coefficient of digital services trade indicates that 10 units of increase in digital services trade increases wealth inequality, on average, by 0.13 6 0.16 units. Similar results are obtained in ICT goods trade: wealth inequality increases, on average, by 0.36 units for the top decile. However, the results for developing countries are contrary to the baseline findings. We find that digital services trade has no significant effect on wealth inequality in developing countries.

Table 3.4
Effects of ICT goods trade on wealth inequality

Variables	Developed countries				Developing countries			
	Top 1 per cent wealth share		Top 10 per cent wealth share		Top 1 per cent wealth share		Top 10 per cent wealth share	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digital service trade	0.0138*** (0.00364)		0.0161*** (0.00391)		0.00185 (0.00543)		0.000327 (0.00519)	
ICT goods trade		0.0362** (0.0176)		0.0150 (0.0193)		0.0210 (0.0138)		0.0259** (0.0131)
Foreign direct investment	0.0137 (0.00832)	0.0123 (0.00859)	0.0349*** (0.00893)	0.0328*** (0.00942)	-0.00602 (0.0179)	-0.00747 (0.0179)	-0.0120 (0.0171)	-0.0139 (0.0170)
Education	3.639 (3.770)	4.305 (3.927)	-3.481 (4.045)	-3.424 (4.306)	-4.714*** (0.859)	-4.637*** (0.848)	-4.360*** (0.821)	-4.311*** (0.809)
Natural resources	0.0922*** (0.0277)	0.101*** (0.0291)	0.0932*** (0.0297)	0.117*** (0.0319)	0.0171 (0.0106)	0.0186* (0.0106)	0.0138 (0.0101)	0.0156 (0.0101)
Urbanization	-0.350*** (0.0871)	-0.221*** (0.0818)	-0.227** (0.0935)	-0.0682 (0.0897)	0.0412 (0.0458)	0.0410 (0.0456)	0.162*** (0.0438)	0.160*** (0.0435)
Constant	42.81*** (12.19)	31.10** (12.32)	83.17*** (13.08)	70.60*** (13.50)	35.07*** (2.103)	34.87*** (2.095)	62.47*** (2.008)	62.28*** (1.998)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	170	170	170	170	505	505	505	505
R-squared	0.480	0.444	0.469	0.406	0.109	0.114	0.113	0.121
Number of cross-sections	10	10	10	10	30	30	30	30

Note: All estimations were carried out using the panel fixed effects model. Countries are classified as developed and developing based on the World Bank classification of income level. Per capita real GDP has been excluded from the estimation. Education is in natural logs. Other variables are in percentages. Wealth inequality is measured using the share of the top 1 per cent and top 10 per cent. Digital services trade is measured as a share of total services trade. ICT goods trade is measured as a share of total merchandise trade. Standard errors are in parentheses. The symbols ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

However, we find a positive effect of ICT goods trade on the wealth concentration of the top 10 per cent. The variations in the effects of digital trade in goods and services across different income groups are not surprising. For instance, Zhu and others (2022) found that the effect of digital trade on income inequality is insignificant for low-income countries. The results also indicate that countries at higher levels of economic development are likely to experience increased wealth inequality.

We find that foreign direct investment and natural resources are highly significant for developed countries and insignificant or weakly significant in the context of developing countries. A possible explanation for such a result is the increased business opportunities facilitated by foreign direct investments triggering skewed distribution of wealth. We observe that the effects of education are high in the context of developing economies. A deviant result from the baseline findings is the switching sign of urbanization in developed countries. The urbanization variable suggests a negative and significant effect on wealth inequality. These results are in line with the findings of Ndoyu and Asongu (2022) who observed a negative effect of urbanization for high-income countries within their sample.

3.5.3. Endogeneity concerns

In this section, we re-estimate equation (1) using the panel IV-FE method by incorporating 1-period lagged values of endogenous variables as instruments. Because we employ only one instrument for an endogenous variable, the equation is exactly identified.[25]

Table 3.5
Endogeneity correction – IV FE estimates

Variables	Top 1 per cent wealth share		Top 10 per cent wealth share	
	(1)	(2)	(3)	(4)
Digital service trade	0.0114** (0.00447)		0.0105** (0.00419)	
ICT goods trade		0.0346** (0.0147)		0.0287** (0.0138)
Per capita real GDP	2.665*** (0.570)	2.455*** (0.563)	2.863*** (0.533)	2.672*** (0.527)
Foreign direct investment	0.0139 (0.00938)	0.00922 (0.00918)	0.0246*** (0.00879)	0.0204** (0.00860)
Education	-4.201*** (0.760)	-3.924*** (0.766)	-4.153*** (0.711)	-3.924*** (0.717)
Natural resources	0.0198** (0.00915)	0.0226** (0.00909)	0.0164* (0.00857)	0.0189** (0.00852)
Urbanization	-0.0687 (0.0424)	-0.0554 (0.0419)	0.0381 (0.0397)	0.0503 (0.0393)
Constant	15.93*** (4.635)	16.77*** (4.589)	41.75*** (4.340)	42.57*** (4.298)
Year fixed effects	Yes	Yes	Yes	Yes
Observations	636	636	636	636
First stage F – stat (prob)	63.06 (0.00)	48.64 (0.00)	63.06 (0.00)	48.64 (0.00)
R-squared (within)	0.1501	0.1571	0.1582	0.1647
Number of cross-sections	40	40	40	40

Note: All estimations were carried out using the instrumental variable panel fixed effects model. Per capita real GDP and education are in natural logs. Other variables are in percentages. Wealth inequality is measured using the share of the top 1 per cent and top 10 per cent. ICT goods trade is measured as a share of total merchandise trade. Digital service trade and ICT goods trade are treated as endogenous variables. They are instrumented by their 1-period lag values, respectively. Standard errors are in parentheses. The symbols ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

[25] We do not report the results of the first stage regression. However, to confirm the significance, we show the F-statistics and corresponding probability values from the first stage. The results are available upon request.

Table 3.6
Developed versus developing countries – IV FE estimates

Variables	Developed countries				Developing countries			
	Top 1 per cent wealth share		Top 10 per cent wealth share		Top 1 per cent wealth share		Top 10 per cent wealth share	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digital service trade	0.0250*** (0.00556)		0.0222*** (0.00580)		0.00510 (0.00756)		0.00329 (0.00696)	
ICT goods trade		0.0519** (0.0256)		0.000424 (0.0275)		0.0353* (0.0189)		0.0384** (0.0173)
Foreign direct investment	0.0167* (0.00877)	0.0145 (0.00889)	0.0372*** (0.00914)	0.0346*** (0.00954)	-0.00593 (0.0182)	-0.00907 (0.0182)	-0.0113 (0.0167)	-0.0149 (0.0167)
Education	3.159 (4.117)	4.180 (4.244)	-5.448 (4.291)	-5.863 (4.556)	-4.123*** (0.890)	-3.878*** (0.874)	-3.700*** (0.818)	-3.482*** (0.803)
Natural resources	0.0791** (0.0308)	0.0928*** (0.0327)	0.0824** (0.0321)	0.118*** (0.0351)	0.0149 (0.0104)	0.0176* (0.0104)	0.0115 (0.00955)	0.0145 (0.00960)
Urbanization	-0.412*** (0.111)	-0.170* (0.0970)	-0.283** (0.116)	-0.0551 (0.104)	0.0154 (0.0490)	0.0141 (0.0486)	0.133*** (0.0451)	0.130*** (0.0447)
Constant	48.68*** (14.33)	27.25* (13.96)	92.53*** (14.94)	75.66*** (14.99)	34.76*** (2.214)	34.31*** (2.207)	62.17*** (2.037)	61.73*** (2.027)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	476	476	476	476
First stage F – stat (prob)	23.12 (0.00)	23.65 (0.00)	23.12 (0.00)	23.65 (0.00)	35.38 (0.00)	32.42 (0.00)	35.38 (0.00)	32.42 (0.00)
R-squared	0.430	0.413	0.436	0.383	0.102	0.109	0.103	0.113
Number of cross-sections	10	10	10	10	30	30	30	30

Note: All estimations were carried out using the instrumental variable panel fixed effects model. Countries are classified as developed and developing based on the World Bank classification of income level. Per capita real GDP has been excluded from the estimation. Education is in natural logs. Other variables are in percentages. Wealth inequality is measured using the share of the top 1 per cent and top 10 per cent. Digital services trade is measured as a share of total services trade. ICT goods trade is measured as a share of total merchandise trade. Standard errors are in parentheses. The symbols ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

The endogeneity corrected estimates confirm the baseline results from tables 3.2 and 3.3, suggesting that digital trade in services and goods has a positive and significant effect on wealth inequality. The coefficients of digital trade from table 3.5 are larger than the ones obtained from table 3.2, indicating that endogeneity leads to a downward bias. Specifically, the coefficients indicate that a 10-unit increase in digital trade, in services and goods, increases wealth inequality, on average, by 0.10-0.34 units. We also found that per capita real GDP, foreign direct investment and education continue to be important determinants of wealth inequality, even after taking care of endogeneity.

Table 3.6 reports the endogeneity-corrected estimates for developed and developing countries. Similar to table 3.4, columns 1-4 of table 3.6 represent developed countries, and columns 5-8 represent developing countries. The results of table 3.6 strengthen the findings from table 3.4. We observe that digital trade has a positive and highly significant effect on wealth inequality in developed countries. The coefficient of digital services trade indicates that 10 units of increase in digital services trade increases wealth inequality, on average, by 0.22 6 0.25 units. Similar results are obtained for ICT goods trade, as 10 units of increase in ICT goods trade leads to an increase in wealth

inequality, on average, by 0.52 units for the top decile. The results for developing countries, reported in columns 5-8, are consistent with the findings of table 3.4. We found that digital services trade has no significant effect on wealth inequality in developing countries. Nevertheless, we found a positive and significant effect of ICT goods trade on the wealth concentration of the top 10 per cent in developing countries.

3.6. Conclusions and policy implications

This study examined the effects of digital trade on wealth inequality for 40 ESCAP developed and developing countries for the period 2005-2021, using a rich panel data set estimated using panel fixed-effects and instrumental variable estimation techniques. The study puts forth the following important findings. First, we find empirical evidence in support of the positive and significant impact of international trade, in both digitally-deliverable services and ICT goods on wealth inequality among ESCAP countries. Second, we observe marked heterogeneity between ESCAP developed and developing countries, with the effect of digital trade on wealth inequality turning out to be significant for developed countries and insignificant for developing countries. Third, education is found to have a significant inverse relationship with wealth inequality, with greater educational attainment leading to lower wealth inequality in developing countries. However, the effect of education is insignificant in the context of developed countries. Fourth, we find that the effect of urbanization on wealth inequality varies depending on the income level of the Member State. Our estimates are robust to potential endogeneity bias and subsample analysis.

Wealth inequality has garnered quite a bit of attention in recent years, especially after the publication of the book entitled *Capital in the Twenty-First Century* by Thomas Piketty. However, there have been only very few studies that have explored the relationship between international trade and wealth inequality, partly due to the paucity of reliable data on wealth distribution. In contrast, there have been numerous studies which have examined the nexus between international trade and income inequality. There is now a consensus that trade reforms have resulted in a worsening of within-country income inequality on one hand, but a reduction in income inequality between countries on the other (Bourguignon, 2016). The impact of international trade on wealth inequality remains an ambiguous question. Our study contributes to the existing literature by delving into how the emergence of digital trade in recent years has influenced within-country wealth inequality in the Asia-Pacific region. Our empirical results indicate that only the wealthier sections of a country have been able to reap the benefits of digital trade in the Asia-Pacific region. The positive relationship between digital trade and wealth inequality should be a cause of concern for Governments and policymakers in the region, and targeted steps should be taken to resolve the skewed wealth distribution in this region and achieve Goal 10 on Reduced Inequalities.

The future of the global economy and international trade lies in digitalization. The regulatory framework of digital trade should be strengthened to make it more inclusive and ensure that the benefits are not cornered by a select few within each country. Human capital accumulation of the poorer sections of society through education and skills training can play an important role in enhancing the uptake of digitalization and accelerating digital trade to bring about material elevation of the people at the bottom of the economic ladder. As the movement of data is the underlying phenomenon behind digital trade, strict regulations should be in place concerning data security, data storage, data usage and the selling and purchasing of data. Monopolistic and restrictive trade practices of huge multinational companies engaging in digital trade as well as their top executives who have amassed huge wealth from it need to be regulated by national Governments as well as through intergovernmental cooperation. The possibility of imposing a wealth tax on individuals or corporations that have disproportionately gained from the growth in digital trade can also be explored, especially for developed countries within the Asia-Pacific region. Obstacles faced by small and medium-sized enterprises, youth and women entrepreneurs participating in digital trade, such as financing and trade credit constraints, information asymmetry, regulatory compliance and barriers to entry, should be resolved as soon as possible by designing targeted policy interventions. The policy approach

to regulating digital trade in developing countries and developed countries should be different due to their differential impact on wealth inequality.

Based on the initial descriptive analysis carried out using OECD digital services trade restrictiveness indices, it was found that barriers to digital services trade are quite low in developed countries, but quite high in developing countries. At the same time, we also found that the smooth and seamless flow of digital trade has resulted in the worsening of wealth inequality in developed countries. Hence, developing countries should follow a guarded approach while loosening their regulations on digital trade and ensure that social security mechanisms are in place for the people who are left behind in the emerging international trade regime, thus making their countries' digital trade policy more inclusive.

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CHAPTER 4

Relevance of digital trade provisions of trade agreements and digital economy agreements to sustainable development

Chapter 4

Relevance of digital trade provisions of trade agreements and digital economy agreements to sustainable development[26]

4.1. Introduction

The insertion of digital inclusion provisions into modern preferential trade agreements and digital economy agreements reflects an important evolution in international trade policies. These provisions, specifically aimed at ensuring that such diverse groups as women, rural populations, low socioeconomic groups and indigenous people benefit from the digital economy, are becoming more prominent.

Key examples of this trend include the New Zealand-United Kingdom PTA, the Singapore-United Kingdom DEA and the Digital Economy Partnership Agreement.[27] These agreements not only focus on e-commerce but also embed sustainable development aspects within their digital provisions. Notably, DEPA Module 10 exemplifies this approach by fostering cooperation and promoting growth for SMEs in the digital sphere.[28]

Sustainable development-related aspects within e-commerce provisions or provisions under digital trade agreements (DTAs) are relevant to the digital inclusion and sustainability related aspects. Evidently, ESCAP findings support that the e-commerce provisions have a statistically significant positive impact on essentially all areas of SDGs through economic, environmental, social, and governance and partnership targets. However, the impact of the provisions on SDGs is not necessarily influenced by the degree of bindingness in e-commerce agreements (ESCAP, UNCTAD and UNIDO, 2023). This suggests that the relationship between digital trade and sustainable development could go beyond the legal strength of the provisions.

This chapter discusses sustainable development aspects in digital trade agreements by categorizing the provisions into three groups: affordable digital access, a trusted digital economy and innovation. These groups are interconnected, with provisions often overlapping across multiple sustainable development areas. Moreover, these groups relate to some of the issues discussed under the World Trade Organization Joint Statement Initiative on E-commerce.[29]

[26] The initial version of this paper was published as: Natnicha Sutthivana, Witada Anukoonwattaka, and Yann Duval (2023). Navigating the Interplay: Digital-Trade Provisions and Sustainable Development Aspects. United Nations ESCAP, Trade, Investment and Innovation Division, December 2023. Bangkok.

[27] Chapter 15 of the New Zealand–United Kingdom PTA on digital trade, specifically article 15.20 on digital inclusion; Section 5 of the Singapore-United Kingdom DEA on digital trade and digital economy, specifically article 8.61-P digital inclusion; and the DEPA Module 11 on digital inclusion, specifically article 11.1 digital inclusion.

[28] Article 10.4 (Digital SME Dialogue) provides that the dialogue may include private, academic and other stakeholders to collaborate with other interested persons: the dialogue shall promote the benefits of DEPA for parties' SMEs and encourage inclusive participation.

[29] In January 2019, 76 WTO members confirmed their commitment to negotiate trade-related aspects of electronic commerce. As of February 2023, 89 WTO members, accounting for 90 per cent of global trade, have participated in the negotiations. The negotiations are aimed at achieving a high standard outcome that builds on existing WTO frameworks, covering six key sections: (a) enabling electronic commerce; (b) openness and e-commerce; (c) trust and e-commerce; (d) cross-cutting issues; (e) telecommunications; and (f) market access.

4.2. Affordability of access

Affordability and availability of ICT products and services enable participation in the digital economy, thus bridging the digital divide gaps and promoting digital inclusion. Competition in the market is a key driver in the affordable access to digital products and services.

Provisions addressing these issues can be found in e-commerce chapters and stand-alone digital trade agreements, encompassing competition in the digital economy, Internet interconnection charge-sharing, duty-free treatment, non-discriminatory treatment and principles on access and use of the Internet (ESCAP, UNCTAD and UNIDO, 2023).

Duty-free treatment and non-discriminatory treatment provisions are often signed as binding commitments by Asia-Pacific economies and are more numerous than those related to competition and Internet access (figure 4.1). Indeed, the provision on non-imposition of custom duties on electronic transmission addresses the uncertainty arising from in the gap of the WTO Moratorium on Customs Duties on Electronic Transmissions 1998 (box 4.1). Meanwhile the non-discrimination provision upholds the WTO basic principles on national treatment and most-favoured nation (MFN) treatment.[30] These provisions endorse the effect of WTO law while providing legal certainty for businesses (Burri, 2021).

In contrast, other provisions supporting market access of digital goods and services, such as the provisions on Internet interconnection charge-sharing, the principle on access and use of the Internet, and competition policy related to the digital economy, are mostly non-binding. These provisions are presented in e-commerce chapters of a few PTAs and DTAs. Specifically, relatively new provisions on "competition in the digital economy" are primarily focused on cooperation (exchange of information and experiences)[31] and some are referenced under consumer protection provisions.[32] Similarly, the Internet interconnection charge-sharing provision enhances competition and creates a level playing field for new service providers.[33] Moreover, as of November 2023, only 6 Internet interconnection charge-sharing provisions and 16 principles on access to and use of the Internet provision are found under the signed and in-force Asia-Pacific PTAs and DTAs.

[30] Although slightly lower than the non-imposition of custom duties, non-discrimination of digital products is commonly established through binding provisions, where parties affirm to providing national treatment for digital products. This means they will not treat digital products from another party less favourably than their own digital products. In some cases, the most-favoured nation concept is also applied, where a party shall extend favourable treatment to the digital products of non-parties.

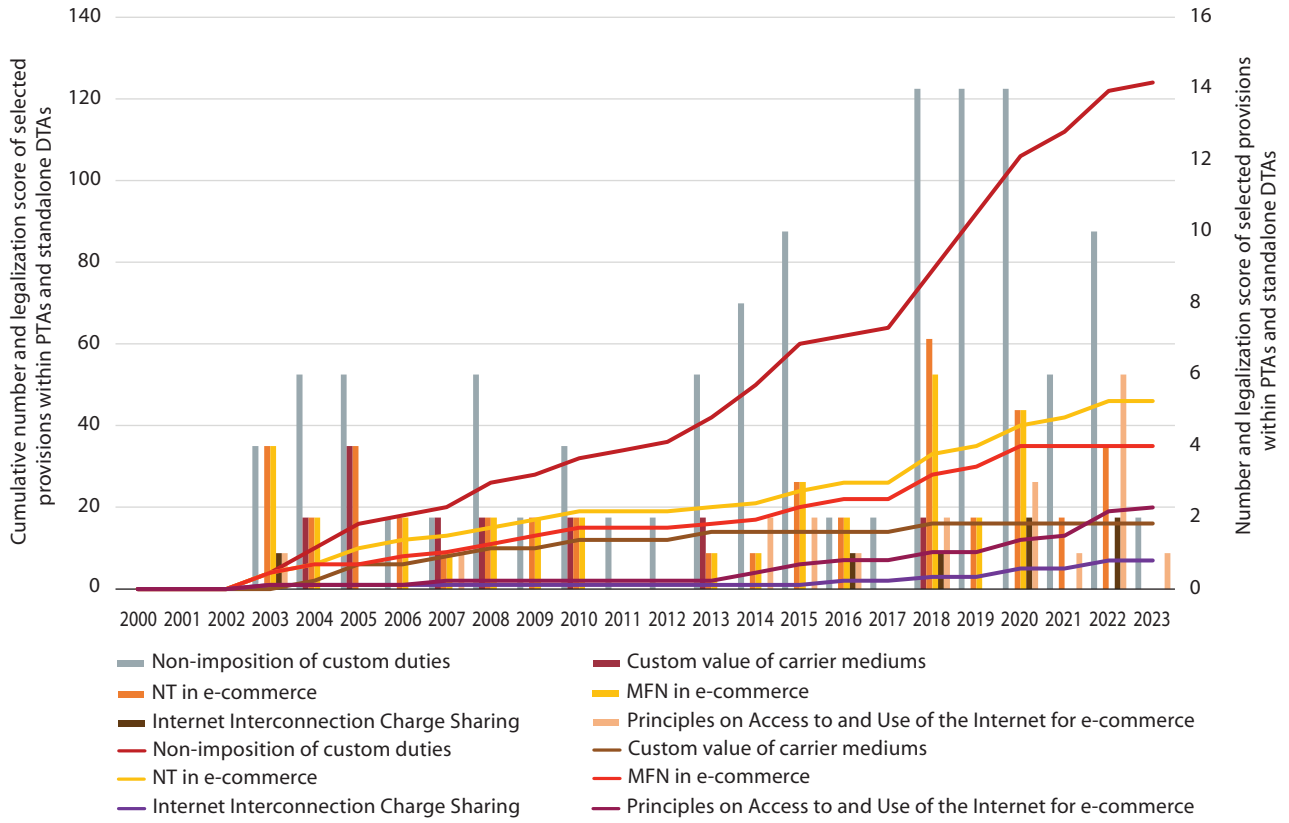
[31] For example, "Recognizing that the parties can benefit by sharing their experiences in enforcing competition law and implementing competition policies to address the challenges [that] arise from the digital economy…". See DEPA Article 8.4 (Cooperation on competition policy); Australia-Singapore DEA Article 16 (Cooperation on competition policy); the Republic of Korea-Singapore DEA Article 14.27 (Competition in digital economy); Singapore-United Kingdom DEA Article 8.61-U.

[32] For example, "The Parties recognise the importance of adopting and maintaining transparent and effective measures to protect consumers as referred to in Article 15.6 (Consumer Protection) of Chapter 15 (Competition policy) when they engage in electronic commerce". Australia-Hong Kong, China Article 11.5 (Consumer protection) under the e-commerce chapter.

[33] This provision has been found in recent trade agreements. It recognizes that a supplier seeking international Internet connection should be able to negotiate with suppliers of another party on a commercial basis.

Figure 4.1

Cumulative number and legalization score of provisions enabling access in the digital economy in Asia-Pacific PTAs and DTAs, 2000-2023



Source: APTIAD and TAPED. Accessed on 25 November 2023.
Note: The figure presents the cumulative number and score for each year, indicating the degree of legalization of the selected provisions within PTAs and stand-alone DTAs in the Asia-Pacific region. Provisions with binding commitments (legally enforceable or hard law) receive a score of 2; those with non-binding commitments (not enforceable or soft law) receive a score of 1; and the absence of such provisions is scored as 0.

Box 4.1

WTO Moratorium on Customs Duties on Electronic Transmissions

The WTO Moratorium on Customs Duties on Electronic Transmissions was introduced in 1998. WTO members have agreed not to impose custom duties on electronic transmissions. However, the discussions on its scope, definition and the impact of the moratorium continue. India, Indonesia and South Africa have raised concerns about the challenges for developing countries, including potential revenue losses.[a] During the Ministerial Conference (MC 12), the parties agreed to intensify the discussions to achieve more clarity on such issues and extend the practice. Following the 13th Ministerial Conference (MC13) in March 2024, members decided to maintain the current practice of not imposing customs duties on electronic transmissions until the 14th Session of the Ministerial Conference (MC 14).[b] The moratorium is set to expire in March 31, 2026, unless a decision was made to extend it at the MC 14 in March 2024. Expert opinions suggest that the lapse of the moratorium could diminish trade and negatively affect inclusive trade, particularly for smaller and women-led businesses, as they rely more heavily on digital tools to benefit from international trade (OECD, 2023; ICC and ITC, 2023).

In line with the MC13 outcome, over the half of the Asia-Pacific e-commerce provisions and stand-alone DTAs have already established binding obligations against custom duties on electronic transmissions at bilateral or plurilateral levels (figure 4.1). The trend reflects that digital trade parties have increasingly negotiated this topic outside WTO. However, among the 62 provisions signed by at least 1 Asia-Pacific economy, most generally exclude internal taxes, fees, and other charges from this provision.[c] Additionally, the definition and scope of "electronic transmissions" vary across different agreements. Some agreements refer to "electronic transmissions" as digital products, such as computer programs, text, video, images, sound recordings and other products that are digitally encoded, or digital services, while others refer to both digital products and services.

However, it remains encouraging to observe that the non-imposition of customs duties, as established under e-commerce provisions of the DTAs, has the potential to inform ongoing discussions at the multilateral level about the importance of establishing a permanent commitment on the moratorium.

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[a] See WT/GC/W/798, Work Programme on Electronic Commerce the E-commerce Moratorium: Scope and Impact, Communication from India and South Africa 2020. WT/GC/W/911, Work Programme on Electronic Commerce, Communication from South Africa 2023, and WT/MIN(24)/W/7/Rev.1, Work Programme on Electronic Commerce, Communication from India and Indonesia 2024.

[b] See WT/MIN(24)/38, Work Programme on Electronic Commerce, Ministerial Decision adopted on 2 March 2024.

[c] For example, "… shall not preclude a Party from imposing taxes, fees, or other charges on electronic transmissions, provided that such taxes, fees, or charges are imposed in a manner consistent with this Agreement". Note that some agreements use "in a manner consistent with Article 3 of GATT1994". See CPTPP (Article 14.3); RCEP (Article 12.11); Australia-United Kingdom (Article 14.3); India-United Arab Emirates (Article 9.15); and the Republic of Korea-Canada (Article 13.3).

4.3. Digital trust

Building trust and transparency in the digital economy is essential for promoting the confidence of consumers and businesses in online activities. According to the Digital Trust Index 2022, every 5 per cent increase in digital trust is related to an average increase in GDP per capita of $3,000. Legal safeguards play a vital role in enhancing trust and resilience.

To address trust-building issues, various provisions in digital agreements are focused on such aspects as personal data protection, online consumer protection, cybersecurity, digital identities and transparency in e-commerce. The non-prescriptive nature of these provisions suggests a shared goal to promote trust and cooperation.[34] This approach allows for flexibility and adaptability in response to the changing technological landscape and cybersecurity challenges.

The prominence of personal data protection and online consumer protection in more than 60 agreements highlights the growing awareness of the importance of personal data and consumer trust in the online sphere (figure 4.2). Personal data protection provisions typically require that a legal framework for the protection of personal information be in place.[35] Various approaches have been implemented, including the best endeavour to adopt non-discriminatory practices, to publishing information about legal compliance and remedies, and considering international bodies' guidelines (ESCAP, 2021).

In parallel, online consumer protection provisions protect consumers from deceptive, misleading and fraudulent commercial practices.[36] These provisions include measures to enhance awareness, provide access to consumer redress mechanisms and explore the benefits of alternative dispute resolutions (ADR). Additionally, the inclusion of provisions preventing or reducing the transmission of unsolicited commercial electronic messages (spam) protects recipients from commercial or marketing electronic messages without their consents or explicit rejection.[37]

As the digital economy relies heavily on data, data have become a valuable resource that is inherently vulnerable to cyber threats. While Asia-Pacific economies have addressed cybersecurity concerns in their agreements, these provisions have typically taken a non-strict approach in focusing on fostering cooperation. For example, DEPA Module 5 on Wider Trust Environment acknowledges that cybersecurity underpins the digital economy and the need for capacity-building, collaboration and workforce development in this field.[38] A recent development in e-commerce chapters and DTAs is the inclusion of digital identity provisions. These provisions generally recognize cooperation on digital identities to increase regional and global connectivity, while each party may adopt different implementation and legal approaches.[39] Despite this diversity, they hold the potential to shape international digital identity regimes and promote common standards to enhance trust and interoperability trust.

[34] For example, Article 19.2 of the Japan-United States DTA (Cybersecurity) stipulates that "Given the evolving nature of cybersecurity threats, the Parties recognize that risk-based approaches may be more effective than prescriptive regulation in addressing those threats. Accordingly, each Party shall endeavour to employ, and encourage enterprises within its territory to use risk-based approaches that rely on consensus-based standards and risk management best practices to identify and protect against cybersecurity risks and to detect, respond to and recover from cybersecurity events".

[35] For example, CPTPP (Article 14.8); RCEP (Article 12.8); ASEAN Ecommerce Agreement (Article 7.5); and DEPA (Article 4.2).

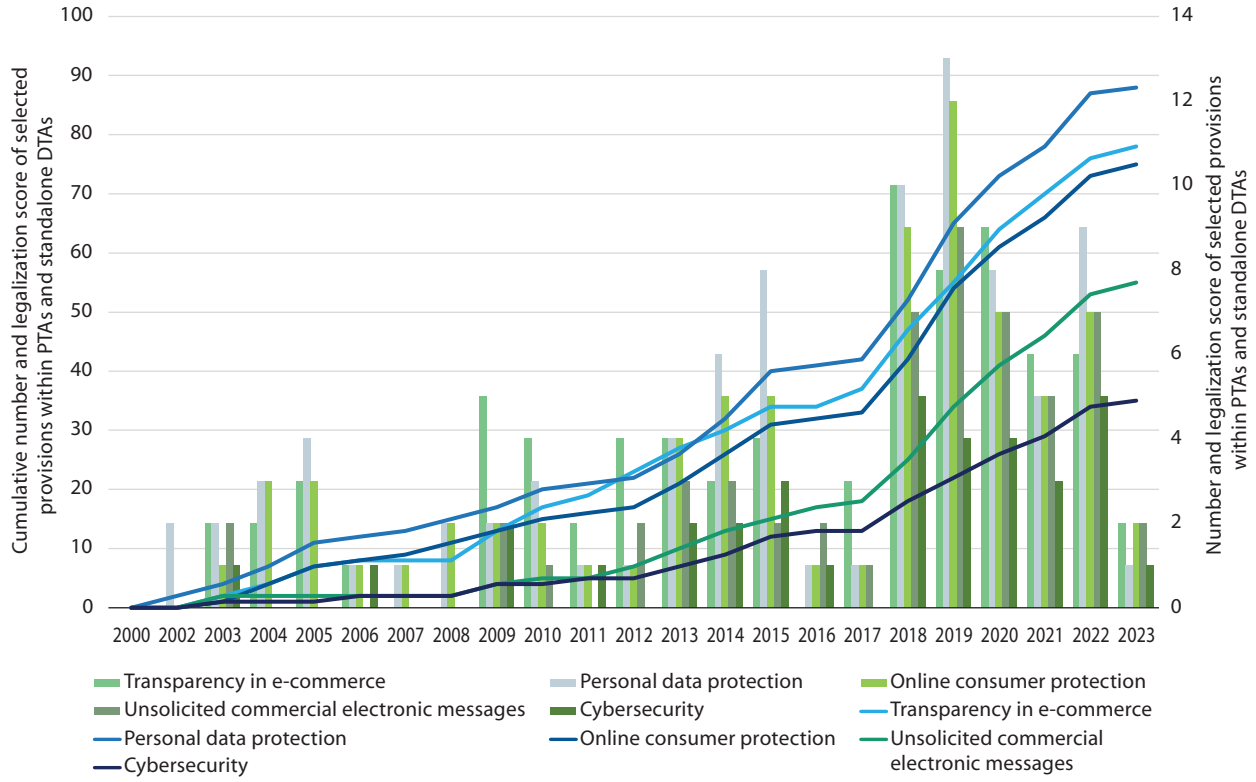
[36] For example, the Republic of Korea-Singapore DPA (Article 14.21); the Republic of Korea-Republics of Central America PTA (Article 14.4); and New Zealand-Singapore PTA (Article 9.6); and New Zealand-European Union PTA (Article 12.12).

[37] For example, CPTPP (Article 14.14); India-United Arab Emirates PTA (Article 9.9); and Australia-Malaysia PTA (Article 15.10).

[38] Additional examples of cybersecurity provisions include the Republic of Korea-Singapore DPA (Article 14.22); RCEP (Article 12.13); and Japan-United States DTA (Article 19).

[39] For example, New Zealand-United Kingdom PTA (Article 15.8); Australia-Singapore PTA (Article 29); DEPA (Article 7.1); Australia-Singapore DEA (Article 29); and the Republic of Korea-Singapore DPA (Article 14.30).

Figure 4.2
Cumulative number and legalization score of provisions building digital trust in Asia-Pacific PTAs and DTAs, 2000-2023



Source: APTIAD and TAPED. Accessed on 25 November 2023.
Note: The figure presents the cumulative number and score for each year, indicating the degree of legalization of the selected provisions within PTAs and stand-alone DTAs in the Asia-Pacific region. Provisions with binding commitments (legally enforceable or hard law) receive a score of 2; those with non-binding commitments (not enforceable or soft law) receive a score of 1; and the absence of such provisions is scored as 0.

4.4. Innovation

Innovation is instrumental in fostering sustainable development by augmenting productivity and propelling economic growth (Lee and Somsiriwong, 2022). Recent notifications of draft regulations submitted to the WTO Technical Barriers to Trade (TBT) Committee reflect a growing number and variety of innovation-related regulations. These encompass a broad spectrum, including IoTs, 5G technology, 3D printing, drones and autonomous vehicles (Lim, 2021). Within e-commerce provisions and DTAs, emerging technologies, such as source code, algorithms, cryptography and artificial intelligence, are addressed.

Provisions related to cross-border data flows, data localization and interactive computer services provisions are the important components in fostering innovation. Notably, these provisions signal a shift of trade negotiations towards addressing digital-era challenges and opportunities. These provisions often offer flexibility, which is essential for balancing the needs of protecting user privacy and data security with the imperatives of facilitating free and efficient data flows, which are vital for innovation and the growth of the digital economy.

The inclusion of specific provisions related to source code, algorithms, cryptography and AI in trade agreements marks a significant advancement in addressing contemporary digital trade issues.

Source code, algorithms and cryptography provisions are designed to protect against unauthorized technology transfer or access as a condition for the manufacture, sale, distribution, import and use of a product. These provisions are aimed at preventing compulsory disclosure of

proprietary information, which is critical for maintaining competitive advantages and encouraging innovation. There are, however, exceptions typically implemented for judicial or administrative proceedings. These exceptions are subject to safeguards against unauthorized disclosure, aligning with the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), specifically Article 39.2(c) concerning trade secrets.[40]

AI provisions, introduced in such agreements as the Digital Economy Partnership Agreement and the Singapore-Australia DEAs in 2020, are focused on the development of harmonized ethical and governance frameworks. These provisions[41] encourage consensus on core principles without dictating the details of domestic laws. This approach allows for a pragmatic and flexible framework that supports international cooperation and discourages unilateral approaches that deviate from international best practices (Mishra, 2022).

The role of big data as an essential input for technologies and analytical tools, such as AI, machine learning and automated decision-making to efficiently function and upgrade their systems, is increasingly being recognized.[42] However, restrictions on data flows, including data localization, potentially hinder innovations.[43] Data governance provisions, particularly those related to cross-border data flows, are regarded as contentious subjects due to the diverse perspectives and values involved.

Nevertheless, in the Asia-Pacific region, the inclusion of data flows[44] and limitations on data localization measures in trade agreements have significantly increased (figure 4.3).[45] This trend is significant as it reflects a regional commitment to facilitating the free movement of data, which is crucial for the development and deployment of advanced technologies. Interestingly, unlike the prevailing trend of non-binding legalization, some data flow provisions carry binding obligations, promoting the free movement of data. This provision, however, gives policy space for the parties to limit cross-border data transfers to achieve a legitimate public policy objective without constituting trade restrictions.

Furthermore, the Asia-Pacific region saw the establishment of the first and only "interactive computer services" provision under the Japan-United States DTA in 2019 (figure 4.3).[46] In fact, this provision exists in two agreements globally; the other agreement is the United States-Mexico-Canada Agreement signed in 2018.[47] Under this provision, information content providers, including suppliers and users of computer services, are not liable if they restrict access of harmful content in good faith. It reflects the safe harbour regime shielding Internet intermediaries from third-party liability, thereby enabling innovations.

[40] WTO TRIPS Article 39.2 (c) "Natural and legal persons shall have the possibility of preventing information lawfully within their control from being disclosed to, acquired by, or used by others without their consent in a manner contrary to honest commercial practices so long as such information… has been subject to reasonable steps under the circumstances, by the person lawfully in control of the information, to keep it secret".

[41] For example, the New Zealand-United Kingdom PTA (Article 15.19); and the Singapore-United Kingdom DEA (Article 8.61)

[42] For more information about the increasing role of data in the digital economy, see UNCTAD (2019), TD/B/EDE/3/2. The value and role of data in electronic commerce and the digital economy and its implications for inclusive trade and development.

[43] For more information, see ITIF (2021). How barriers to cross-border data flows are spreading globally, what they cost and how to address them?

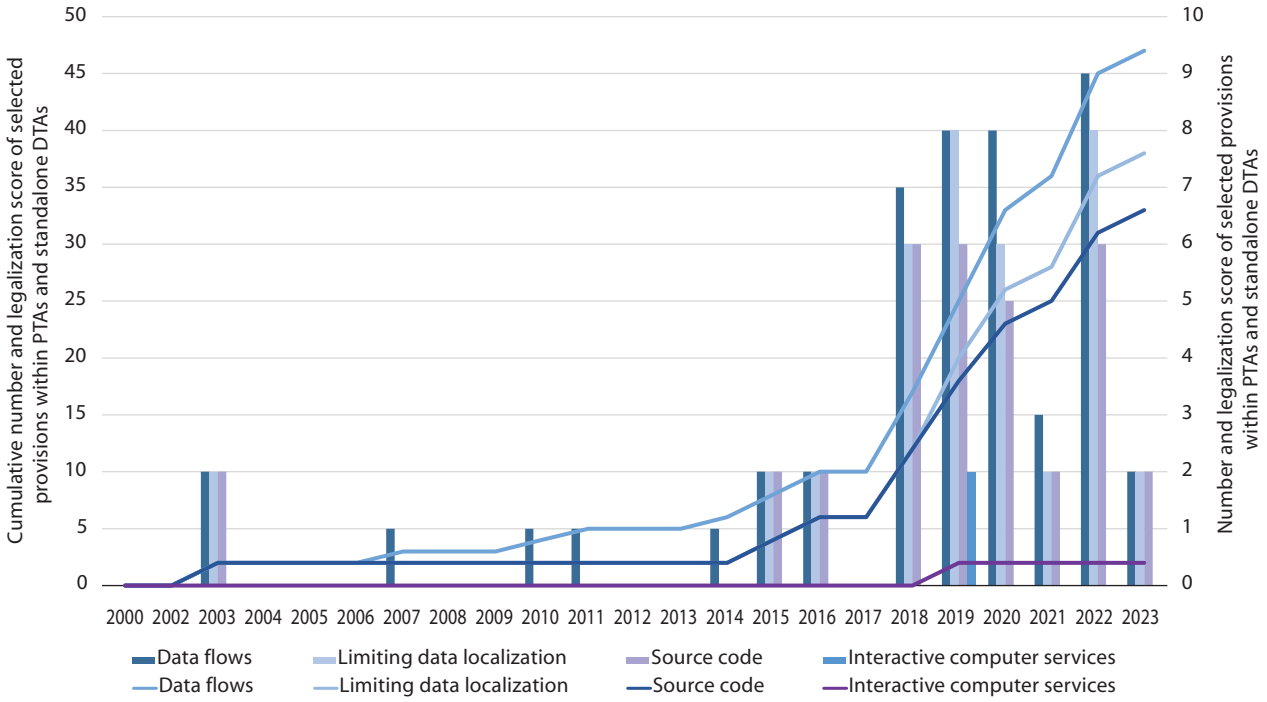
[44] For example, CPTPP (Article 14.11); RCEP) (Article 12.15); DEPA (Article 4.3); and Japan-Mongolia PTA (Article 9.10).

[45] For example, CPTPP (Article 14.13); RCEP (Article 12.14); DEPA (Article 4.4); and Australia-Peru PTA (Article 13.12).

[46] Please see Article 18. The Japan-United States DTA defines "interactive computer services" as a system of services that provides or enables electronic access by multiple users to a computer server.

[47] See the United States-Mexico-Canada Agreement (Article 19.17).

Figure 4.3
Cumulative number and legalization score of provisions fostering innovation in the digital economy in Asia-Pacific PTAs and DTAs, 2000-2023



Source: APTIAD and TAPED. Accessed on 25 November 2023.
Note: The figure presents the cumulative number and score for each year, indicating the degree of legalization of the selected provisions within PTAs and stand-alone DTAs in the Asia-Pacific region. Provisions with binding commitments (legally enforceable or hard law) receive a score of 2; those with non-binding commitments (not enforceable or soft law) receive a score of 1; and the absence of such provisions is scored as 0.

4.5. Conclusion

This chapter discussed the evolving landscape of PTAs in the Asia-Pacific region, marked by a deeper integration of digital and sustainable development considerations. This transformation is characterized by three key aspects: affordability of access, digital trust and innovation.

The growing emphasis on affordability of access in these agreements is a progressive step towards democratizing the digital economy. By addressing such issues as competition, Internet interconnection charges and duty-free treatment, these agreements have the potential to enhance digital inclusivity and equity, thereby narrowing the digital divide.

The growing number of provisions focusing on digital trust highlights a proactive approach to the challenges and risks inherent in the digital space. Provisions for data protection, online consumer rights and cybersecurity are not mere legal requirements but pillars of confidence for both consumers and businesses. The intricate balance these agreements strive to achieve between openness and security is pivotal for sustaining the digital economy's growth.

Lastly, the thrust on innovation, especially in such areas as AI, machine learning and data governance, underscores a forward-looking vision. By fostering an environment conducive to technological advancement while protecting intellectual property and ethical standards, these agreements are not just responding to the present but are shaping the future. The inclusion of provisions for cross-border data flows and interactive computer services, for instance, reflects a nuanced understanding of the digital ecosystem's complexities.

In essence, these trends in PTAs represent a sophisticated blend of trade policy, digital strategy and socioeconomic foresight. They mark a potential shift from traditional trade models to ones that are more agile, inclusive and forward looking.

The impacts will be felt, however, only if these new digital provisions are actually implemented. Monitoring of implementation and impact assessment are important areas for which more research is needed.

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CHAPTER 5

Assessing the policy environment for digital connectivity and accessibility in the Asia-Pacific region

Chapter 5

Assessing the policy environment for digital connectivity and accessibility in the Asia-Pacific region[48]

5.1. State of play in digital infrastructure and access in Asia and the Pacific

Digital infrastructure is the backbone of the digital economy, consisting of both physical components, such as hardware, cables, data centres and ICT devices, and intangible components, such as software and online platforms. This infrastructure enables digital connectivity, allowing data transmission between individuals, machines and various combinations thereof. High-quality connectivity is essential for the adoption of new technology, remote access to health care, education and employment. According to the Alliance for Affordable Internet, meaningful connectivity covers four elements: (a) a fast connection (4G mobile connection as the minimum threshold); (b) an appropriate device (a smartphone and wide range of device types); (c) enough data (unlimited broadband connection, including data packages); and (d) regular Internet (daily access).[49]

Although digital infrastructure investment has been prioritized in many Asia-Pacific economies, a significant digital divide is still evident (figure 5.1) – 75 per cent of Asia-Pacific economies record less than half the sustainable digital integration level of Singapore, the top-performer of the index. One area where this gap is evident is in the gender divide with regard to the use of mobile or formal bank accounts. Indeed, such countries as Afghanistan, Bhutan, Maldives and Pakistan are considerably distant from advanced countries, such as Australia, Japan and New Zealand, where shares of female access to mobile banking are highest. In addition, the digital divide also appears within countries between urban and rural areas, men and women, people with disabilities and different age groups (box 5.1).

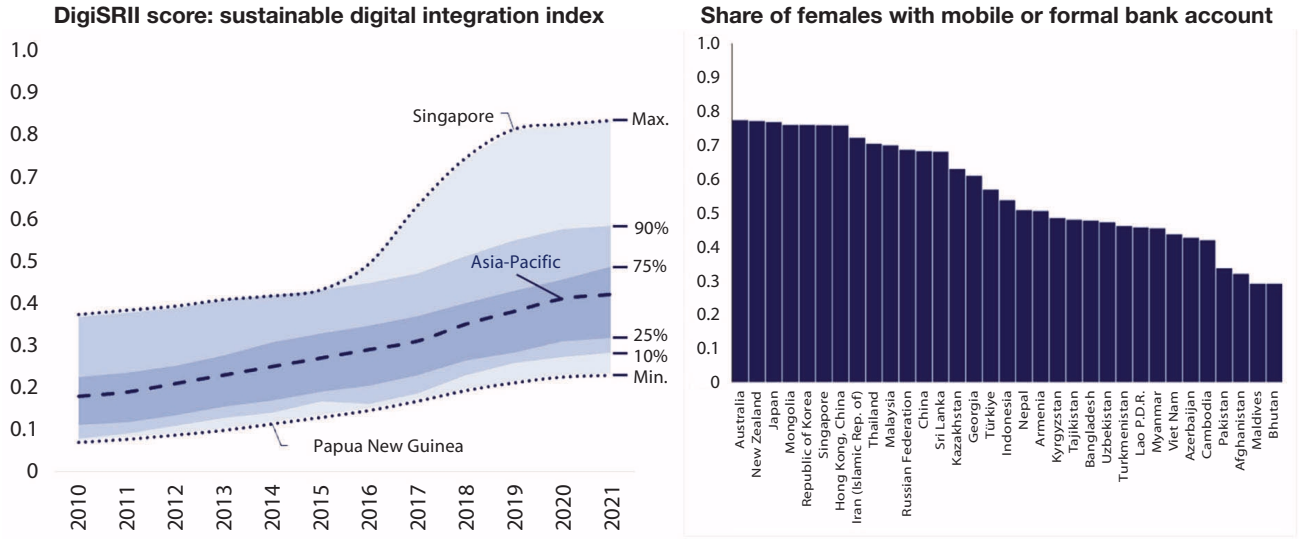
According to ITU (2021), telecommunication and ICT services, including mobile voice, mobile data and fixed broadband services, have become more affordable, and the price tends to be lower across the world. Nonetheless, the affordability of these services is diverse in the Asia-Pacific region. The telecom services in certain economies, in China for example, are at low prices, below 1 per cent of gross national income (GNI) per capita, while other economies exhibit prices above 15 per cent GNI per capita (ITU, 2021) (figure 5.2).[50]

[48] The initial version of this paper was published as: Witada Anukoonwattaka, Natnicha Sutthivana, and Yann Duval (2024). "Assessing the Policy Environment for Digital Connectivity and Accessibility in the Asia-Pacific Region", ARTNeT Working Paper Series No. 240, May 2024, Bangkok, ESCAP.

[49] The Alliance for Affordable Internet (A4AI) introduced the concept of meaningful connectivity in 2020 to help policymakers set targets for better quality and affordable access. For details, see https://a4ai.org/meaningful-connectivity/.

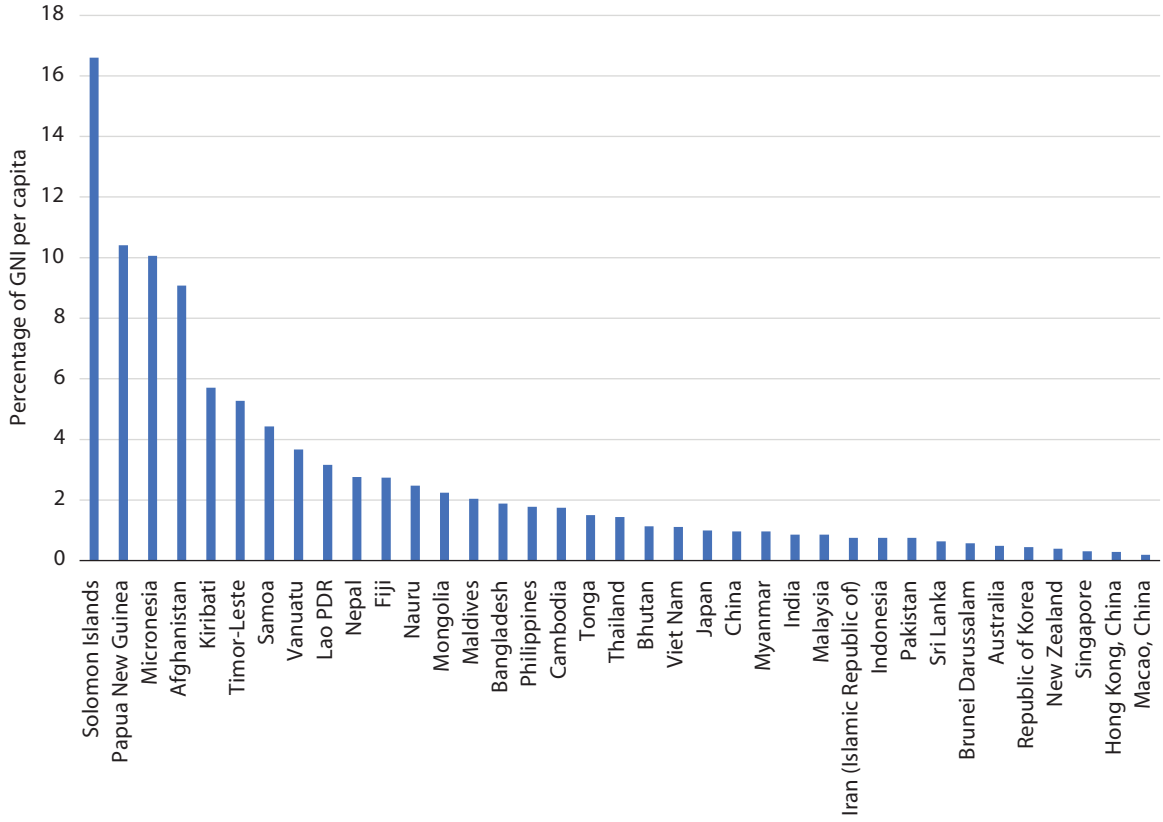
[50] ITU/UNESCO Broadband Commission for Sustainable Development set a target for 2025 that entry-level broadband services should be affordable in developing countries at less than 2 per cent of monthly GNI per capita. For more information, see www.broadbandcommission.org/broadband-targets/ and www.itu.int/en/mediacentre/backgrounders/Pages/affordability.aspx.

Figure 5.1
Increasing integration into the digital economy accompanied by significant disparity in the Asia-Pacific region, 2023



Source: Compilation from the ESCAP DigiSRII database. Available at https://riva.negotiatetrade.org/#/rioverview. Accessed on 5 May 2023.

Figure 5.2
Mobile-data prices as a percentage of GNI per capita, and monthly data allowance, 2019



Source: Compilation by ESCAP, based on ITU Price Baskets (IPB) Available at www.itu.int/net4/ITU-D/ipb/#ipbrank-tab. Accessed in May 2023.
Note: Data correspond to the GNI per capita in 2019. The mobile data broadband basket refers to a data plan with a monthly allowance of at least 1.5 gigabytes, irrespective of the device used, over a 3G or higher data transmission network. GNI per capita values are World Bank data.

Challenges in ensuring digital infrastructure and services are primarily found in marginal or rural areas, where the free market often fails to provide access due to a lack of commercial viability for private operators. In contrast, these services tend to be more concentrated in populated and profitable areas. To address this disparity, government intervention in remote areas is essential to bridge the digital divide. In line with this, the chapter presents a comprehensive overview of trade and investment policies that influence the accessibility of digital services, the affordability of digital infrastructure and the availability of ICT products. It includes a detailed discussion on policies related to competition in the telecommunications market and the availability of products crucial for the development of digital infrastructure

Box 5.1

Digital divide in the Asia-Pacific region

The percentage of individuals using the Internet is increasing as household Internet access grows. Notably, the mobile market plays the main part, as 96 per cent of the Asia-Pacific population had access to mobile broadband networks in 2022 (ITU, 2021; GSMA, 2022). These trends have also been driven by the COVID-19 pandemic since 2020. The pandemic has emphasized the importance of connectivity for social and economic inclusion (Garnett, 2021). Nonetheless, it widens the digital divide within the Asia-Pacific region.

Internet user penetration and broadband download speed vary widely across the region. In 2021, the percentage of individual access to the Internet was more than 80 per cent in Australia; Brunei Darussalam; Hong Kong, China; Malaysia; New Zealand; and Singapore. While in populous and less-developed economies, such as Bangladesh and Pakistan, and such Pacific island economies as Papua New Guinea and Solomon Islands, user penetration reached only 20 per cent.[51]

The mobile and fixed broadband download speeds between the advanced and landlocked economies in the region are diverse. Advanced digital economies, such as China, Japan and the Republic of Korea, have higher average national mobile broadband download speeds of 202 Mb/s, 29 Mb/s and 122 MB/s, respectively, compared with 17 Mb/s in landlocked economies. The fixed broadband download speed in Thailand of 109 Mb/s and the Republic of Korea of 103 Mb/s were four times higher than the average in Asia and the Pacific (‘Ofa and Aparicio, 2021).

The significant digital divide appears in rural areas and marginalized communities. Rural areas tend to have a lower rate of speed and access, and such groups as women, people with disabilities and the ageing population have less access to digital tools. The divides can be expressed on multiple dimensions, including the lack of access to effective broadband, appropriate ICT devices and the ability to use digital technologies.

In 2023, the proportion of women in the region using the Internet was 54 per cent versus 59 per cent for men (ESCAP, UNCTAD and UNIDO, 2023). ESCAP (2021) found a similar situation that the gender divide is related to the rural-urban digital divide. Female entrepreneurs, labourers and students experienced negative impacts more than other groups, especially during the pandemic. Hence, harmonizing the level of connectivity, accessibility and affordability should be accomplished. The hard and soft digital infrastructures should be accessible to all in order to bridge digital divides.

[51] ITU Country ICT data, percentage of individuals using the Internet. Available at www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

5.2. Trade and investment policies affecting competition in telecom markets

Trade and investment policies at the international level frequently interact with and influence domestic regulations. Specifically, international trade agreements can establish minimum standards for the regulation of telecommunications and often mandate that countries open their telecommunications markets to foreign service providers. These standards typically address such issues as fair competition, interconnection pricing and independent regulators of telecommunications entities. Furthermore, obligations in these agreements may involve reducing or removing limits on foreign ownership, granting licences to foreign telecommunications operators and ensuring non-discriminatory practices in public procurement for infrastructure projects. As a result, domestic regulations might need adjustments to meet these requirements, thereby promoting a competitive environment in telecom markets. Such an environment enhances quality, affordability and access, ultimately fostering economic growth and social development.

According to the ESCAP Regional Digital Trade Integration Index (RDTII) 2.0 data set for 2023, the telecom regulatory environment in 21 Asia-Pacific sample economies is heavily regulated, offering substantial scope to enhance market competition (ESCAP, ECA and ECLAC, 2023; 2024; ESCAP, UNCTAD and UNIDO, 2023). Similarly, the OECD Services Trade Restrictiveness Index (STRI) for telecommunication services confirms the same for 13 Asia-Pacific sample economies. In this section, the following matrices are examined using data from ESCAP RDTII 2.0: regulating telecom market structure, adhering to international frameworks, openness to foreign entry and foreign participation in public procurement.

5.2.1. Telecom market structure

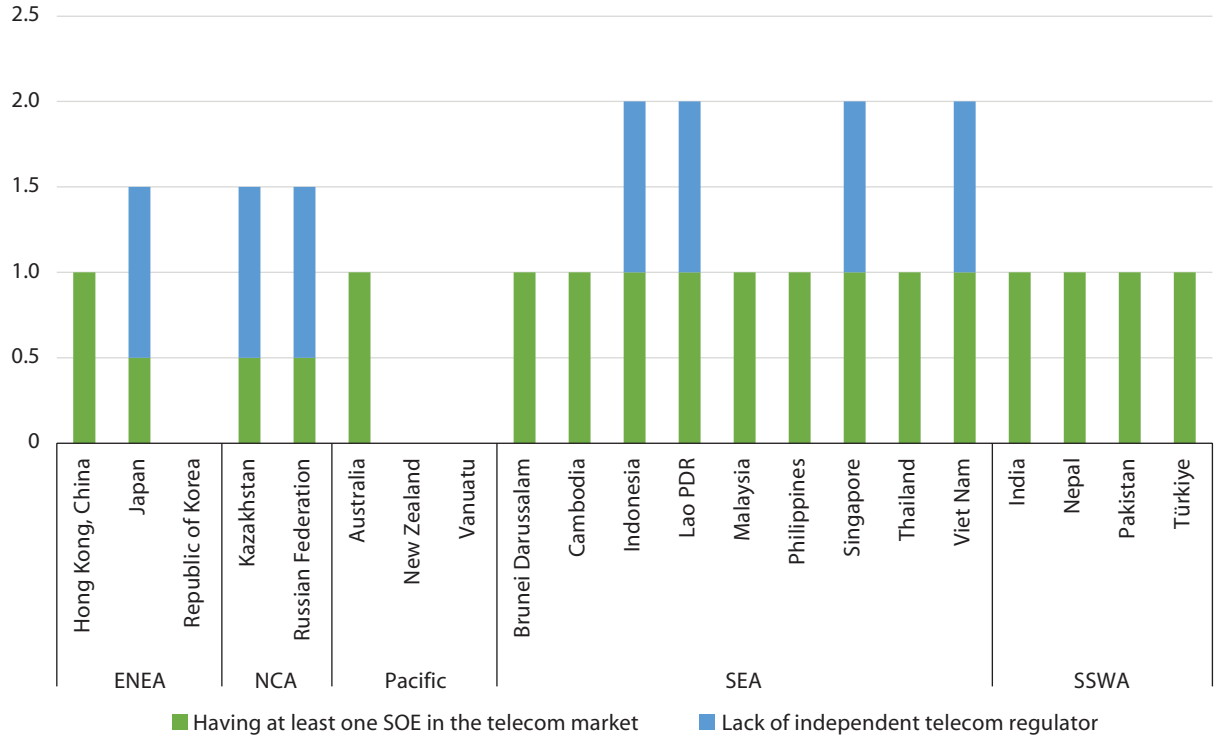
In the Asia-Pacific region, telecom markets are characterized by the significant presence of dominant players, including both State-owned and privately owned companies. Although private firms are allowed to operate, the extensive presence of State-owned enterprises in the telecom sector stands out as a distinctive feature in this region (ESCAP, UNCTAD and UNIDO, 2023). Among the 21 economies in the RDTII dataset, 18 of them have at least one government-controlled telecom company (figure 5.3).[52]

In the Asia-Pacific region, Governments frequently maintain majority ownership in telecom companies. In such countries as Brunei Darussalam, Cambodia and India, government ownership of telecom companies reaches 100 per cent. In addition, in some instances these State-owned companies also wield significant market power. For example, Viet Nam's publicly owned companies, Viettel (owned by the Ministry of National Defense), VNPT (Vietnam Posts and Telecommunications Group, owned by the Commission for the Management of State Capital at Enterprises), and Mobifone, hold more than 90 per cent of the fixed telephone service, mobile telephone and mobile broadband market shares. Thailand's National Telecom Public Company, fully owned by the Government, is a dominant firm in the fixed-line telephone service market.

However, it is encouraging that many Asia-Pacific economies have independent telecom regulators. Such a setup is seen as a way to promote fair competition and improve market transparency (ESCAP, UNCTAD and UNIDO, 2023), because these regulators are not accountable to telecom-munication service providers.

[52] See Annex 1 in the original working paper: Witada Anukoonwattaka, Natnicha Sutthivana and Yann Duval (2024). Assessing the policy environment for digital connectivity and accessibility in the Asia-Pacific region, ARTNeT Working Paper Series, No. 240, May 2024, Bangkok, ESCAP. Available at http://artnet.unescap.org.

Figure 5.3
Presence of State-owned enterprises and absence of independent regulators in telecom sector, 2023



Source: Compilation by ESCAP based on ESCAP RDTI. Available at https://dtri.uneca.org. Accessed in December 2023.
Note: For space considerations, the following abbreviations are used: ENEA = East and North-East Asia; NCA = North and Central Asia; SEA = South-East Asia; SSWA = South and South-West Asia; and SOE = State-owned enterprise.

5.2.2. International frameworks

WTO frameworks

WTO frameworks establish rules and guidelines that encourage fair competition, transparency and non-discriminatory practices, ultimately benefiting telecom users both in households and the business sector. Adhering to international frameworks is supposed to promote a more competitive and harmonized telecom environment.

Specifically, the adoption of the WTO Telecommunications Service Reference Paper, supplementing the WTO General Agreement on Trade in Services Annex on telecommunications, ensures reasonable access to and use of public telecommunications services. The Telecom Reference Paper contains a set of best practices for policy reform in the telecommunications sector. It encompasses six frameworks concerning a pro-competitive environment: competitive safeguards; interconnection; universal services obligation; public availability of licensing criteria; independent regulators; and allocation and use of scarce resources. This legally binding regulatory framework applies to the WTO member States that appended the document to their schedules of commitments, and is enforceable through the WTO dispute settlement mechanism. Notably, the flexible nature of the Reference Paper, which allows members to fully or partially undertake the commitments, facilitate member States, including developing economies, to adopt the Reference Paper. It is encouraging that all 21 Asia-Pacific sample economies in the RDTII database have adopted the Reference Paper, and 17 economies have committed to it by appending the document in whole to their schedules of commitments (figure 5.4).[53]

In addition, given the critical role that government procurement plays in developing telecommunications infrastructure, the WTO Government Procurement

[53] When a country commits in whole, it agrees to implement all the principles and guidelines outlined in the WTO Telecommunications Services Reference Paper. If a country commits in part, it adopts only certain elements or principles of the Reference Paper.

Agreement (GPA) is crucial in fostering a competitive environment within the telecommunications sector. The WTO GPA is a plurilateral agreement aimed at opening government procurement markets to international competition, which allows member States to voluntarily determine their coverage schedules. However, within the 21 RDTII sample economies, only 6 have committed the telecom sector to GPA. Among these, Australia; Hong Kong, China; and New Zealand have included schedules that are relevant to both telecommunications services (CPC 752) and telecommunications-related services (CPC 754) (figure 5.4).

Regional approaches

Telecommunications tend to be covered in a number regional and subregional initiatives, including regional trade agreements (RTAs). Among the 21 sampled economies, all except Nepal and Pakistan have RTAs that include provisions specific to telecommunications (figure 5.4). Most economies[54] negotiated the telecom provisions through plurilateral agreements, such as the Regional Comprehensive Economic Partnership (RCEP), Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), Eurasian Economic Union (EAEU) and Pacific Agreement on Closer Economic Relations (PACER) Plus.

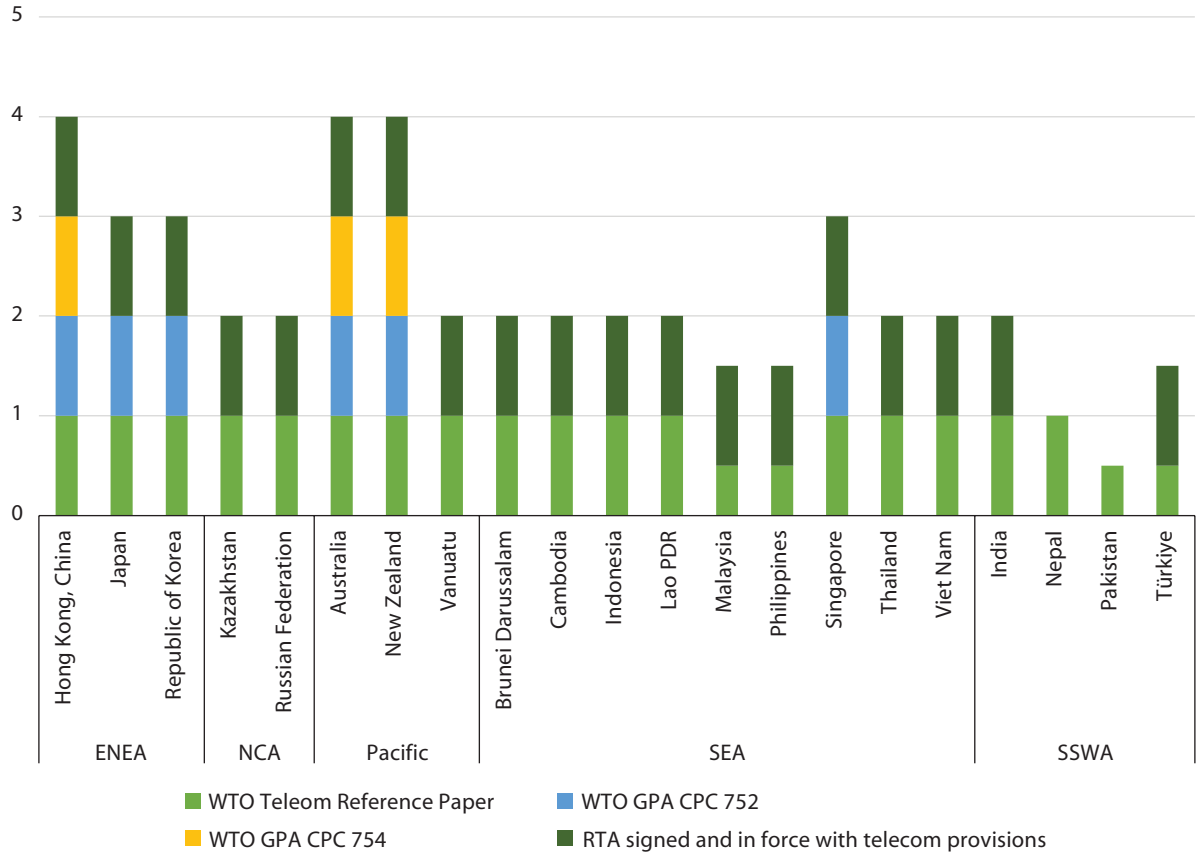
Many RTAs notified to WTO have adopted the WTO rules on telecommunications services, namely the GATS Annex on telecommunications and the previously mentioned Reference Paper, as a baseline and have added further clarifications (WTO, 2022). For instance, the Telecommunication Annex 8B of RCEP and Chapter 13 of CPTPP cover measures in accordance with WTO baseline's scope, including obligations on access to and use of public telecommunications networks and services. Provisions regarding suppliers of public telecommunications networks and services, such as interconnection, universal service, licensing and allocation and use of scarce resources, are also incorporated.

Major regional trade agreements in the Asia-Pacific region typically include a chapter on telecommunications services (table 5.1). Specifically, the CPTPP agreement is more comprehensive, with specific and binding obligations that surpass those found in other RTAs. It even includes institutional mechanisms, such as establishing a committee on telecommunications, to review and monitor its implementation. The RCEP and North-South comprehensive agreements, such as the Indonesia-EFTA agreement, share several similarities with CPTPP. However, a significant difference is the absence of institutional mechanisms for monitoring implementation and settling disputes.

Other regional initiatives, such as those of APEC, ASEAN, CAREC and South Asian countries, are focused more on setting common goals and visions than establishing concrete obligations. For example, the APEC Telecommunications and Information Working Group, established in 1990, intends to ensure that all people in the Asia-Pacific region have affordable access to ICT and the Internet through the exchange of information, identification of best practices and capacity-building (APEC, 2023). Similarly, ASEAN member States have adopted action plans and framework agreements to enhance ICT competitiveness in the region. These initiatives encourage sharing best practices, capacity-building and establishing working groups.

[54] Of the 19 sample economies with telecom agreements, all economies except India are parties to the plurilateral agreements with a telecom provision or chapter (Australia; Brunei Darussalam; Cambodia; Hong Kong, China; Indonesia; Kazakhstan; Japan; Lao People's Democratic Republic; Malaysia; New Zealand; Philippines; Republic of Korea; Russian Federation; Singapore; Thailand; Türkiye; Vanuatu; and Viet Nam). India participates only through bilateral RTAs, such as Australia-India, India-Japan, India-Malaysia, India-Republic of Korea and India-Singapore.

Figure 5.4
Participation in international frameworks and RTAs related to telecom in selected Asia-Pacific economies, 2023



Source: Compilation by ESCAP based on ESCAP RDTII. Available at https://dtri.uneca.org. Accessed in December 2023.
Note: For the Telecommunications Services Reference Paper, a score of 0.5 indicates partial appending to the Reference Paper, while a score of 1.0 indicates full appending. For the WTO GPA, Kazakhstan and the Russian Federation have negotiated accession to GPA. India, Indonesia, Malaysia, Pakistan, Philippines, Thailand, Türkiye and Viet Nam are observers. Additionally, the RTA captures at least one signed and in-force agreement with telecom provision. For space considerations, the following abbreviations are used: ENEA = East and North-East Asia; NCA = North and Central Asia; SEA = South-East Asia; and SSWA = South and South-West Asia.

Table 5.1
Comparative analysis of regional agreements with telecommunication or digital connectivity provisions

Regional frameworks/focused scope	Digital connectivity and accessibility				Enforcement and implementation
	International roaming	Interconnection	Spectrum management	Universal service	
1. APEC Telecommunications and Information Working Group Strategic Action Plan 2021-2025	X	X	Share regulatory updates on spectrum management.	Exchange information and best practices on universal telecommunications/ ICT service strategies. Develop Next-Generation Universal Service Obligations frameworks (USO 2.0).	Establish three steering groups for knowledge sharing and capacity-building
2. Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) Chapter 13 Telecommunications	Cooperate on transparent and reasonable rates for international mobile roaming services, including wholesale roaming services. Update rates for retail international mobile roaming services to other parties.	(a) Ensure public telecommunications services and major suppliers provide interconnection with suppliers of another party. (b) Publicly disclose interconnection offers and agreements with a major supplier in its territory.	(a) Allocate and use scarce resources, including frequencies, in an objective, timely, transparent and non-discriminatory manner. (b) Publicly disclose the current status of allocated frequency bans (excluding government uses). (c) Encourage relying on market-based approaches.	Right to define the universal service obligation. The obligation should be transparent, non-discriminatory and competitively neutral.	(a) Incorporate specific provisions on enforcement and resolutions of telecommunication disputes, for example sanctions and suspension of licences; administrative proceedings; and review and appeal to resolve arising telecom disputes. (b) Establish a committee on telecommunications to monitor implementation by enabling responsiveness to technological and regulatory developments.

Table 5.1 *(continued)*

Regional frameworks/focused scope	Digital connectivity and accessibility				Enforcement and implementation
	International roaming	Interconnection	Spectrum management	Universal service	
3. Indonesia-European Free Trade Association (EFTA) Comprehensive Economic Partnership Agreement Annex XIII Telecommunications Services	X	Same as CPTPP (a) and (b)	Same as CPTPP (a) and (b)	Same as CPTPP.	(a) No specific enforcement provisions on telecommunications. (b) Telecommunications services constitute an annex within the service chapter of this agreement. The parties commit to review the trade in services chapter at least every three years or more frequently. The dispute settlement chapter is applicable for any dispute in breach of this agreement.
4. Republic of Korea-Republics of Central America Free Trade Agreement Chapter 13 Telecommunications	X	Same as CPTPP (a) b. Require suppliers of public telecommunications services to file their interconnection contracts.	Same as CPTPP (a) and (b)	Same as CPTPP.	Same as CPTPP (a)
5. Central Asia Regional Economic Cooperation (CAREC) Digital Strategy 2023	X	N/A	N/A	N/A	(a) Establish implementation principles and governance structure, including a Central Asia Regional Economic Cooperation Program digital strategy steering committee. (b) Set key implementation priorities, such as sharing best practices and establishing a monitoring system for digital transformation progress and impact.

Table 5.1 *(continued)*

Regional frameworks/focused scope	Digital connectivity and accessibility				Enforcement and implementation
	International roaming	Interconnection	Spectrum management	Universal service	
6. Regional Comprehensive Economic Partnership (RCEP) Annex 8B Telecommunications Services	Cooperate on transparent and reasonable rates for international mobile roaming services, including wholesale roaming services.	Same as CPTPP (a) Same as Republic of Korea-Central America (b) Same as CPTPP (b)	Same as CPTPP (a, b, c)	Same as CPTPP	Same as CPTPP (a) Quite similar to Indonesia-EFTA (b), but with a longer period for review (five years instead of three years).
7. ASEAN Digital Masterplan 2025	Lowering roaming rates for mobile data services across ASEAN. Review previous ASEAN initiatives to reduce roaming charges. Re-examine the costs and benefits of achieving the proposed goal.	N/A	Ensure harmonized spectrum allocation across the region. Adopt a regional policy to deliver best practice guidance on the spectrum.	N/A	(a) Set eight desired outcomes, including enabling actions and timelines. The monitoring and implementation have been specified under each outcome.
8. ASEAN Framework on International Mobile Roaming 2017	Encourage telecommunications operators in ASEAN to provide transparent and affordable international mobile data roaming service on a daily flat rate basis.	X	X	X	(a) Establish implementing bodies (designated telecom regulatory body) of each participant responsible for monitoring and coordinating, including providing advice to encourage their operator(s) to negotiate with the operator. (b) Review implementation every six months.

Table 5.1 *(continued)*

Regional frameworks/focused scope	Digital connectivity and accessibility				Enforcement and implementation
	International roaming	Interconnection	Spectrum management	Universal service	
9. ASEAN Siem Reap Declaration 2017	Promote transparent and affordable international mobile roaming services.	Promote regional connectivity (direct connectivity and Internet exchange points) and link landlocked developing countries to regional and global opportunities via access to the international fibre optic network, including submarine cables in the region.	Promote harmonized radio spectrum regulations, notably accelerating the analogue switch off (ASO) and digital migration in the 700 MHz band.	Promote universal, equitable and affordable access to ICT	(a) Share best practices and undertake a midterm review to take stock of the progress and identify areas for improvement.
10. Pacific ICT Ministers Dialogue 2023 (Lagatoi Declaration)	X	X	X	X	(a) Instruct senior officials to develop a Pacific ICT and digital transformation action plan, which would be reviewed at the next Pacific Ministerial Dialogue in 2025.

Table 5.1 *(continued)*

Regional frameworks/focused scope	Digital connectivity and accessibility				Enforcement and implementation
	International roaming	Interconnection	Spectrum management	Universal service	
11. South Asian Telecommunication Regulators Council (SATRC) Action Plan[a]	Recommend adopting a uniform and transparent roaming tariff and avoid double taxation. Ensure negotiation with the local operators and implementation of the recommendations.	Recommend ISPs to procure their own international capacity directly instead of obtaining it from the incumbent telecom operators. Suggest establishing and connecting Internet exchange points (IXPs) to reduce the costs of international Internet connectivity.	Encourage the harmonized spectrum towards implementing 5G services, including developing a proper 5G implementation policy.	Recommend establishing a national broadband network rollout project providing a full suite of voice and broadband products and services on a wholesale basis.	(a) Establish a working group on policy, regulation and services to deal with the issues related to policy, regulation and services in the region, and a working group on spectrum to deal with the issues related to spectrum management, monitoring, sharing and coordinated efficient use of spectrum.

Source: ESCAP compilation.

Note: "X" refers to the absence of specific aspects of digital connectivity and accessibility. N/A refers to when information is not available.

[a] The information about the South Asian Telecommunication Regulators Council (SATRC) Action Plan was taken from joint statements, reports and approaches, such as the Joint Statement by SATRC members for the Adoption of Regional Mobile Roaming SAPIV-REP-10; and Approaches to Spectrum Harmonization for 5G in SATRC Countries.

5.2.3. Foreign entry

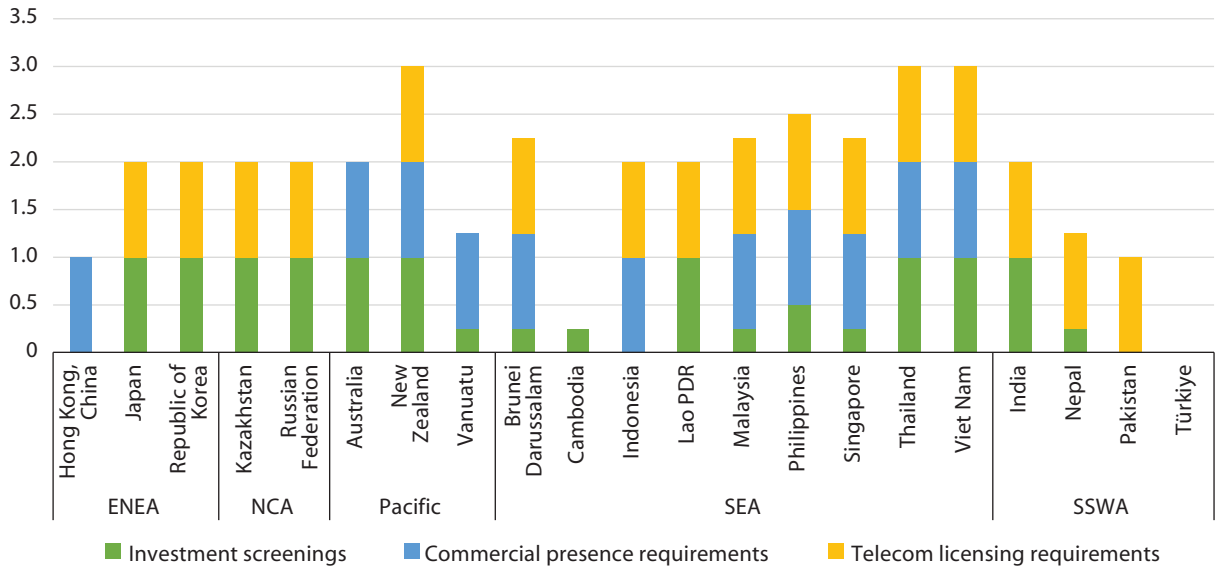
Digital information policies can play a crucial role in fostering competition, affordability and wider access to digital infrastructure. By attracting international capital, technology and expertise, these policies can stimulate competitive markets, driving down costs and expanding digital connectivity.

The trend of opening up the telecommunications sector to FDI has been growing in the Asia-Pacific region. For instance, Indonesia removed telecommunication services from the list of restricted sectors in 2021, allowing for 100 per cent foreign ownership in the telecom sector. In the same year, India also approved foreign investment in the telecom sector up to 100 per cent, an increase from the previous limit of 49 per cent.[55] Furthermore, in 2022, the Philippines amended legislation to lift the 40 per cent FDI limits in the telecom sector, allowing for 100 per cent foreign ownership.

However, some economies still maintain limits on foreign ownership and control. For example, Brunei Darussalam, the Republic of Korea, Thailand and Viet Nam limit foreign ownership in the telecom sector to a minority stake of only 49 per cent of the shares.[56]

There are other regulatory policies that have impacts on foreign entry into the telecom sector. These include licensing requirements, investment screenings and commercial presence requirements (figure 5.5). In particular, the region implements complicated licensing requirements, such as mandating telecom service providers to acquire multiple licences to operate their services or imposing discriminatory conditions and fees solely on foreign operators.[57]

Figure 5.5
Regulatory challenges for foreign investment in the telecom sector of selected Asia-Pacific economies, 2023



Source: Compilation by authors based on ESCAP's RDTII. Available at https://dtri.uneca.org. Accessed on December 2023.
Note: For space considerations, the following abbreviations are used: ENEA = East and North-East Asia; NCA = North and Central Asia; SEA = South-East Asia; and SSWA = South and South-West Asia.

[55] FDI in India is governed by automatic route and approval route. Under the automatic route, foreign investors are not subject to government approval or Reserve Bank approval. While under the approval route (known as the government route), investors are required to obtain prior approval from the Government or specified agencies. Previously, India permitted 100 per cent FDI in telecommunications, but approval of the Government is required for FDI above 49 per cent. For more information about the FDI limit raised in India, see Press Note No.4 of 2021 (issued on 6 October 2021).
[56] See Licensing and Regulatory Framework of the Authority for Info-communications Technology Industry of Brunei Darussalam (AiTi) for Brunei Darussalam, and the Telecommunications Business Act and Foreign Business Act for Thailand.
[57] For example, Nepal imposes a cap on the maximum number of licences for facility providers. No other licences will be issued for five years after the two licences have been issued for the development of telecommunication infrastructure. Kazakhstan requires telecom service providers to connect their channels to a public network controlled by a State-owned telecom company as a condition for obtaining a licence. India imposes a one-time licence fee for "the Unified License" for foreign investment in telecommunication services generally and sector-specific licences for wireless and wired connection (see ESCAP RDTII database at https://dtri.uneca.org/escap/home).

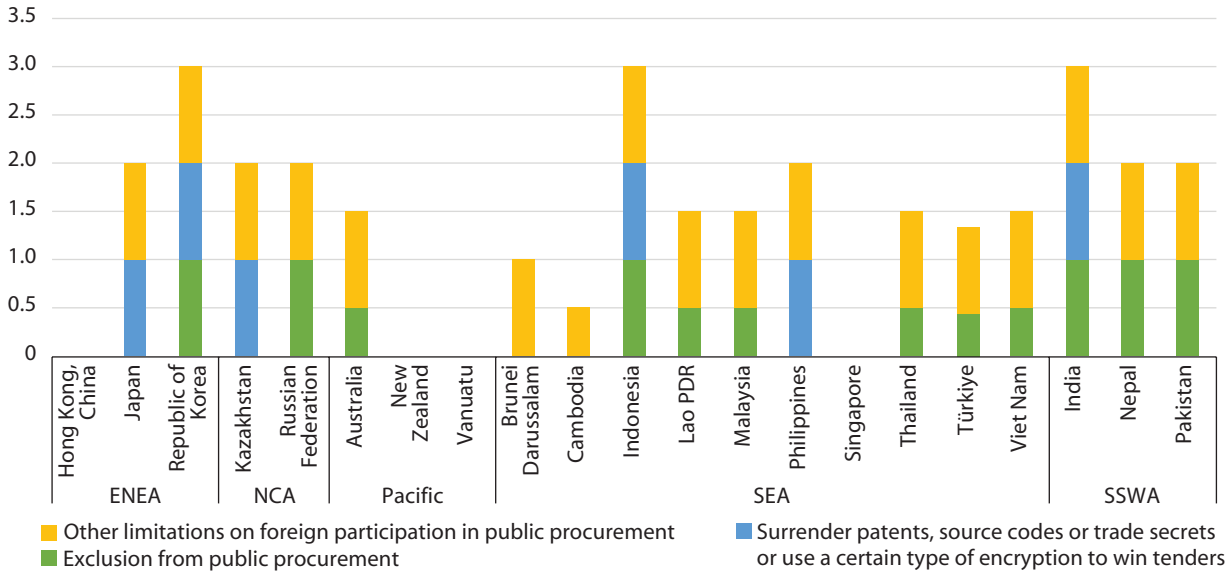
5.2.4. Public procurement

By establishing transparent and non-discriminatory rules for public purchasing of telecom services and infrastructure, the policy can encourage a level playing field for market players. Additionally, Governments can design procurement policies that prioritize universal access, promoting infrastructure development in underserved and remote regions.

Public procurement rules typically apply across different sectors, including telecommunications. In 18 of the 21 RDTII sampled economies, limitations are placed on foreign participation in public procurement (figure 5.6). In countries such as India, Indonesia and Viet Nam, foreign bidders can participate in procurement only when local goods or services cannot be procured at competitive prices or are not available locally.[58] Alternatively, foreign operators have to join with local firms to be eligible bidders. Indonesia, Lao People's Democratic Republic, Pakistan, Philippines and Thailand explicitly state that local firms receive priority in public procurements.

Moreover, the stipulation to surrender source codes, encryption keys and trade secrets as a prerequisite for participating in public tenders is present. Such requirements are controversial and may not align with the WTO Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement principles[59], as firms might be reluctant to partake in these tenders, fearing the loss of their proprietary information (ESCAP, UNCTAD and UNIDO, 2023). Specifically, six sample economies, namely India, Indonesia, Japan, Kazakhstan, the Philippines and the Republic of Korea, require the bidder to submit the source codes of hardware and/or software, including cloud computing and network equipment (figure 5.6).[60] Apart from the ICT products, the Philippines requires foreign consultants to transfer their technology and knowledge, possibly patents and trade secrets, as a condition to be hired under public procurement.[61]

Figure 5.6
Regulatory challenges for public procurement in selected Asia-Pacific economies, 2023



Source: Compilation by ESCAP based on ESCAP RDTII. Available at https://dtri.uneca.org. Accessed in December 2023.
Note: For space considerations, the following abbreviations are used: ENEA = East and North-East Asia; NCA = North and Central Asia; SEA = South-East Asia; and SSWA = South and South-West Asia.

[58] Hong Kong; China; New Zealand; Singapore; and Vanuatu and have established an open public procurement regime despite the general trend. Specifically, New Zealand has enacted specific provisions on equal treatment to all suppliers and explicitly prohibits discrimination against foreign suppliers. For more information, see New Zealand's Government Procurement Rules. Available at https://www.procurement.govt.nz/assets/procurement-property/documents/government-procurement-rules.pdf.
[59] The WTO TRIPS Agreement sets out the minimum standards of protection for intellectual property rights, including copyrights and related rights, trademarks, industrial rights, patents, the layout-designs of integrated circuits and undisclosed information (trade secrets and test data).
[60] India's Policy on Adoption of Open Source Software for the Government of India and Framework for Adoption of OSS in eGovernance applications; Indonesia's Government Regulation No.71/2019; Japan's Management Standards for Information Security Measures for the Central Government Computer Systems; the Philippines' Republic Act 9184 (Government Procurement Reform Act), particularly in 2003, 2009 and 2016 Implementing Rules and Regulations; and the Republic of Korea's Electronic Government Act, Cryptographic Module Testing and Validation Guidelines, Cryptographic Module Validation Standards.
[61] Republic Act 9184 (Government Procurement Reform Act).

5.3. Trade policies pertaining to ICT products

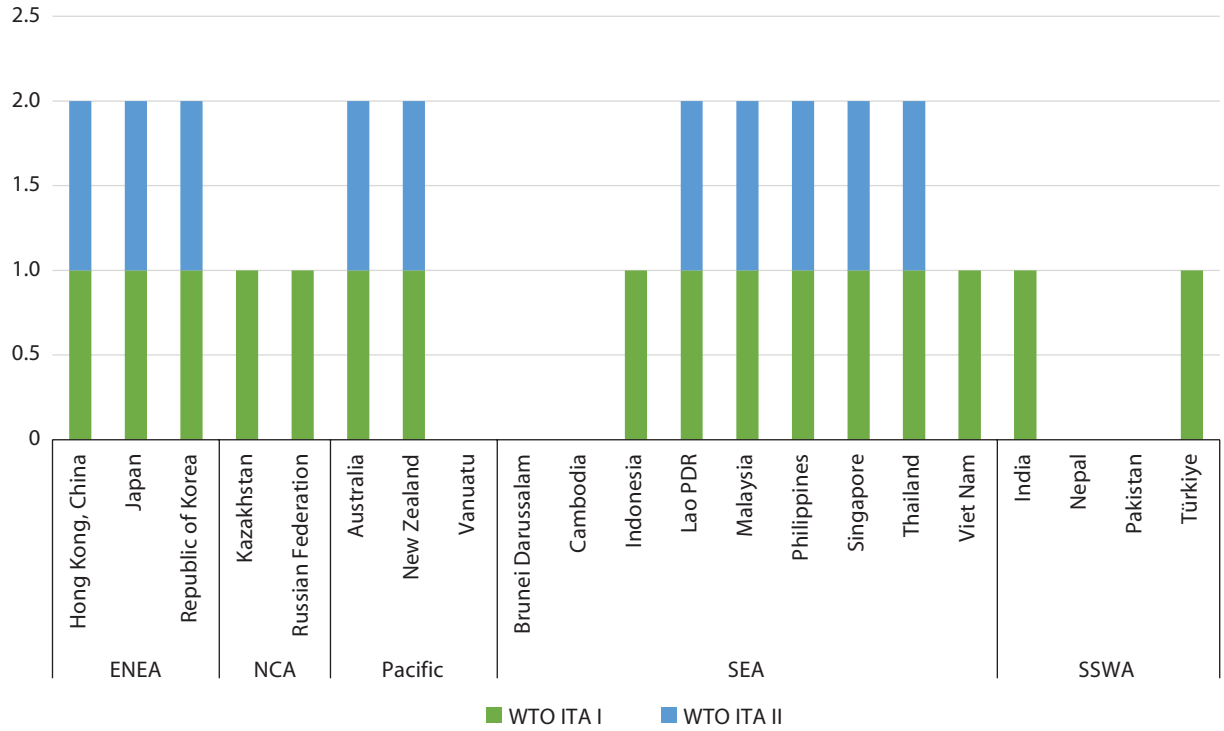
ICT products are vital for the digital economy. Reducing trade barriers on these products fosters digital connectivity and productivity. Trade restrictions can hinder the use of digital infrastructure, making it essential to develop affordable and accessible ICT products alongside telecommunication services. This ensures that users can fully utilize these services with the necessary devices and equipment.

According to ESCAP, ECA and ECLAC (2023), Asia-Pacific economies have low tariffs and non-tariff measures on ICT products. The average Asia-Pacific RDTII scores, especially for tariffs, are also lower than those of the African and the Latin American and the Caribbean regions. These low scores indicate that the Asia-Pacific region's trade policies have been effective in reducing the overall burden on businesses and end-users when it comes to accessing ICT products.

5.3.1. Tariff barriers

The WTO Information Technology Agreement (ITA) promotes tariff liberalization in ICT goods.[62] Products listed in ITA (I and II) encompass roughly 97 per cent of global trade in ICT products (WTO, 2017).[63] Although many Asia-Pacific economies have yet to participate in ITA or its expanded version (figure 5.7), several have reduced ICT goods tariffs through regional trade agreements, achieving significant zero-duty tariff line coverage (ESCAP, ECA and ECLAC, 2023).

Figure 5.7
Asia-Pacific economies in ITA I and ITA II, 2023



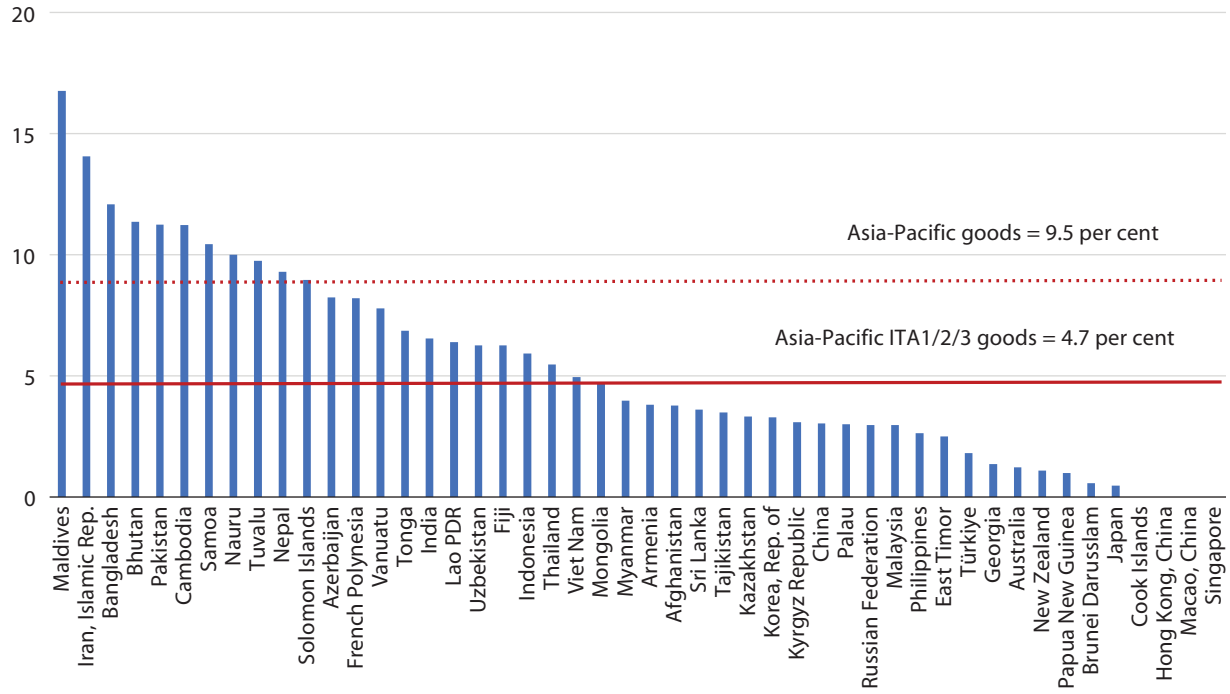
Source: ESCAP compilation based on ESCAP RDTII. Available at https://dtri.uneca.org. Accessed in December 2023.

[62] ITA I, established in 1996, requires members to eliminate customs duties on a wide range of ICT products, including computers, telecommunication equipment, semiconductors, software, as well as most of the parts and accessories of these products. In 2015, ITA II expanded coverage by removing tariffs on 201 additional items. For the lists of ITA II and ITA II, see WTO (1996; 2015), respectively.
[63] The ITA III list was proposed by the Innovation Technology and Innovation Foundation (ITIF). The list includes an additional 250 ICT products, see Ezell and Dascoli (2021).

Consequently, the Asia-Pacific region generally has low average tariffs on ICT goods. In 2022, the average effectively applied tariff was 9.5 per cent, while for WTO ITA-listed goods, it was 4.7 per cent (figure 5.8) (ESCAP, UNCTAD and UNIDO, 2023). The region, however, displays considerable diversity in ICT tariffs, ranging from 0 per cent (Cook Islands; Hong Kong; China; Macao; China; and Singapore) to about 17 per cent (Maldives). Furthermore, such countries as Brunei Darussalam, Cambodia, the Islamic Republic of Iran, Maldives and Tuvalu have higher average ITA product tariffs than their average total goods tariffs.

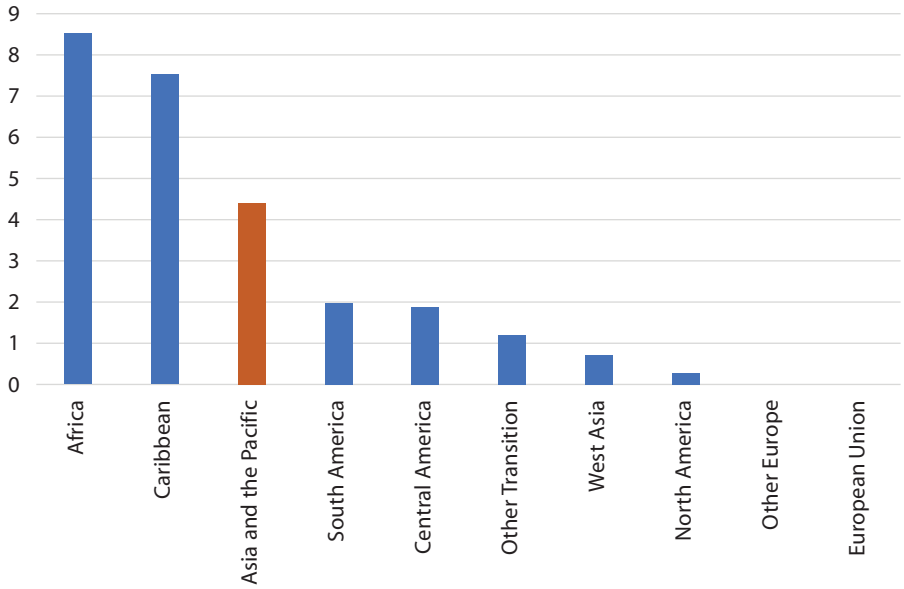
Moreover, the intra-Asia-Pacific tariff rate for ITA is approximately 4.5 per cent, higher than intraregional tariffs in all other regions except for Africa and Latin America and the Caribbean (figure 5.9). This underscores the potential benefits of regional cooperation to remove tariff barriers on ICT goods.

Figure 5.8
Average effectively applied tariffs on ICT goods by Asia-Pacific economies, 2022
(Percentage)



Source: ESCAP compilation using TRAINS data, downloaded from the World Integrated Trade Solutions website. Available at wits.worldbank.org. Accessed on 30 April 2023.
Note: The ICT goods are products included in the ITA I, II, III lists, which are available from the annex of WTO (1996; 2015), and Ezell and Dascoli (2021), respectively.

Figure 5.9
Intraregional effectively applied tariffs on ICT goods, by region, 2022



Source: ESCAP compilation using TRAINS data. Available at wits.worldbank.org. Accessed on 30 April 2023.
Note: The ICT goods are products included in the ITA I, II, III lists; they are available from the annex of WTO (1996; 2015), and Ezell and Dascoli (2021), respectively.

5.3.2. Non-tariff measures

ICT products are extensively subject to non-tariff measures (NTMs), such as licensing, certification and labelling requirements for such products as smart televisions and mobile phones. Electrical products must comply with domestic standards related to radio transmissions, electromagnetic interference (EMI) and electromagnetic compatibility (EMC).[64] These non-tariff measures are implemented for various reasons, such as ensuring product safety, protecting consumer interests and addressing environmental concerns. However, they can also lead to added complexities and increased costs for businesses engaged in the trade of ICT products. This is particularly true when the setting of NTMs lacks transparency or deviates from internationally accepted technical standards (ESCAP, UNCTAD and UNIDO, 2023).[65]

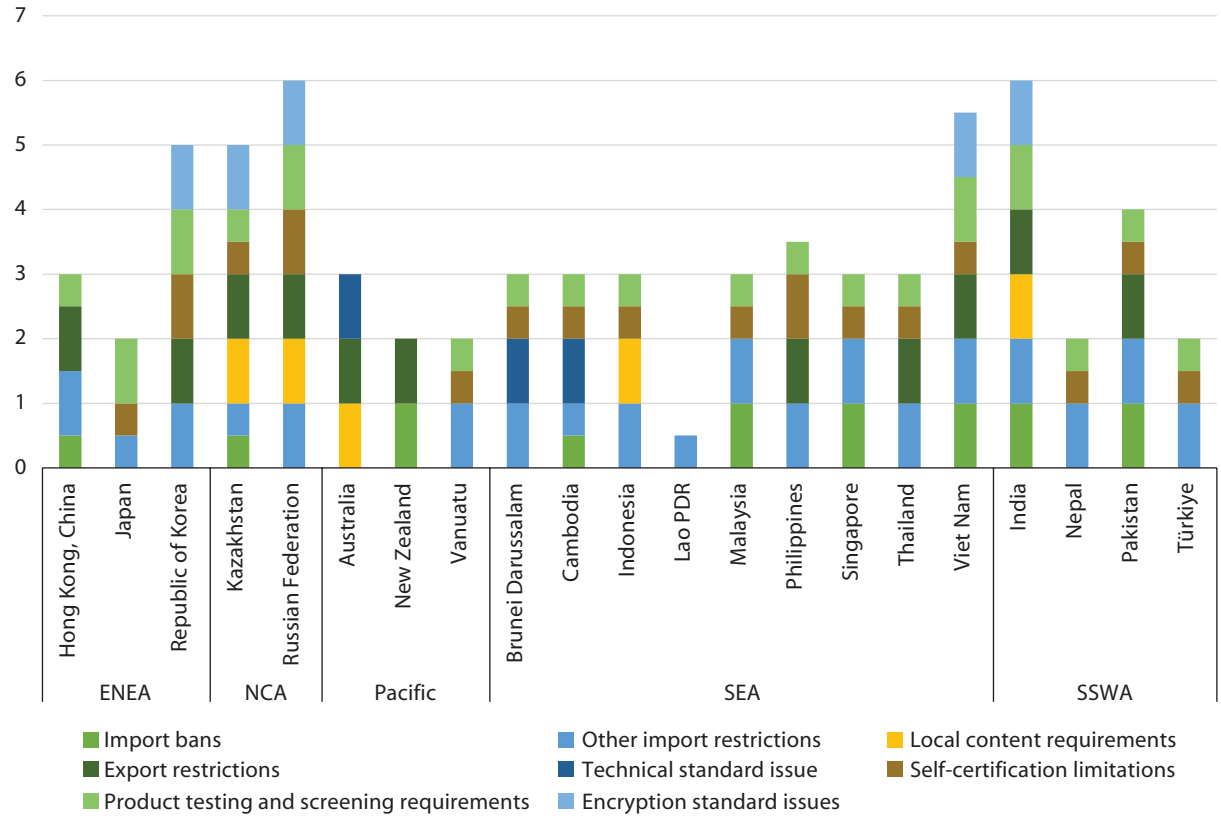
In the 21 Asia-Pacific sample economies, technical standards and testing requirements generally follow good practices (figure 5.10). Most allow foreign businesses to participate in public consultations for technical standard-setting bodies. Many of these economies accept testing results from recognized foreign certifications or accredited foreign laboratories for ICT products, streamlining the process of bringing products to market and reducing the burden on businesses by avoiding redundant testing.

In most of the sample economies, foreign businesses are not permitted to submit self-declarations through supplier declaration of conformity for imported ICT products. However, the economies accept third party certification from conformity assessment bodies (CABs) in economies with mutual recognition arrangements. However, in certain economies with extensive certification processes, foreign suppliers are required to undergo mandatory certification and local laboratory testing. This adds challenges and costs for businesses importing ICT products due to

[64] The EMC testing measures determine whether electrical devices can function in the environment without interfering with surrounding equipment by emitting radiation, while EMI testing gauges whether electrical products can function in the presence of a certain amount of electromagnetic interference. Different requirements and interpretations of the definition of EMC and EMI in the United States and the European Union could cause confusion when it comes to testing (Hayes, 2021; ESCAP, ECA and ECLAC, 2022).
[65] In some cases, these measures can be perceived as protectionist, limiting market access and creating inefficiencies in the global market (UNCTAD and WTO, 2019).

complex regulatory environments and potential repetitive testing processes. Local content requirements and import bans are less common, but when they occur, they can potentially increase costs and limit consumer choice. Export restrictions, including bans, licences and pre-approval requirements, are imposed in less than half of the 21 sample economies, generally targeting dual-use products (electronic products potentially fit for military use) to control sensitive technology dissemination and maintain national security.

Figure 5.10
Non-tariff measures applied on ICT products by Asia-Pacific economies, 2023



Source: ESCAP compilation based on ESCAP RDTII. Available at https://dtri.uneca.org. Accessed in December 2023.
Note: For space considerations, the following abbreviations are used: ENEA = East and North-East Asia; NCA = North and Central Asia; SEA = South-East Asia; and SSWA = South and South-West Asia.

5.4. Conclusion

This chapter provided an overview of digital trade policies and regulations that influence the costs and accessibility of digital infrastructure across 21 Asia-Pacific economies, as outlined in the ESCAP Regional Digital Trade Integration (RDTII) Database. It highlights the critical role of trade and investment policies, alongside regional cooperation efforts, in shaping the telecommunications infrastructure and services, as well as the ICT products sector.

While a significant shift towards trade and investment liberalization in the telecom and ICT sectors is observed across Asia-Pacific economies, the substantial presence of State monopolies and varied regulatory frameworks leads to elevated digital connectivity costs and stifled competition. The absence of effective telecom market competition risks compromising the quality of digital infrastructure and its inclusive accessibility.

Moreover, analysing data from the ESCAP RDTII Database outlines the diverse trade and investment policies sculpting the competitive landscape in the telecom sector. This chapter illustrates how

domestic regulations and competition policies are woven into broader global and regional trade and cooperation frameworks. Specifically, it highlights the critical importance of aligning with the WTO Telecommunications Services Reference Paper and leveraging regional trade agreements to foster regulatory coherence, interoperability and dispute resolution within the telecommunications services. While numerous trade agreements include telecommunications chapters, the extent of their commitments greatly varies. Notably, except for the CPTPP, RCEP and North-South agreements, the obligations tend to be vague and more limited in scope.

Moreover, the chapter underscores the need to lower trade barriers on ICT equipment and services to make digital devices needed for digital connectivity more accessible and affordable. Although there has been a general trend towards reducing tariff barriers, substantial room for enhancement still exists in the area of non-tariff measures. Efforts should be focused on addressing the diverse regulations and standards, including licensing, certification and labelling requirements. Moreover, it is important to simplify the intricate certification processes for imported ICT products and ensure domestic standards align with international ones.

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CHAPTER 6

Regulatory barriers to implementing digital health interventions

Chapter 6

Regulatory barriers to implementing digital health interventions[66]

6.1. Introduction

Digital health (DH) expands electronic health (eHealth) and refers to the development and use of digital technologies including smart devices, artificial intelligence (AI), big data, and robotics to enhance health services and improve outcomes. The integration of digital technology into health-care systems offers significant opportunities to enhance health-care services in hard-to-reach regions and bring about health-care cost savings.

However, the implementation of digital health initiatives in low- and middle-income countries and, particularly, their long-term sustainability are frequently hindered by a set of common challenges (Al Meslamani, 2023; Kaboré and others, 2022; Leslie and others, 2023). These obstacles encompass technical issues, such as network connectivity and the reliability of power supply, which are common in remote areas with limited infrastructure (Al Meslamani, 2023; Ittefaq and Iqbal, 2018; Macariola and others, 2021; Parajuli and others, 2022; Zharima, Griffiths and Goudge, 2023). Policy-related challenges originating from political instability and insufficient government support, lack of sustainability of programmes once donor support diminishes, financial constraints and limited IT operational skills and literacy among stakeholders (health-care professionals, administrators and patients) create additional hurdles. Independent of the level of economic development, persuading both health-care providers and patients to adopt digital health solutions and establish trust between health-care professionals and patients in virtual consultations are also common concerns.

The rapid growth of digital health interventions demands the parallel establishment of strong regulatory frameworks that facilitate responsible and secure utilization of digital technologies for prevention, diagnostics and therapeutics. These frameworks must ensure that digital health interventions are ethically, safely and reliably deployed while promoting equity and sustainability. However, crafting regulatory frameworks that harmonize these objectives while fostering digital health innovation is a complex balancing task. Beyond the need for ensuring the free, secure and safe handling of personal health data, various other aspects within regulatory frameworks can become significant barriers to the effective implementation and adoption of digital health solutions.

6.2. Regulatory barriers to digital health interventions

Regulatory frameworks can pose obstacles to the implementation and utilization of digital health interventions through various mechanisms. Digital health interventions differ from traditional medical devices and drug therapies, requiring fit-for-purpose regulations that do not necessarily apply to conventional health services and solutions. Technological advancements often outpace regulatory bodies, resulting in outdated guidelines and legal ambiguities. In many developing countries, there is either a lack of specific regulations for digital health solutions, or existing regulations lack the necessary comprehensiveness, clarity and consistency (Al Meslamani, 2023; Jain, 2023; Parajuli and others, 2022; Parums, 2021; Zhong, Kirwan and Duan, 2013). This ambiguity pertains to what qualifies as a digital health intervention, software, mobile application, or

[66] The initial version of this paper was published as: Antonio Postigo (2023). "Regulatory Barriers in Implementing Digital Health Interventions", ARTNeT Working Paper Series No. 231, December 2023, Bangkok, ESCAP.

device, as well as the necessity for regulation and the predictability of its implementation. Fragmented regulations in many developing countries also hinder the effective use of digital health solutions and potentially create health risks. For example, in several ESCAP countries (e.g. Bangladesh and India) have multiple organizations regulating digital health with overlapping responsibilities that lead to inefficiencies (Ahmed and others, 2023; Al Meslamani, 2023; Chandwani and Dwivedi, 2015; Hoque, Mazmum and Bao, 2014; Jain, 2023; Merten, Roth and Allaudin, 2020; Parajuli and others, 2022; Parums, 2021; Patel and others, 2021). While ASEAN countries are making strides in removing regulatory obstacles, the absence of a comprehensive digital health policy framework, which includes data protection and considerations in clinical, ethical, legal and operational domains, hinders the adoption and effective use of digital health solutions (Cascini and others, 2023; Macariola and others, 2021; Merten, Roth and Allaudin, 2020; Resilience Development Initiative, 2023). According to the Global Digital Health Index, several ASEAN States are trailing behind in establishing and consistently enforcing telemedicine regulations. Stringent or unclear regulations, which place the onus of determining compliance on the stakeholders developing or adopting digital interventions, can delay or impede innovation and/or inflate the costs of new digital solutions. Consequently, during the COVID-19 pandemic, some countries eased or eliminated regulatory barriers to the adoption of digital services across various sectors, notably in health care (Parums, 2021). Given that digital health interventions can potentially transcend national borders, countries should address not only challenges related to technical compatibility and interoperability but also establish consistent and predictable regional regulatory frameworks (bilateral, regional and global) for cross-border digital health interventions.

In certain instances, Governments have incorporated IT into their public health services and overseen the collection and management of personal health data. However, efforts to guide or oversee the private sector development and/or implementation of digital health solutions have been less proactive. Weak or absent regulations concerning insurance coverage for telemedicine and digital health services can put these services financially out of reach for many individuals. For example, in Bangladesh digital health regulations delineate the roles and responsibilities of government agencies, but regulatory gaps persist regarding the types of services a company can offer, the qualifications required for health professionals offering advice, company ownership and pricing policies. Interestingly, while regulators in Bangladesh have addressed these issues in the context of digital financial services, similar regulations are still lagging in the realm of digital health.

Innovations in digital health technology necessitate innovative and risk-based approaches in regulation and policymaking that can, in turn, foster continued innovation (Al Meslamani, 2023; Parums, 2021). Conventional methods for assessing and authorizing medical devices are inadequate when dealing with digital health solutions that involve ongoing adjustments of devices and software. As used in other regulatory realms, regulatory sandboxes can help balance robust regulation of digital health interventions and health professionals with the promotion of technology innovation (Leslie and others, 2023) The incorporation of new digital health solutions into health-care systems can be tested in limited pilot schemes using regulatory sandboxes before being implemented more widely. Some countries have introduced pre-certification schemes to evaluate and oversee digital health software and allow faster regulatory review and market entry. National regulations for digital health devices and software should safeguard each country's autonomy to oversee the integration of digital health solutions into their health-care systems. However, inconsistencies in approval and regulatory systems can create non-technical barriers and deter innovation and the adoption of new digital solutions by health professionals and patients. The International Medical Device Regulators Forum encompasses medical device regulators in Australia, Brazil, Canada, China, European Union, Japan, Russian Federation, Singapore and the United States; it has issued recommendations for international regulation of digital health solutions, which proved useful during the COVID-19 pandemic (Parums, 2021).

The health-care service landscape has rapidly evolved, particularly during the COVID-19 pandemic, with the widespread adoption of virtual care and telemedicine services. This transformation has ushered in new challenges, potential risks and disparities in health-care delivery. In virtually all countries, health-care providers are subject to rigorous regulation, defining required professional competencies, registration and/or licensure

requirements, and practice standards for virtual health care (Leslie and others, 2023). These standards must evolve with technology, requiring health-care regulatory authorities to continually monitor and adapt them. This proactive and continuous regulatory approach is essential to ensure safety, quality, equitable access and affordability in virtual health care. Regulation should also address those aspects that are particularly salient in digital health interventions, such as privacy, security and confidentiality. Naturally, the establishment of robust regulatory frameworks designed to safeguard the public from professional negligence, unethical behaviour and incompetence in virtual health care is just the first step. Health authorities must create systems to actively and efficiently monitor and enforce those standards.

Regulation of professional practice has been often ideologized and viewed by some as barriers to free market competition and driven by the private interests of the providers of those services rather than the public good (Leslie and others, 2023; Parums, 2021). In many countries, the COVID-19 pandemic prompted the issuance of waivers on certain health-care provider regulations, expanding access to health care. As in most cases this occurred without negative impacts on safety or effectiveness, which led some to question the necessity of many of these regulations in the first place. However, regulators must escape such ideological debates and regulate health-care providers to ensure safe and effective health care, while avoiding the creation of barriers to equity in health-care access and use.

In countries with multiple jurisdictions overseeing health-care provision, subnational regulation can allow each local authority to establish its own standards according to its specific local conditions and needs. Digital technologies facilitate cross-jurisdictional health-care practice, but requirements for subnational registration and licensure can create impediments to free competition. Once again, in response to the increased and geographically diverse demands for virtual health care during the COVID-19 pandemic, some counties temporarily eased or eliminated the need for multiple subnational licensures and established regulatory consortiums and compacts for cross-jurisdictional virtual health-care services (Parums, 2021).

In the realm of digital health, varying regulations across jurisdictions pose challenges to data protection, privacy and health-care practices. Distinct requirements in different legal systems further complicate cross-jurisdictional (within and between countries) data-sharing, especially concerning breach notification and liability determination in cases of disputes or malpractice events. Legal responsibility may differ based on the location of health-care providers, patients and where digital health services are accessed. Licensing health-care professionals involves navigating diverse legal requirements. The ethical dimensions of digital health, such as obtaining consent for data-sharing and respecting patient privacy, require thoughtful consideration that accommodates cultural and legal disparities across subnational or national jurisdictions. Protecting patient rights, encompassing access to health information and control over its use, is a fundamental aspect of both cross-jurisdictional and cross-border digital health care. Addressing these complexities calls for policymakers to develop and regularly update regulations specifically tailored to the challenges of cross-jurisdictional digital health. This involves creating frameworks for data governance, liability and patient rights that can be consistently applied across different legal systems at national and subnational levels. International collaboration is imperative in the realm of cross-jurisdictional health care in digital health to establish shared standards, guidelines and agreements. Harmonizing legal frameworks is essential in facilitating smoother interactions and diminishing legal uncertainties in the global landscape of digital health.

6.3. Conclusion

The transformative potential of digital health lies in its ability to enhance healthcare delivery, reduce costs, and increase access, particularly in underserved regions. However, this potential remains constrained by significant regulatory barriers. Fragmented legal frameworks, inconsistent licensing practices, and inadequate data governance are among the primary obstacles limiting the widespread adoption of digital health technologies. These challenges are compounded by underdeveloped interoperability standards and limited cross-border regulatory alignment, creating uncertainty for providers and users alike.

A critical priority is the development of comprehensive and fit-for-purpose digital health regulations that address the unique needs of this dynamic sector. Traditional regulatory approaches, often designed for physical healthcare delivery, are ill-suited to accommodate the rapid evolution of digital health tools and services. Policymakers must establish clear guidelines for licensing and certification while ensuring that new frameworks promote innovation without compromising patient safety. For instance, pre-certification schemes for digital health software can streamline approval processes, allowing for faster deployment of new technologies.

Equally important is the harmonization of cross-border regulations to facilitate interoperability and trust in digital health systems. International frameworks can serve as models for creating consistent standards across jurisdictions. These frameworks must be complemented by robust policies for data privacy and security, ensuring that patients' sensitive information is protected, particularly in contexts involving cross-border data exchanges. Addressing data breaches and liability issues requires clear rules on breach notifications and accountability mechanisms.

Innovation in digital health can be further supported through the establishment of regulatory sandboxes, which allow developers to test new technologies in controlled environments. This approach provides a balance between fostering innovation and maintaining high standards of safety and efficacy. Simultaneously, public-private partnerships can play a pivotal role in scaling digital health solutions. Incentives such as grants and tax breaks can encourage private sector investment, particularly in regions with limited resources and infrastructure.

Capacity building is another essential component of addressing regulatory barriers. Healthcare providers, regulators, and other stakeholders must be equipped with the technical knowledge and operational skills necessary to navigate the digital health landscape. Investments in digital infrastructure, particularly in rural and remote areas, are critical to ensure that the benefits of digital health reach all segments of the population.

In conclusion, the chapter emphasizes that addressing these regulatory barriers is essential to unlocking the full potential of digital health technologies. By fostering innovation, harmonizing regulations, and investing in capacity building, policymakers can create an enabling environment for digital health to thrive. This harmonized approach ensures that digital health interventions deliver equitable and sustainable benefits across all regions and populations.

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