

Output Report on ITU-D Question 4/1 **Economic aspects of national telecommunications/ICTs**

Study period 2022-2025



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Executive summary

i. Introduction

Fast-paced development of telecommunication and information and communication technologies (ICTs) has been facilitated by the transition from traditional switched/voice telecommunication networks to digital networks. The digital economy was generated through the pervasive digital transformation process that resulted from the mass-integration of ICTs across traditional economic sectors such as medicine, agriculture, education, and energy. Alongside the development of the digital economy, consumer needs have also evolved, and to such an extent that simply providing Internet access, is no longer sufficient to fulfil the goal of making telecommunication services universally available. For this reason, Member States need to establish an enabling environment that not only provides accessibility but also ensures the key issue of affordability.

The World Telecommunication Development Conference (WTDC) which was held in Kigali, Republic of Rwanda, in 2022, confirmed the need for developing countries to continue studies related to the economic aspects of national telecommunications/ICTs, including affordability, and set several additional related topics for study, including:

- Topic 1: New charging methods (or models, if applicable) for services provided over next-generation networks (NGN), including methods for determining the costs of wholesale services.
- Topic 2: The impact of infrastructure-sharing (local loop unbundling, tower companies, etc.) on investment costs, provision of telecommunication/ICT services, competition and prices to consumers – case studies with quantitative analysis.
- Topic 3: Consumer price evolution and impact on ICT service usage, innovation, investment and operator revenues.
- Topic 4: Trends in the development of virtual mobile operators and their regulatory framework.
- Topic 5: Impact of new converging ICTs on cost-modelling strategies traditionally carried out by stakeholders constituting the ICT networked value chain (e.g. telecom operators, over-the-top, digital service providers, etc.).
- Topic 6: The role and impact on achieving the SDGs, of new types and modes of investment in telecommunications/ICTs, e.g. blended investment and crowdfunding.
- Topic 7: Analysis of case studies on the economic contribution of digital telecommunication/ICT technologies and services to the national economy.
- Topic 8: Framework for establishing the contribution of telecommunications/ICTs to a country's gross domestic product (GDP).
- Topic 9: Economic incentives and mechanisms for bridging the digital divide.
- Topic 10: Analysis of the economic impact of the COVID-19 pandemic on telecommunication/ICT markets.
- Topic 11: Analysis of the contribution of telecommunications/ICTs on the economic recovery from the COVID-19 pandemic.
- Topic 12: Economic aspects/implications of digital transformation.

- Topic 13: Impact on innovation and productivity, and other national economic aspects of digital financial inclusion.
- Topic 14: National experiences on the contribution to the national economy in bridging the digital divide, to provide accessible and affordable connectivity.
- Topic 15: Different models of infrastructure sharing, including on commercially negotiated terms.
- Topic 16: The economic value of usage of personal data.

Topics 1-4 set by WTDC-17 are considered in the Final Report on Question 4/1 for the ITU-D study period 2018 2021¹, which was revised during the study period 2022-2025². This report is based on the materials from the topics selected by the ITU-D Study Group 1 meeting in 2023 and finalized at the ITU-D Study Group 1 meeting in 2024. Selection of topics and approval were based upon the available contributions from ITU-D Membership. The remaining topics will be retained as possible topics for other types of deliverables or for the Final Report of next study period following 2025, and with due consideration of the decisions agreed at WTDC-25.

ii. Studies related to the Question 4/1 Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks

To avoid duplication of effort and in order to consider the results of studies carried out in ITU Radiocommunication Sector (ITU-R) and ITU Telecommunication Standardization Sector (ITU-T), it is necessary to refer to past ITU deliverables related to economic policies:³

ITU-R

- ITU-R Handbook on National Spectrum Management. Geneva, 2015.
<http://www.itu.int/pub/R-HDB-21>
- Report ITU-R SM.2012. Economic aspects of spectrum management. Geneva, 2016.
<http://www.itu.int/pub/R-REP-SM.2012>
- Report ITU-R SM.2404. Regulatory tools to support enhanced shared use of the spectrum. Geneva, 2017.
<https://www.itu.int/pub/R-REP-SM.2404>

ITU-T

- Recommendation ITU-T D.000. Terms and definitions for the D-series Recommendations. Geneva, 2010.
<https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=10437>
- Recommendation ITU-T D.261. Regulatory principles for market definition and identification of operators with significant market power - SMP. Geneva, 2016.
<https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12829>
- Recommendation ITU-T D.263. Costs, charges and competition for mobile financial services (MFSs), Geneva, 2019.
<https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13596>
- Recommendation ITU-T D.264. Shared uses of telecommunication infrastructure as possible methods for enhancing the efficiency of telecommunications, Geneva, 2020.
<https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13918>

¹ <https://www.itu.int/hub/publication/d-stg-sg01-04-2-2021/>

² ITU-D Document <https://www.itu.int/md/D22-SG01-C-0486/> from the Rapporteur for Question 4/1

³ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0254/> from the Rapporteur for Question 4/1

- Recommendation ITU-T D.271. Charging and accounting principles for NGN. Geneva, 2016.
<https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12830>
- ITU-T D Supplement 1. Cost and tariff study method. Geneva, 1988.
<https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=1>
- ITU-T D Supplement 3. Handbook on the methodology for determining costs and establishing national tariffs. Geneva, 1993.
<https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=3662>
- ITU-T D Supplement 4. ITU-T D.263 - Supplement on Principles for increased adoption and use of mobile financial services (MFSs) through effective consumer protection mechanisms. Geneva, 2020.
<https://www.itu.int/itu-t/recommendations/rec.aspx?rec=14239>

iii. Methodology and sources of information for the report on Question 4/1 Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks

The main source of information for ITU-D study group reports is contributions from Member States, ITU-D Sector Members, and Academia (Annex 6 contains the list of received contributions for ITU-D Study period 2022-2025). Such contributions were received by the Telecommunication Development Bureau (BDT) for the meetings of ITU-D Study Group 1 and its rapporteur groups. Furthermore, in the context of some topics of mutual interest, Question 4/1 conducted 2 joint workshops:

- Question 4/1 and Question 5/1 joint workshop on Challenges and opportunities of the use of Universal Service Funds for bridging the digital divide (15 May 2023)⁴;
- Question 4/1 and Question 6/1 joint workshop on personal data usage (17 April 2024)⁵.

The conclusions from these workshops have been taken into account in the development of this report. Moreover Question 4/1 and Question 5/1 produced a joint deliverable as a product of the workshop⁶. Annexes 1 and 2 to this report provide a summary of the main findings of both workshops.

⁴ <https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/joint-session-Q4-1-Q5-1-may23.aspx>

⁵ https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/workshop-personal-data_april24.aspx

⁶ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0333/> from Rapporteur for Q4/1 and co-rapporteurs for Q5/1

Abbreviations

Abbreviation	Term
BDT	ITU Telecommunication Development Bureau
CAGR	compound annual growth rate
GDP	gross domestic product
ITU-D	ITU Development Sector
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunication Standardization Sector
ML	machine learning
MFS	mobile financial services
OECD	Organization for Economic Co-operation and Development
PIMS	personal information management systems
SDG	sustainable development goal
USAID	United States Agency for International Development
WTDC	World Telecommunication Development Conference

Chapter 1 – The role and impact on achieving the SDGs of new types and modes of investment in telecommunications/ICTs

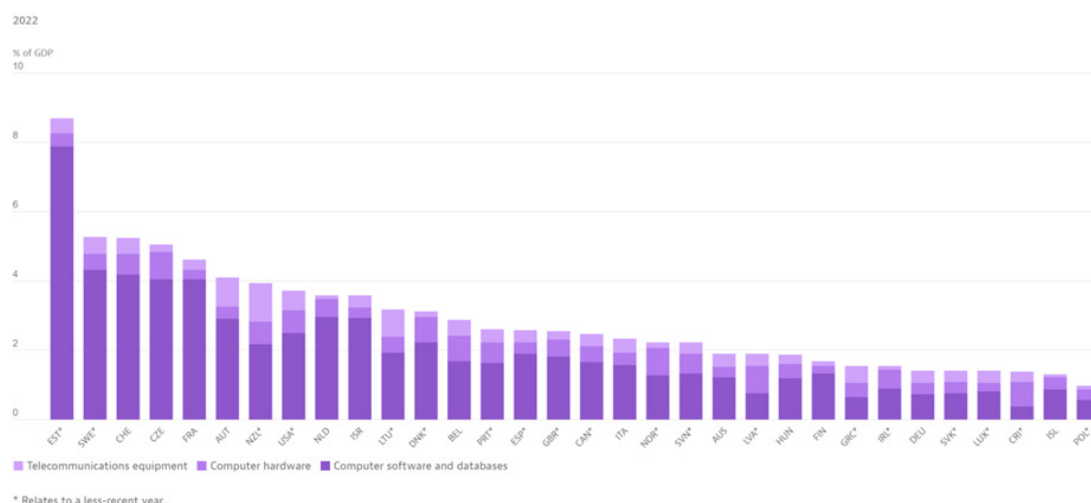
1.1 Value of investment in telecommunications/ICTs

With purchasing power parity (PPP) at USD 575 billion, the United States of America were by large the first ICT investor among Organization for Economic Co-operation and Development (OECD) countries, followed by Japan (USD 158 billion) and France (USD 94 billion)⁷. Computer software and database accounted for a large majority – between half and two-thirds of ICT investments in all OECD countries except in the Republic of Latvia (39%), Costa Rica (28%) and Greece (42%)⁸.

When looking at ICT investment relative to gross domestic product (GDP) (see following exhibit), the landscape across OECD countries is very different. While the United States are still among the top-ten countries for ICT investment relative to GDP (3.72%), this ratio is the highest in the Republic of Estonia (8.69%), Sweden (5.26%), Switzerland (5.25%), Czech Republic (5.06%), France (4.63%), Austria (4.09%) and New Zealand (3.95%)⁹.

Many observers have suggested that an apparent decrease in ICT investment over GDP from a peak in 2000, is a worrying sign of a slowdown in digitalization. A decrease in OECD average investment in ICT over GDP did occur over the period 2000-2022, but this decrease was in

Figure 1.1 – ICT investment as a share of gross domestic product (GDP)



⁷ Value of investments in ICT equipment, software, and databases per OECD country in 2017, or in the latest year available.

⁸ [ICT investment as a share of GDP by OECD country](#) in 2022, or the latest year available, OECD.

⁹ Ibid

average investment in computer hardware of -21 per cent, with a compound annual growth rate (CAGR) of -1.09 per cent, and in telecommunication equipment of -19 per cent, with a CAGR -0.93 per cent. However, during this same period OECD average investment in computer software and databases increased by 67 per cent, with a CAGR at +2.35 per cent.

1.2 Blended investment^{10 11}

The global network for blended finance convergence¹² (including membership from public, private, and philanthropic investors among others) defines blended finance as "the use of catalytic capital from public or philanthropic sources to increase private sector investment in sustainable development."

The importance of blended finance is emphasised by the World Bank¹³ as being a tool to mitigate risk and facilitate financing for private sector-led projects. It is private finance, possibly stimulated by public or philanthropic financial sources, that has a key role to play in the investment required to reach the sustainable development goals (SDGs) set out by the United Nations.

The key requirement of blended finance investments in technology, is to generate impact without compromising the return on investment to private investors. The need for return on investment is essential to ensure that private investors will make investments again in the future, and that the public funding efforts result in a long-term, impactful, and virtuous circle. It is also important that there is no deviation in the investment thesis¹⁴, and that impact criteria, defined when the fund was set-up, are maintained.

A number of contributions¹⁵ report on blended finance projects in the technology sector that combine public funding support with private investors, and that must comply with stringent SDG requirements. In none of the experiences reported, were the investors confronted with a negative return. In some cases, the returns were in the upper decile of the global venture capital industry. This proves that impactful blended finance projects can be generated without negatively affecting economic returns.

While there are various types of blended finance, all blended finance projects contribute to development objectives and are expected to generate a positive financial return. The participation of governments, donors, or other philanthropic actors, improves the overall risk/return profile of a financial facility or project, thereby playing a pivotal role in "crowding in" private investors. Public and private participants in a blended finance transaction will generally expect different types of returns (social returns versus financial returns, for example) and will support the transaction with different types of capital or support. Blended finance leverages a limited budget, to mobilize a higher volume of private capital, to address key development objectives.

¹⁰ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0241/> from United States

¹¹ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0157/> from Axon Partners Group

¹² Convergence webpage <https://www.convergence.finance/>

¹³ <https://ieg.worldbankgroup.org/blog/what-blended-finance-and-how-can-it-help-deliver-successful-high-impact-high-risk-projects>

¹⁴ The investment thesis in a fund means the strategic rationale and guiding principles of the fund investment decisions, which are defined when the fund is set up.

¹⁵ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0157/> from Axon Partners Group; ITU-D Documents <https://www.itu.int/md/D22-SG01-C-0241/> and <https://www.itu.int/md/D22-SG01-C-0423/> from United States.

In order to leverage from public or philanthropic funding, Venture Capital firms (VCs) anchor on leading public or multilateral institutions such as the European Investment Bank (EIB), the European Investment Fund (EIF) or the International Finance Corporation (World Bank private investment arm), as well as with regional or national operators such as the fond-ICO in Spain, Bancoldex in Republic of Colombia or Corporación Andina de Fomento (CAF) in Latin America.

Typically, the leverage of private to public is two to one, i.e. of for each euro of public funding brings two euros of private funding are added on top.

Many VCs in the investment industry have inserted SDG requirements in the investment vehicles, especially in the European Union (EU). In most of the cases, EU Sustainable Finance Disclosure Regulation (SFDR)¹⁶ article 8 (which basically is about recommending and monitoring SDG goals) and article 9¹⁷ (where investments need to commit to particular sustainability goals by contract) are applicable.

The great advantage of blended finance projects for ICT investments, is that this technology is often very much aligned with SDG trends in most categories. Within ICT related investments, the SDGs tend to be concentrated into sustainable cities (SDG 11), sustainable infrastructure (SDG 9), and employment quality and growth (SDG 8). In many other cases of ICT related investment, other SDGs such as those concerned with equality, responsible production, energy efficiency, and education and health are also applicable.

1.3 Online Crowdfunding¹⁸

Online crowdfunding platforms provide a powerful alternative for addressing unfilled credit demand, especially in countries with emerging market economies where microentrepreneurs are often confronted with significant barriers to accessing credit through traditional financial channels.

The crowdfunding platform Kiva is a typical example of an online crowdfunding platform¹⁹ and lends an average USD 2.5 million to micro-projects each week. Online crowdfunding platforms enable online matching possibilities that would not otherwise occur between investors and microbusinesses, and these crowdfunding platforms fill the gaps in financing where other lender investors might be wary of the risks typically associated with micro-projects.

However, a study²⁰ based on a large sample of crowdfunding projects, has found evidence of potential gender bias in some crowdfunding platforms. These findings can be explained through the concept of "latent network capital" based on the connections formed among funders of a given project. By supporting several different projects, a funder shows shared confidence and signals trust, reducing the uncertainty for additional funders and leading to

¹⁶ European Union's Sustainability-related disclosure in the financial services sector https://finance.ec.europa.eu/sustainable-finance/disclosures/sustainability-related-disclosure-financial-services-sector_en

¹⁷ article 9 of the SFDR discusses the absence of harmonised Union rules on sustainability-related disclosures to end investors, and addresses existing obstacles to the functioning of the internal market to enhance the comparability of financial products

¹⁸ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0203/> from Anglia Ruskin University, UK

¹⁹ Kiva webpage <https://www.kiva.org/>

²⁰ Davies, W. E. and Giovannetti, E. (2022). "Latent Network Capital and Gender in Crowdfunding: evidence from the Kiva platform". *Technological Forecasting and Social Change*; Volume 182, September 2022 https://www.sciencedirect.com/science/article/pii/S0040162522003894?utm_campaign=STMJ_AUTH_SERV_PUBLISHED&utm_medium=email&utm_acid=230412792&SIS_ID=&dgcid=STMJ_AUTH_SERV_PUBLISHED&CMX_ID=&utm_in=DM279002&utm_source=AC_

more funding being raised. The study found that for every 10 per cent increase in network capital, projects run by men raised an extra 1.22 per cent in funds. However, this same effect resulted in a 0.89 per cent increase in funds for projects run by women. The incremental effect of additional network capital varies therefore according to the gender of the project proposer, and this may increase existing gender gaps if remedies and balancing actions are not considered. Finding innovative solutions to mitigate this possibly unconscious bias of the "crowd" involved in crowdfunding, would further improve the impact of crowdfunding platforms, which operate as a digital signalling infrastructure to facilitate access to credit.

These biases have potential economic impacts that policy-makers and platforms should consider, especially when considering the economic aspects of telecommunications/ICTs. As demonstrated above, women may face additional barriers in accessing financial resources, which can hinder their ability to participate fully in the digital economy. This bias not only limits the growth potential of women-led businesses but also stifles innovation and economic diversity. Addressing gender and other biases in microfinancing or crowdfunding, policy-makers can enhance digital inclusion and equality and foster a vibrant and diverse ICT sector within a country. This, in turn, can drive broader economic growth and development, benefiting society as a whole.

1.4 Startups²¹

The startup index is an innovation indicator used by the OECD as a measure of business dynamism as "young startup firms drive productivity-enhancing reallocation, as resources flow from inefficient laggards to smaller, dynamic firms. Startups also drive digital innovation because they play an important role in commercialising new technologies."

Startups are at the forefront of ICT economy growth in sectors such as financial technology (fintech), e-commerce, healthcare, e-logistics, renewable energy, e-mobility and food delivery. Fintech startups lead the way in terms of funding and received 54 per cent of all African startup investment funding in 2019. This could indicate high investor trust, which is a significant factor given the important role of this sector in serving the unbanked and financially excluded in Africa.

An electronic payments and commerce platform, Interswitch, in the Federal Republic of Nigeria provides an example of a successful fintech startup²², which received USD 200 million in equity funding in 2019, as well an International Financial Corporation (IFC) investment of USD 10.5 million. These investments came at a time of strong growth in the electronic payments market, and the fintech startup has since helped transform the infrastructure of the banking system in Nigeria, while extending its services to 23 other countries.

1.5 World Bank programmes²³

Digital Development Global Practice (DD GP) is one of a number of World Bank global practices, and is implemented in over a hundred countries worldwide, including fragile and conflict states, helping to create the solid foundations necessary for a thriving digital economy. Working in collaboration with global bodies across the World Bank, such as the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA), a range of

²¹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0119/> from Liberia

²² Interswitch webpage <https://interswitchgroup.com/>

²³ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0070/> from World Bank

products, services, and partnerships are deployed to advance global knowledge around key digital development topics, and to support countries in defining and implementing their vision for digital transformation. Digital Development Global Practices include the provision of:

- financing to governments in the form of grants, loans, guarantees, and risk management products to support digital investment projects and implement policy reforms;
- advisory services including targeted policy guidance, technical assistance, and capacity building;
- knowledge products including data and diagnostics to provide actionable insights at regional, country, and local levels, and research and thought leadership to expand the global knowledge base;
- convening services that bring together key stakeholders, from both public and private sectors, involved in advancing global digital development.

1.6 Country experience and case studies

Blended investment examples^{24 25}

Following on from section 1.2 where the concept of blended investments was introduced, this section presents some examples of blended investment programmes:

- **Access to quality infrastructure:**
 - CSquared²⁶, an Africa-based technology company focused on broadband enabling infrastructure, is establishing a 350-kilometre open-access fibre-optic backbone network in Republic of Liberia to provide transformative network capacity to Internet service providers (ISPs) and mobile network operators. This will bring quality Internet access to as many as one million people in Liberia.
 - Modus Capital²⁷ launched a venture-builder programme for early-stage financial technology (fintech) companies that improve financial well-being across underserved populations in Arab Republic of Egypt, building off the infrastructure and best practices of the Modus venture platform, comprising venture capital funds, venture builders, and a corporate innovation arm.
 - Connectivity Capital²⁸ is launching a sector-specific impact fund across emerging markets in Africa, Asia, and the Latin America region, focused on expanding Internet access, and supporting ISPs in building open and secure digital infrastructure to increase access to affordable broadband.
 - Amerigo²⁹ is a blended public-private investment platform focused on venture capital in the ICT sector in the Latin America region. Amerigo, in a partnership with Axon, Telefónica and Corporación Andina de Fomento, together created Amerigo funds, a network of regional VC funds that invest in early- and growth-stage technology companies across a number of countries in the Latin America region.

²⁴ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0241/> from United States

²⁵ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0157/> from Axon Partners Group

²⁶ CSquared webpage <https://www.csquared.com/>

²⁷ Modus Capital webpage <https://modus.vc/>

²⁸ Connectivity Capital webpage <https://www.connectivitycap.com/>

²⁹ Amerigo funds launched by Axon Partners Group Investment Division <https://axonpartnersgroup.com/investment/>

- **Digital access for community institutions:**
 - Microsoft Airband and Resonance³⁰ are supporting the development and launch of a global incentive fund, managed by Resonance, for ISPs providing digital access to community institutions such as health clinics, schools, and local government facilities.
 - SIMA Funds³¹, an impact investment firm, is launching a new crowdfunding platform "Sow Good Investments"³² that will catalyse United States retail investments into fintech-enabled microfinance institutions and pay-as-you-go (PAYGo) solar financing and distribution companies operating across the sub-Saharan Africa and Southeast Asia regions.
- **Expanding connectivity and Internet usage:**
 - E3 Capital³³ (formerly Energy Access Ventures) seeks to improve access to digitally-enabled services across the sub-Saharan Africa region, with a portion of their fund dedicated to expanding connectivity to drive Internet access and use.
- **Access to digital financial services:**
 - Accion Venture Labs³⁴, the investment arm of Accion International, provides early-stage capital and extensive support to innovative, scalable fintech startups that improve the reach, quality, and affordability of financial services for the underserved.
 - Integra Partners³⁵ seeks to empower technology entrepreneurs to drive access to affordable and responsible financial and digital healthcare services across the South- and Southeast Asia region, with the vision that every person and business in the region should be able to manage and improve their financial and physical health digitally, and at a reasonable cost.
 - Lendable³⁶ offers debt financing for financial technology companies (fintechs) operating in emerging and frontier markets, with a focus on increasing access to credit for small- and medium-sized enterprises and supporting the digital business ecosystem.
- **Digitalization:**
 - Axon Partners Group³⁷ has created funds to support specific regional developments, such as those put together with the European Investment Bank, where the investment thesis was to support innovative industry with a focus on digitization, in the southern Spain region of Andalucía. Axon has also generated funds alongside the European Investment Fund, such as the ISETEC fund, to develop specific strategic markets with a focus on promoting initial public offerings (IPOs) and capitalization processes of technology microcaps (very small publicly traded micro-capitalization companies) in alternative stock markets in Europe, mostly focused on software companies and next-generation networks (NGNs).

³⁰ Airband & Resonance initiative by Microsoft's Corporate Social Responsibility <https://www.microsoft.com/en-us/corporate-responsibility/airband-initiative>

³¹ SIMA Funds webpage <https://simafunds.com/>

³² Sow Good Investments webpage <https://sowgoodinvestment.com/>

³³ E3 Capital webpage <https://e3-cap.com/>

³⁴ Accion Venture Labs webpage <https://www.accion.org/how-we-work/invest/accion-venture-lab>

³⁵ Integra Partners webpage <https://integrapartners.co/>

³⁶ Lendable webpage <https://lendable.io/>

³⁷ Axon Partners Group webpage <https://axonpartnersgroup.com/>

Digital Invest programme^{38 39}

Digital Invest⁴⁰ is another blended investment programme that supports fund managers, project developers, and other private sector partners seeking to accelerate sustainable market growth for Internet service providers (ISPs) and financial technology companies (fintechs), that reduce the digital divide by serving traditionally excluded communities in developing markets. The Digital Invest programme is specifically connected to SDG 17⁴¹: The power of partnerships.

The Digital Invest programme "blends" United States Agency for International Development (USAID) grant capital with new investment fund structures, technical assistance facilities, and infrastructure projects to maximize market impact. While each partnership under Digital Invest utilizes a different structure, typically investment fund managers are leveraging the USAID grant capital to:

- offset structuring and design costs;
- enable first loss protection;
- measure, demonstrate, and expand their social impact; and
- provide technical assistance to portfolio companies.

These partnerships enable portfolio companies to launch or expand their funds (debt or equity funds), attract new investors, and get capital to fintechs and Internet service providers (ISPs) in the market more quickly.

Digital Invest also works with connectivity infrastructure providers who are deploying broadband-enabling projects (such as fibre-optics, towers, Internet exchange points, etc.) which can expand the infrastructure required for ISPs to grow their networks and thus expand meaningful connectivity, advance competition and choice, and bring coverage to underserved areas of emerging market countries.

Another relevant feature of Digital Invest is that it uses a co-creation approach to expand broadband Internet and digital financial services in historically underserved communities. This approach involves collaboration with funding recipients through brainstorming, stakeholder engagement, and customized planning to address barriers in emerging markets. It recognises that the private sector offers important insights into the current barriers in emerging markets, enabling the design of customized blended finance structures that best support the organizations addressing these market-level challenges.

Examples of co-creation include:

- In the case of Broadband Connectivity Partnerships, a co-creation project with local telecom companies identified optimal locations for Internet infrastructure based on underserved areas, commercial viability, technical feasibility, and sustainability. Additionally, strategies were developed to lower Internet costs, making connectivity more affordable for low-income communities.

³⁸ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0070/> from World Bank

³⁹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0423/> from United States

⁴⁰ Digital Invest program, by the USAID <https://www.usaid.gov/digital-development/digital-invest>

⁴¹ <https://www.itu.int/en/mediacentre/backgrounders/Pages/icts-to-achieve-the-united-nations-sustainable-development-goals.aspx>

- With regards to Digital Finance Partnerships, collaboration with investment fund managers helped early-stage fintech companies collect gender and business size data to refine impact strategies. Technical assistance was also provided to improve gender equity, including improved human resources (HR) policies, recruitment processes, and financial products tailored to women's needs.

The programme is implemented by USAID, with core funding from the United States Department of State-led Digital Connectivity and Cybersecurity Partnership (DCCP). USAID supports international development and disaster assistance through partnerships and investments that save lives, reduce poverty, strengthen democratic governance, and help people emerge from humanitarian crises and progress beyond assistance. USAID is leveraging an initial USD 8.45 million in United States government funding to support Digital Invest partners in mobilizing an estimated USD 500 million in investment capital. To date, Digital Invest partners have raised over USD 300 million and have invested in 68 ISPs and fintech companies operating in 40 countries. As a result, these companies have raised an additional USD 1.2 billion in financing from external investors.

The following examples in Republic of Uganda highlight some of the outcomes of the Digital Invest programme:

- The partnership with Roke Telkom, a Ugandan telecommunications company, identified the need to develop new fixed wireless infrastructure and provide affordable wholesale and co-location services for ISPs in 12 under-connected districts. Today in one of those under-connected districts, Yumbe, the Digital Invest-supported infrastructure enables Internet coverage for over 200 000 people. The infrastructure is offered on a wholesale commercial basis so that other ISPs can use it.
- Another partner, Lendable, through its micro, small & medium enterprises (MSME) Fintech Credit Fund, raised USD 110 million to support over 20 fintechs across 15 countries, benefiting 70 000 MSMEs and 800 000 consumers. Numida, one of those fintechs, provides unsecured business loans in Uganda and Republic of Kenya.

Country examples from World Bank investment⁴²

Following on from section 1.5 where World Bank programmes were introduced, this section presents some examples of World Bank programmes in a number of countries:

⁴² ITU-D Document <https://www.itu.int/md/D22-SG01-C-0241/> from United States

- Nearly 40 country-specific digital economy diagnostics reports have been prepared under the Digital Economy for Africa⁴³ (DE4A) initiative. These country diagnostics report on key levers that drive the development of the digital economy, and on the World Bank Group operational engagements in individual countries. Each diagnostics report uses a common methodology based around five pillars: (i) digital infrastructure, (ii) public platforms, (iii) financial services, (iv) skills, and (v) businesses. The latest digital economy country diagnostics reports completed during the last fiscal year (fiscal year 2022) include Republic of Botswana⁴⁴ and Republic of Guinea-Bissau⁴⁵. reports for Republic of Chad, Republic of Mali, Federal Republic of Somalia, Republic of South Sudan, Republic of Djibouti, Republic of Namibia, and Republic of Equatorial Guinea are in progress. The recent World Bank Country Economic Memorandum also includes a specific focus on the digital sector concerning Republic of Cabo Verde⁴⁶, Republic of Côte d'Ivoire⁴⁷, Democratic Republic of Congo⁴⁸, Central African Republic⁴⁹, Egypt⁵⁰ and Ghana⁵¹.
- The first digital economy diagnostic report from the Digital Economy for Latin America and the Caribbean (DE4LAC) initiative focused on Republic of El Salvador⁵² has already been published. The report covers challenges and opportunities to promote widespread access to digital technologies, and provides actionable policy recommendations that would accelerate the pace of the country's digital transformation. Similar reports for Republic of Colombia, Ecuador, and Jamaica are in progress. Also in the region, a lending project preparation was initiated in the Argentine Republic, which will combine last mile access to unconnected communities and regionalization of data centres, to enable security and redundancy of public data infrastructure, and better support the migration of public services.
- In the Middle East and North Africa region, a project in Republic of Djibouti⁵³ aims to ensure that more citizens and businesses have access to quality and affordable Internet, by developing an enabling environment for the gradual introduction of competition and private-sector investment in ICTs, and by fostering the uptake of digital skills and services.
- In the South Asia region, a project in Republic of Maldives⁵⁴ aims to enhance the competitiveness of the broadband market and to leverage digital technologies for climate resilience, while in Federal Democratic Republic of Nepal⁵⁵, work is focused on expanding access to broadband and engaging more people in the digital economy. In addition, a recent report⁵⁶ presents both the opportunities and the challenges to furthering the digital agenda in the region, while a new policy research working paper⁵⁷ focuses on the demand for digital and complementary skills in the Southeast Asia region.

⁴³ Digital Economy for Africa Initiative, by the World Bank <https://www.worldbank.org/en/programs/all-africa-digital-transformation/country-diagnostics>

⁴⁴ <https://openknowledge.worldbank.org/handle/10986/37786>

⁴⁵ <https://openknowledge.worldbank.org/handle/10986/37730>

⁴⁶ <https://thedocs.worldbank.org/en/doc/61714f214ed04bcd6e9623ad0e215897-0400012021/related/Cabo-Verde-Potential-Digital-Dividends-06082022-vf.docx> .

⁴⁷ <https://thedocs.worldbank.org/en/doc/61714f214ed04bcd6e9623ad0e215897-0400012021/related/P1774220ef9ded03e09df002ef08dab4e63.pdf>

⁴⁸ <https://openknowledge.worldbank.org/entities/publication/a07ce227-6995-5f8e-af65-0854e71add3b>

⁴⁹ <https://openknowledge.worldbank.org/handle/10986/37419>

⁵⁰ <https://thedocs.worldbank.org/en/doc/61714f214ed04bcd6e9623ad0e215897-0400012021/related/Egypt-Economic-Monitor-December-2021-The-Far-Reaching-Impact-of-Government-Digitalization.pdf>

⁵¹ <https://thedocs.worldbank.org/en/doc/61714f214ed04bcd6e9623ad0e215897-0400012021/related/Ghana-Rising-Accelerating-Economic-Transformation-and-Creating-Jobs.pdf>

⁵² <https://openknowledge.worldbank.org/handle/10986/37886>

⁵³ <https://www.worldbank.org/en/news/press-release/2021/12/02/new-project-to-support-the-emergence-of-a-digital-economy-in-djibouti>

⁵⁴ <https://projects.worldbank.org/en/projects-operations/project-detail/P177040>

⁵⁵ <https://www.worldbank.org/en/news/press-release/2022/06/16/one-million-people-to-be-connected-to-broadband-as-part-of-world-bank-support-to-nepal-s-digital-transformation>

⁵⁶ <https://openknowledge.worldbank.org/handle/10986/37230>

⁵⁷ <https://openknowledge.worldbank.org/handle/10986/37503>

- The World Bank has also supported the implementation of regulatory reforms to develop digital economy enablers through several Development Policy Loans (DPLs) embedding digital components. In Republic of Senegal⁵⁸, support provided to the Government focuses on introducing a strategic reform to strengthen market competition in the telecommunication sector while establishing a regulatory framework for a consolidated national social protection system. In Republic of the Gambia⁵⁹, support provided to the Government is aimed at liberalizing the telecommunication sector to improve the accessibility and affordability of broadband services across the country. In Burkina Faso⁶⁰, through a DPL, the Government is rolling out a tax administration digitalization reform to promote transparency and accountability in tax processes. In Kingdom of Eswatini⁶¹, support provided for the efforts of the Government aims to strengthen the legal foundations and institutional framework to facilitate electronic transactions, strengthen online consumer protection, and enable digital and contactless payments. In addition, the Government receives support from the World Bank to establish a regulatory framework to increase telecommunication sector competition and to incentivize the private sector in digital infrastructure. In Republic of Angola⁶², the Government revised its regulatory frameworks on infrastructure sharing to increase investment and network coverage, and on payment infrastructure and services to enable digital financial services and promote financial inclusion.
- The Digital Development Partnership (DDP)⁶³, administered by the World Bank Digital Development Global Practice, brings public and private sector partners together to advance digital solutions and accelerate green, resilient, and inclusive digitalization in developing countries. The DDP portfolio supports more than 120 programmes across 80 countries.

Futures By Design EU (North Sea Basin)⁶⁴

Futures By Design (FBD)⁶⁵ is an Interreg North Sea Region project, funded by the European Union, and created to help small and medium-sized enterprises (SMEs) in rural areas of the North Sea region, to use data analysis to innovate, grow and increase their digital skills to enhance their productivity. The Futures By Design project was developed in accordance with the challenges identified by the World Telecommunication Development Conference (2017), and the ITU Plenipotentiary Conference (2018), mandate on "Accelerating digital innovation ecosystems for digital transformation⁶⁶", that "talent is unfulfilled, SMEs are struggling, and slow digital transformation of communities is affecting social conditions and achievement of national ambitions".

The Futures By Design project is focused on enabling SMEs in regions of lower economic success to embark in a project supporting the adoption of a business relevant digital innovation, to grow and increase productivity. SMEs are critical to regional economies and contribute considerably to regional employment, however, their capacity for success can be limited by insufficient access to data, and by the inability to analyse data to drive innovation and obtain improved results.

⁵⁸ <https://projects.worldbank.org/en/projects-operations/project-detail/P172723>

⁵⁹ <https://www.worldbank.org/en/news/press-release/2022/05/10/afw-gambia-secures-20-million-development-policy-grant-to-strengthen-fiscal-resilience>

⁶⁰ <https://projects.worldbank.org/en/projects-operations/project-detail/P173529>

⁶¹ <https://www.worldbank.org/en/news/press-release/2022/05/06/world-bank-approves-75-million-loan-to-support-eswatini-s-economic-recovery-from-covid-19>

⁶² <https://projects.worldbank.org/en/projects-operations/project-detail/P169983>

⁶³ Digital Development Partnership webpage <https://www.digitaldevelopmentpartnership.org/>

⁶⁴ ITU-D Document <https://www.itu.int/md/D18-SG01-C-0413/>

⁶⁵ <https://northsearegion.eu/fbd/>

⁶⁶ <https://www.itu.int/itu-d/sites/innovation/>

The six regions where the FBD project is operating are: Cambridgeshire (United Kingdom), Antwerp (Belgium), Groningen (Kingdom of the Netherlands), Osterholz and North-West Germany (Federal Republic of Germany), Halland (Sweden) and Fryslan (Netherlands). Each of these regions has a sub-region of lower economic success.

Based on innovation tools and direct interaction with more than 250 SMEs in the North Sea region, the FBD project measured progress towards the objective of enabling 150 of these SMEs to grow, innovate, and increase productivity and so take a major step to being better equipped for the digital age, and for future success. After the support provided to the SMEs, the project found that the main positive effect on SMEs ability to compete their process of adoption of data driven innovations was the ability to acquire and assimilate databased knowledge, its *Potential Absorptive Capacity*. The opposite effect is exerted by the ability of a company to transform and exploit data-based knowledge, its Realized Absorptive Capacity, holding back the likelihood of a company project completion.

Chapter 2 – Analysis of case studies on the economic contribution of digital telecommunication/ICT technologies and services to the national economy and country's GDP

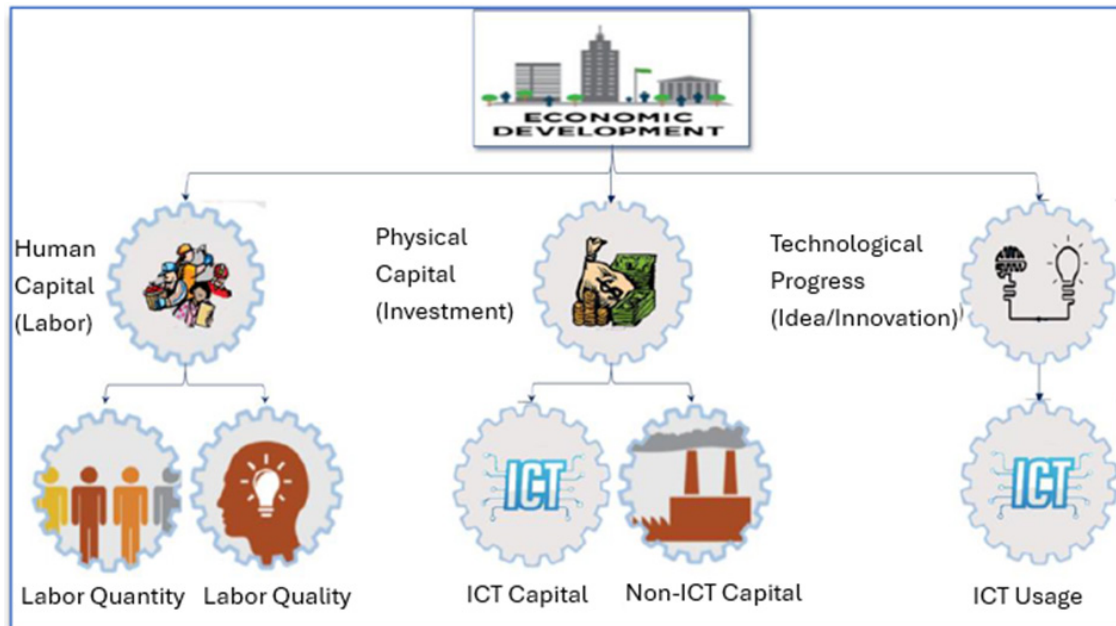
2.1 Global econometric studies on the impact of telecommunications/ICTs on national economy and country's gross domestic product (GDP)

The identification of economic growth determinants is one of the most significant issues examined by economists. From the seminal work of Solow's neoclassical growth model in the 1950s, to a number of recent studies, economists have used an aggregate production function and have assumed that technological progress has a permanent impact on economic growth, that is distinct from human and physical capital. Because information and communication technology (ICT) is considered to be one of the main technological developments in recent decades, economists regularly investigate the relationship between ICT and economic growth.

The econometric model proposes that the real GDP (Y) is a function of labour (L), capital (K), and technological changes (A). Labour measures can be divided into labour quantity and quality, while capital measures can be divided into non-ICT capital, and ICT capital. In a study that investigated how ICT capital and usage affects economic growth ⁶⁷, a modified version of this production function inserts additional measures for ICT usage (S), as one of the technological changes, in order to assess the impact of using ICT services on economic growth. A lag indicator for lagged GDP is also inserted to accommodate for highly persistent series of outputs.

⁶⁷ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0055/> from Egypt

Figure 2.1 – Components of economic development



Accordingly, the following growth equation is used:

$$Y_{it} = f(Y_{i,t-1}, L_{it}, K_{it}, S_{it}, \varepsilon_{it}) \quad (1)$$

This is often represented, after linearizing through a log transformation as:

$$Y_{it} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 L_{it} + \beta_3 K_{it} + \beta_4 S_{it} + \varepsilon_{it} \quad (2)$$

Where:

Y_{it} , L_{it} , K_{it} , and S_{it} represent the growth rates measured by log change in GDP, labour, capital, ICT usage measures and random error respectively for country (i) and year (t).

β_1 , β_2 , β_3 , and β_4 represent output elasticity or regression coefficients for lagged GDP, labour, capital and ICT usage measures respectively.

In order to investigate the impact of ICT capital and usage on economic growth, a multiple linear regression model is applied according to the level of development (developing, emerging, and advanced economies).

A sample of 47 countries is used in this study to determine the impact of ICT on economic growth over a 15-year period (2001-2016) using an econometric panel data analysis. The study provides statistical evidence for the impact of ICT capital and usage on economic growth, but this impact differs between regions and level of development.

The capital provided by ICT assets has a positive and significant impact on economic growth in all regression models including Middle East and North Africa (MENA) and OECD regions as well as different levels of economies. It is observed that the impact of ICT capital on economic growth for emerging and developing economies is higher than its impact in developed countries. Regarding the ICT usage measures, both mobile service subscription and fixed broadband service usages shows positive and significant impact on economic growth. This impact appears only in OECD countries and advanced economies but not in MENA, developing, and emerging economies. It is also observed that the impact of mobile service usage is much higher than the impact of broadband, this might be due to fixed broadband not yet reaching critical mass that could help in accelerating the potential benefits of broadband services and eventually contribute in the economic development in those countries.

On the other hand, as a scientific economic structure analysis method, the input-output method can analyse the impact of the ICT industry on the national economy from the perspective of the economic system. An important modelling method in the field of systems engineering, the input-output method characterizes the interdependence of production and consumption among various sectors of the national economy, as well as within departments or internal organizations of enterprises. It can be used to analyse important basic issues such as macroeconomic proportional relationships and industrial structure. The International Input Output Association (IIOA)⁶⁸, established in 1988, has gradually developed the input-output method into a widely used and relatively scientific economic structure analysis method on a global scale.

For example, China uses the input-output analysis method to analyse the role and development trend of China's ICT services in the national economy⁶⁹, where the driving capacity of China's information transmission, software, and information technology service to upstream industries and downstream industries has been increasing within the years, and the speed of increase ranks first among 39 industries. The study shows that the importance of China's information transmission, software, and information technology service industry in the national economic system is gradually becoming prominent, manifested in three main characteristics: significant improvement in its influence on upstream and downstream industries, stable and healthy development pattern, and enhanced leadership in other industries.

In the United Kingdom⁷⁰, an input-output approach was similarly used in a study focussing on the transmission of ICTs expenditure spillovers across the entire production system. ICT expenditure spillovers can in fact be incorporated as an additional covariate in equation (2), to capture the additional benefits emanating from ICT innovations, not through their direct capital investment, but through their non-market mediated impact, such as for example, the indirect positive impact on ICT skills. In particular, the study proposes metrics to calculate ICT spillovers by leveraging geographic and sectoral proximity to estimate the impacts of ICT investments on innovation outcomes.

Conducting such a study requires the availability of national and/or regional microdata that provides granular information on ICT expenditures, R&D activities, and intra sectoral trade flows. Geographic spillovers require defining geographic areas, based on workforce commuting patterns, so that ICT investments within these areas produce spillovers decaying with the geographic distance between regions. ICTs sectoral spillovers are instead calculated using

⁶⁸ The International Input-Output Association (IIOA) <https://www.iioa.org/>

⁶⁹ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0235/> from People's Republic of China

⁷⁰ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0465/> from Anglia Ruskin University, UK

inter-sectoral trade flows obtained from published input-output tables of a given economy. R&D and ICT expenditures are then weighted according to the intensity of trade linkages between industries to calculate R&D and ICT sectorial spillovers, on innovation activities and growth. Finally, the impact of ICT spillovers can be assessed, using multistage regressions to estimate the likelihood of introducing product, process, and organizational innovations. This nuanced method allows policy-makers to identify critical nodes within innovation ecosystems where ICT investments have the most substantial impact⁷¹.

A recent ITU study⁷² found that broadband has a significant economic impact in all countries, despite with different levels of development. Results show that, for a sample of developed and developing countries, a 10 per cent increase in fixed broadband penetration leads to a 0.8 per cent increase in GDP per capita, and that a 10 per cent increase in mobile broadband leads to a 1.5 per cent increase in GDP per capita. Countries can achieve such gains after reaching a threshold in broadband penetration level (approximately 30 per cent penetration for mobile broadband, while the exact percentage remains unclear for fixed broadband penetration). Additionally, the Organization for Economic Cooperation and Development (OECD) estimates that a 10 per cent increase in broadband penetration can raise labour productivity by 1.5 per cent. The economic contribution of fixed broadband continues to be greater in developed countries than in developing countries, while the impact of mobile broadband is greater in developing countries than in developed countries.

The work referred to above, on global econometric modelling, was continued in two additional ITU reports:

- The Economic impact of broadband and digitization through the COVID-19 pandemic – Econometric modelling⁷³, and
- The impact of digital transformation on the economy – Econometric modelling⁷⁴.

Figures 2.2 and 2.3 show the economic impact of increased broadband penetration across countries with different levels of income.

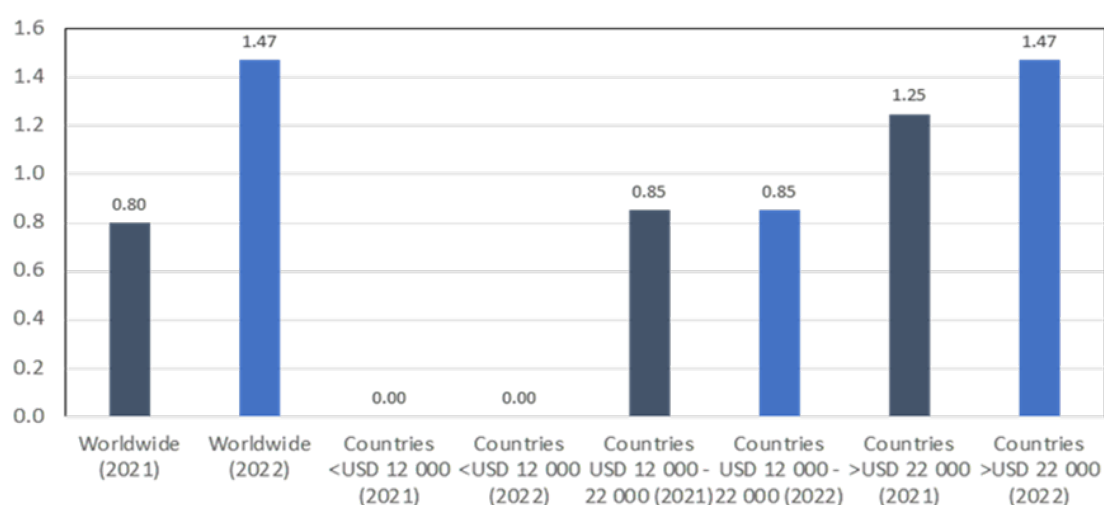
⁷¹ This extends the work done in Giovannetti and Hamoudia (2022), that was focused instead on how to capture the effect of indirect externalities on the diffusion of mobile social networks, by assessing the impact of the degree of diffusion of smartphones on the rate of adoption of mobile social media. See ITU-D Document <https://www.itu.int/md/D22-SG01-C-0465/> from Anglia Ruskin University, UK

⁷² ITU. How broadband, digitalization and ICT regulation impact the global economy: Global econometric modelling. November 2020 https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.BDR-2020-PDF-E.pdf

⁷³ https://www.itu.int/hub/publication/d-pref-ef-cov_eco_impact_b-2021/

⁷⁴ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0324/> from BDT; <https://www.itu.int/hub/publication/d-pref-econ-mod-2025/>

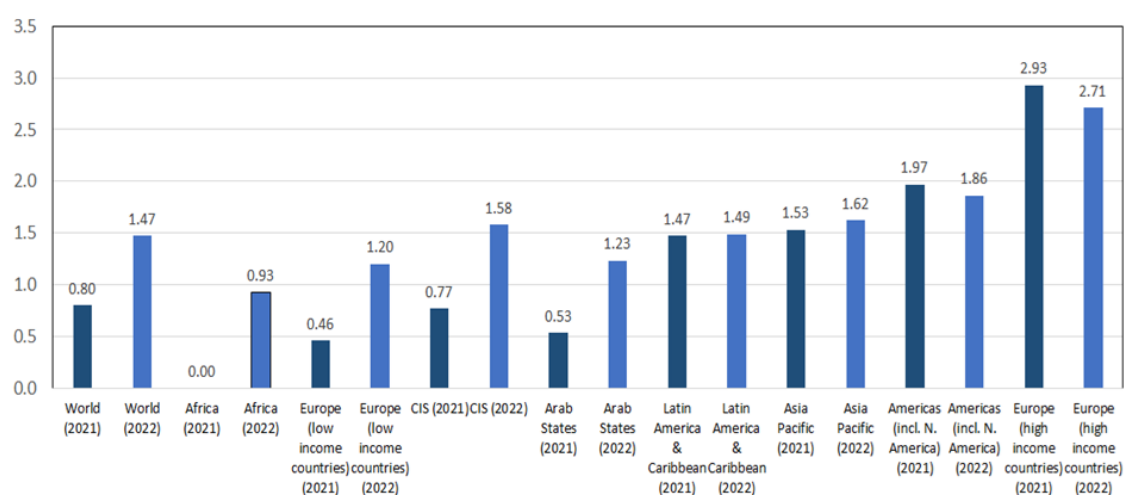
Figure 2.2 – 2021 vs 2022 studies: ICT investment as a share of gross domestic product. GDP growth impact of a 10 per cent increase in fixed broadband penetration (percentages)



2.2 Regional econometric studies

The findings from ITU econometric studies⁷⁵ were corroborated by running the econometric model per world region, as shown in Figure 2.3.

Figure 2.3 – 2021 vs 2022 studies: Regional GDP growth impact of a 10 per cent increase in fixed broadband penetration (percentage)



(Source: ITU; analysis by the authors)

The structural model was applied to all world regions with the 2010-2022 dataset, calculating the effect of a hypothetical 10 per cent increase in fixed broadband penetration on GDP per capita. While the coefficients of impact changed to an extent, the values obtained were all

⁷⁵ <https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Economic-Contribution.aspx>

within the margin of error, and the models yielded results consistent with those generated in the 2021 study:

- **Africa region:** reflecting the growth in fixed broadband adoption that has taken place in Africa in the last two years, the technology has emerged as a contributor to economic growth.
- **Americas region:** driven by the increasing returns to scale, countries across the North America, Latin America and Caribbean regions continue to benefit from the increase in broadband penetration, with a GDP increase of 1.86 per cent (down slightly from 1.97 per cent).
- **Europe region:** the 2021 study determined that an increase of 10 per cent in fixed broadband penetration in high-income countries in this region would yield an increase of approximately 2.93 per cent in GDP per capita. This dropped slightly to 2.71 per cent using the data through 2022. By contrast, for low-income countries in the Europe region in the same period the coefficient increased from 0.46 per cent to 1.20 per cent. This confirms again the increasing returns to scale effect driven by higher broadband penetration. In low-income European countries the coefficient increased from 42.78 per cent in 2019 to 48.29 per cent in 2022.
- **CIS region:** with the 2010-2020 dataset, the model estimated that the CIS region would see an increase of 0.77 per cent in GDP per capita, while in the period ending in 2022 that increased to 1.58 per cent.
- **Asia and Pacific region:** in the time-span ending in 2022, the impact on GDP of broadband adoption increased to 1.62 per cent from 1.53 per cent, which might indicate an increasing return to scale of higher adoption levels.
- **Arab States region:** a similar effect might exist in the case of countries of the Arab States region, although the change in GDP percentage of the impact of broadband adoption which was 0.53 per cent in the period ending in 2021, to 1.23 per cent in the series ending in 2022) might be also due to additional effects that are as yet difficult to interpret.

Economic contribution of Internet economy in Africa⁷⁶

According to the report of the International Finance Corporation and Google⁷⁷, "The Internet economy in Africa has the potential to reach USD 180 billion by 2025, accounting for 5.2 per cent of the continent's GDP. By 2050, the projected potential contribution could reach USD 712 billion, accounting for 8.5 per cent of the continent's GDP."

Implementation of new and emerging technologies in this region will also provide a lot of potential benefits for national economies. A preliminary assessment by Access Partnership estimates that artificial intelligence (AI) applications could support up to USD 136 billion worth of economic benefits for Ghana, Kenya, Nigeria, and Republic of South Africa by 2030, based on current the growth rates and scope of the analysis. To put this in perspective, this figure is higher than the current GDP of Kenya and represents 12.7 per cent of the 2022 GDP for these four economies. This number represents incremental benefits to the four economies (measured in terms of economic benefits such as cost savings or revenue gains) in 2030, in a scenario where the relevant AI applications are fully adopted, compared to a scenario of no AI applications adoption.⁷⁸

⁷⁶ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0119/> from Liberia

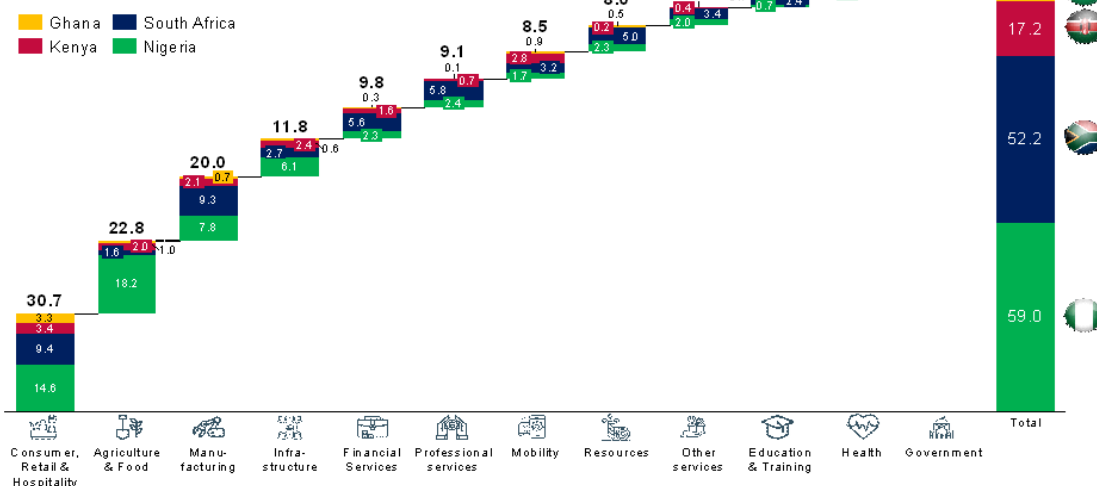
⁷⁷ <https://www.ifc.org/content/dam/ifc/doc/mgrt/e-economy-africa-2020.pdf>

⁷⁸ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0242/> from Access Partnership Limited, UK

Figure 2.4 – Potential annual economic value from AI applications by sector (source: Access Partnership)

Sub-Saharan Africa could gain up to USD136 billion worth of economic benefits from AI in 2030

Potential annual economic value from AI applications, by sector¹
USD billion, 2030



2.3 Country experience and case studies

Socio-economic value of satellite communications⁷⁹

Satellite Internet technology can deliver high-speed broadband to households in unserved or underserved areas. The global socio-economic benefits of satellite broadband for households were estimated to be approximately USD 26 billion in 2022. When the annual socio-economic benefits of household broadband in each region are indexed to the benefits of the baseline year of 2022, such benefits are expected to reach USD 52 billion in 2030. Although in absolute values, the economic benefits are higher in the Americas region, Europe, and CIS due to the greater digitalization of their economies, in relative terms the Asia-Pacific region, together with Africa and the Arab States regions, are set to see the biggest growth in benefits by 2030.

Experience of United States of America⁸⁰

According to a study in 2022, *Recent Trends in U.S. Services Trade*, from the independent, non-partisan United States International Trade Commission (USITC), the global market for mobile telecommunications services, measured according to revenues, was estimated to be approximately USD 1 trillion. Overall, the global market grew by 1.8 per cent during 2020, after experiencing an average annual decline of 1.3 per cent during the period 2016-2019. According to industry research, in 2020, the mobile services industry contributed USD 4.4 trillion, or 5.1 per cent, to global gross domestic product (GDP), and directly supported more than 12 million jobs, while indirectly supporting another 13 million jobs. Global mobile services industry revenue is expected to continue to grow over the next five years, rising at an average annual rate of 2.8 per cent through 2025. Such revenue growth is expected to be driven not only by an expanding subscriber base, which is expected to grow at an average annual rate of 3.2 per cent through 2025, but also by the adoption of higher-margin data services. In the context

⁷⁹ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0108/> from GSOA

⁸⁰ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0102/> from United States

of this global market, the United States GDP is supported by telecommunications services trade. The broader tertiary services sector represented the largest share of the United States economy in 2020. It also supports 81.7 per cent of all private employment, or approximately 92.4 million full-time employees. According to USITC, trade in telecommunications services accounted for 7.0 per cent of United States cross-border exports and 6.5 per cent of cross-border imports.

Experience of China⁸¹

Telecommunication operators in China implemented a number of solutions to promote rural economic development and consequentially improve the impact of ICTs for the whole national economy. Two of these solutions for rural economic development are outlined below:

- The Chongqing municipality in southwest of China, in addition to the city of Chongqing, the region comprises a number of mostly rural areas. Since 2018, China Mobile has built over 9 000 information service centres in the region, forming coverage for offline information services in most villages. This has helped establish 25 smart agriculture pilot applications in nine agricultural production bases, increasing labour productivity by more than 15 per cent and improving the yield efficiency per unit area by over 10 per cent.
- Dabu County in Guangdong Province is the largest pomelo fruit planting base in China, with over 70 000 farmers engaged in pomelo cultivation. China Mobile established a big data platform for pomelo industry public services, aggregating data and information on planting varieties, production quantities, and quality from over 30 000 farmers. This platform facilitated collaboration between farmers and 18 provincial-level large enterprises, streamlining production and sales channels. In 2020, the platform facilitated an average income increase of CNY 2 658 per household in the entire county, and an overall increase in pomelo industry revenue of CNY 223 million.

Experience of Australia⁸²

The Government of Australia "Be Connected" programme, launched in 2017, aims at increasing the confidence, skills, and online safety of people aged over 50 using digital technology. Through the Be Connected programme, participants learn about the basics of digital technology, and about online banking and shopping, accessing government services, and online security when using social media to stay connected with family and community.

Over the period 2017-2028, the Government will invest over AUD 126 million in the Be Connected programme. The annual cost of delivering all elements of the programme is approximately AUD 10 million.

An independent evaluation of the Be Connected programme⁸³ was undertaken by Swinburne University from 2017 to 2020. The evaluation assessed the appropriateness, effectiveness and efficiency of the programme as a national response to the digital inclusion needs of people aged over 50 in Australia.

⁸¹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0221/> from China

⁸² ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0256/> from Australia

⁸³ Evaluation of Be Connected | Department of Social Services, Australian Government dss.gov.au

The results of a social return on investment (SROI) analysis showed significant economic benefits of the model⁸⁴. The social return was found to be significantly higher than the initial investment in the programme with AUD 4.01 created in social value for every AUD 1.0 invested in the programme. This resulted in the Be Connected programme creating an additional AUD 229.5 million in social value.

This added social value is encapsulated in several successful programme outcomes:

- More than 3 000 non-profit organizations were enabled through Be Connected programme inputs to deliver digital skills support.
- Conditions were generated for non-profit organizations to co-invest, contributing at least 30 per cent above the value of grants awarded for digital inclusion work, including among organizations new to this goal.
- Increased digital knowledge and skills among a diverse range of senior participants.
- Increased digital confidence, unlocking further digital skills learning and participation among participants.
- Increased social connection and decreased loneliness, both of which impact significantly on the health and mental wellbeing of older Australians.
- Improved online safety for the population segment most heavily exposed to fraud and scams.
- Digital mentors have created unexpected and significant additional value with network partners recruiting 9 800 digital mentors to provide peer-to-peer learning and support for older Australians (the number of digital mentors has since increased to over 15 500).

Case of Republic of Zambia⁸⁵

A study carried out in Zambia showed that a 10 per cent increase in the mobile penetration rate in a given quarter, will on average lead to an increase in the GDP growth rate of 7.1 per cent in the subsequent quarter. After 2 quarters, the overall impact on GDP is estimated to increase by 8.39 per cent. Similarly, a 10 per cent increase in the Internet penetration rate in a given quarter, will on average lead to an estimated increase of 3 per cent in GDP after 2 quarters. The estimated impact of broadband penetration in the country was slightly above the regional average. The study mentioned that the impact of mobile cellular and mobile Internet penetration on economic activity remains significant, and so there is a need to attain universal access to extend these benefits. However, the measurement of ICT sector economic activity may limit the scope of impact of ICT on an economy given its limitations in demonstrating these benefits in other sectors. The use of ICT satellite accounts would therefore be beneficial in showcasing the increasing activity in the sector⁸⁶.

In 2023, the Government of Zambia introduced a turnover tax on the gig economy (a segment of the digital economy which involves individuals carrying out business through an online platform, and under flexible or temporary conditions, and includes independent contractors or freelancers conducting business through an online platform). This essentially allows individuals providing a service on an online platform, identified as independent contractors, to account for taxes under the turnover tax regime, as opposed to the previously imposed income tax regime.

⁸⁴ Social Return on Investment (SROI): An outcomes-based measurement tool used to measure extra-financial value such as environmental and social value not currently reflected in conventional financial accounts.

⁸⁵ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0300/> from Zambia

⁸⁶ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0301/> from Zambia

By comparing African countries based on the total sum of consumption taxes, meaning value added tax (VAT) and excise duty, on the purchase of ICT services, it was concluded that Zambia strongly deviates from the average total consumption tax of approximately 22.8 per cent, by charging a much higher total consumption tax of 33.5 per cent on ICT services⁸⁷. Based on a 12-year period, the elasticities are estimated as follows - a 10 per cent increase in the effective price for ICT services would lead to a 4.29 per cent drop in the total traffic, an 8.28 per cent drop in subscription, and a 13.5 per cent decline in penetration rates. In another study by GSMA⁸⁸ on mobile taxes in Zambia, it was shown that the gradual reduction of excise duties, regulatory fees and corporate taxes would have a significant impact on the uptake of ICTs in the country, and on the sector contribution to GDP.

⁸⁷ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0301/> from Zambia

⁸⁸ GSMA (2018) Reforming Mobile Sector Taxation in Zambia

Chapter 3 – The economic value of usage of personal data⁸⁹

With the development of artificial intelligence (AI) and the large-scale adoption of machine learning (ML) algorithms, data has become a key economic factor worthy of further analysis. Personal data can help personalise government e-services by tailoring services to individual needs and improving efficiency and user satisfaction. For small businesses, leveraging personal data through digital transformation can enhance customer experiences, drive targeted marketing, and optimise operations. At the same time, given the unique characteristics of data as an economic good (it is replicable at zero cost, is reusable, and is a non-rivalrous good; it can derive value in combination, through algorithms, and with other data, and its value depends heavily on the purpose and context of use⁹⁰), companies might have economic incentives not to share it.

As a result of these features, some players that are integrated throughout the various steps of personal data networked value chains, have an outsized influence compared to other economic sectors⁹¹ and exhibits regional imbalance.⁹² It is, therefore, not surprising that unleashing the economic potential of data is a key policy objective for the European Union (EU),⁹³ which has estimated that the 'data economy' in its 27 Member States will reach EUR 827 billion in 2025.⁹⁴ Other studies estimate that the global economic impact of the data economy could go as high as USD 2.5 trillion by 2025,⁹⁵ and that the annual economic output of AI could exceed USD 13 trillion by 2030.⁹⁶

This chapter focuses on the economic value of personal data, before moving on to the role of data portability for competition in digital platform markets, and concludes with reporting on a number of country cases.

⁸⁹ ITU-D Document <https://www.itu.int/md/D22-SG01.RGO-C-0011/> from Axon Partners Group, Spain

⁹⁰ D. Coyle, S. Diepeveen, J. Wdowin, J. Tennison, and L. Kay. The value of data – policy implications. Bennett Institute for Public Policy, Cambridge, 2020

⁹¹ C. Shapiro and H. R. Varian. Information Rules: A Strategic Guide to the Network Economy. Harvard Business School Press, 2000

⁹² United Nations Conference on Trade and Development UNCTAD. Digital economy report. cross-border data flows and development: For whom the data flow (2021) https://unctad.org/system/files/official-document/der2021_en.pdf

⁹³ European Union, A European Strategy for Data <https://digital-strategy.ec.europa.eu/en/policies/strategy-data#:~:text=The%20European%20strategy%20for%20data,of%20Common%20European%20Data%20Spaces>.

⁹⁴ G. Cattaneo, G. Micheletti, and al. The European Data Market Monitoring Tool. Key Facts and Figures, First Policy Conclusions, Data Landscape and Quantified Stories. Final Study Report. European Commission, 2020

⁹⁵ N. Henke, J. Bughin, and al. The age of analytics: Competing in a Data-driven World. McKinsey Global Institute, 2016

⁹⁶ J. Bughin, J. Seong, J. Manyika, M. Chui, and R. Joshi. Notes from the ai frontier: Modeling the impact of ai on the world economy. McKinsey Global Institute, 2018

3.1 The economic value of personal data

Various valuation methodologies have been proposed for estimating the value of personal data, frequently giving disparate and even contradictory results.⁹⁷ These methodologies include estimates based on market capitalization, the volume of sales or net revenue per individual for highly data-intensive organizations, analysis of prices per unit volume of data or per user, and the cost of potential data breaches. Some economic valuation methodologies quantify the social and economic impact of the cases of use of personal data.⁹⁸ Other valuation methodologies are based on surveys of users who are asked to quantify their willingness to pay for their privacy to be protected.⁹⁹ A review of empirical methodologies is provided by the University of Cambridge - Bennett Institute for Public Policy.¹⁰⁰

The economic value of personal data requires a better understanding of how these data are collected, analysed and integrated into digital business models, as well as an awareness of both its intended and unintended consequences. For example, the consent given to service providers by users to use personal data can sometimes be granted without due attention, even though it can be a key element in shaping competition in the digital markets.

Among the business models found in the data economy, a special case is that of cooperative entities or personal information management systems (PIMS)¹⁰¹. Working within existing laws on the protection of data, these entities aim to empower users to take control of their data, help them to exercise their legal rights, and manage their consent to share personal data with third parties. Similar to funds managing investors' money, they aim to act as data trusts that protect and manage the personal data of their users, allowing consented sharing of this data with third parties, with or without an economic compensation. The main challenges facing these companies, and the technologies that they can use to overcome these challenges, have also been identified in research surveys.

Notwithstanding the difficulties and challenges associated with trading in such a peculiar economic good, a relevant business-to-business (B2B) market for data is already in operation and goes beyond just personal data. A recent study of entities that sell data on the Internet found more than 2 000 data providers and identified 10 different business models.¹⁰² These include data and service providers, marketplaces that are embedded in governance and data management systems (e.g., Snowflake, Carto, Cognite), and data market platforms. Data market platforms include general-purpose platforms (e.g., AWS, Advaneo, Datarade) that aim to trade any kind of data. More recently niche marketplace data and service providers have been developed that target specific industries, such as the automobile industry (e.g., Caruso,

⁹⁷ OECD. Exploring the economics of personal data: A survey of methodologies for measuring monetary value. OECD Digital Economy Papers, 2013 https://www.oecd.org/en/publications/exploring-the-economics-of-personal-data_5k486qtxldmq-en.html

⁹⁸ S. Diepeveen and J. Wdowin. The value of data policy implications report – accompanying literature review. Bennett Institute for Public Policy, Cambridge, 2020

⁹⁹ P. Carrascal, C. Riederer, V. Erramilli, M. Cherubini, and R. de Oliveira. Your browsing behavior for a big mac: Economics of personal information online. In Proc. of WWW'13

¹⁰⁰ D. Coyle, and A. Manley. What is the value of data? A review of empirical methods. Bennett Institute for Public Policy, Cambridge, 2022. <https://www.bennettinstitute.cam.ac.uk/publications/value-of-data/>

¹⁰¹ Midata.coop, a Swiss Health-focused cooperative that offers a secure, user-controlled data platform for storing personal health data (e.g., from wearables, electronic health records). Members decide who can access their data for research. (<https://www.midata.coop>). Also in Spain, Salus Co., a non-profit data cooperative specialising in health data, provides individuals with the tools to control, manage, and donate their data to research institutions. <https://salus.coop>

¹⁰² S. Andrés Azcoitia and N. Laoutaris. A Survey of Data Marketplaces and their Business Models. ACM SIGMOD Record, 51(3), (Sep 2022)

Otonomo), the energy and logistics industries (e.g., Veracity), and the finance industry (Refinitiv, S&P). Others focus on specific data types such as Internet of things (IoT) real-time sensor data (e.g., IOTA, Terbine), or cover data sourcing for specific purposes, such as feeding machine learning (ML) algorithms (e.g., Nokia DM, DefinedCrowd).

This shows a trend towards federated or distributed platforms for exchanging data, which can also leverage the growing capabilities of computing at the edge of the cloud. Through commodifying and specialising data trading, data markets are moving away from integrated, monolithic, siloed data providers, and towards distributed "niche" exchange platforms (e.g., Ocean Protocol, SettleMint), sometimes using blockchain and cryptocurrencies for transactions, and federated learning for local computation (e.g., Nokia DM, Accuratio, Sherpa.ai). In this connection, it is worth noting three high-profile, industry-supported European initiatives for standardizing secure and sovereign data sharing: the International Data Spaces standard¹⁰³, the Gaia-X initiative¹⁰⁴ and the European Distributed Data Infrastructure for Energy (EDDIE)¹⁰⁵.

Once the economic relevance of personal data is recognised, the issue of data pricing becomes of central importance. Various studies, with researchers coming from different disciplines, suggested pricing methods based on auctions, data quality, or quantification of the loss of privacy or information, in relation to different database views.¹⁰⁶ A recent study collected and analysed information on more than 200 000 products offered via 43 different markets and providers of commercial data, to find out what categories are the most popular and valuable, what characteristics define the products that command the highest prices on the market, and which of them are used for pricing the products. Based on the information contained in this data, ML models make it possible to compare products between markets, and study how those characteristics relate to market prices, as a first step towards predicting them and increasing transparency.¹⁰⁷

Often, the value of personal data can be discovered via marketing and advertising on the Internet. Some related research has examined the prices observed in these markets for advertising spaces aimed at different user profiles¹⁰⁸, and tools exist to estimate the value that a user's activity generates for social media.¹⁰⁹

Finally, the ability to precompute the value of personal data helps to avoid the indiscriminate replication of data, that subsequently turns out to be useless and is filtered out. Knowing the expected utility of data allows the buyer to tailor acquisition to its specific needs.¹¹⁰

¹⁰³ <https://internationaldataspaces.org/>

¹⁰⁴ <https://gaia-x.eu/>

¹⁰⁵ <https://eddie.energy/about>

¹⁰⁶ J. Pei. Data pricing - from economics to data science. In Proc. of SIGKDD. ACM, 2020

¹⁰⁷ S. Andrés Azcoitia, C. Iordanou, and N. Laoutaris. Understanding the Price of Data in Commercial Data Marketplaces. IEEE International Conference on Data Engineering 2023

¹⁰⁸ P. Papadopoulos, N. Kourtellis, P. Rodriguez, and N. Laoutaris. If you are not paying for it, you are the product: How much do advertisers pay to reach you? In Proc. ACM IMC'17

¹⁰⁹ J. Cabañas, A. Cuevas, and R. Cuevas. FDVT: Data valuation tool for facebook users. In Proc. of CHI Conf., 2017

¹¹⁰ Cao, H. Truong, T. Truong-Huu, and M. Nguyen. Enabling awareness of quality of training and costs in federated machine learning marketplaces. In Proc. of IEEE/ACM International Conf. on Utility and Cloud Computing, 2022

3.2 Evaluations on the economic value of the usage of personal data

Policy-makers can evaluate aspects of the economic value of personal data usage by considering the following:

- The original data owners may benefit economically from the availability and visibility of their personal data. For example, for a business, being more visible brings significant economic benefits, as this helps by extending its potential customer base, and facilitating trade across digital supply chains, as well as by enabling business-to-business (B2B) exchanges, and presence on different sides of digital trading platforms, for B2C trades.¹¹¹
- Richer and more complex analytics, obtained from the original personal data, may also help in forming digital profiles, whose features can be essential in determining success or failure in digital businesses. An example is that of online crowdfunding. In crowdfunding, the project proposer looking for online funders, publicly displays a digital profile that is often combined with additional publicly visible data. This can include the existing network of funders, or the number of project supporters on social media. All these original and derived project data contribute to signalling about the quality of the project, and add to its social capital¹¹², itself an essential element in determining a project success in raising the necessary funds through crowdfunding platforms.
- Users' data are a key and essential component for the planning, managing and forecasting of new digital infrastructures. For example, the accessing in real time of users' power consumption data, via smart meters, is beneficial for the integration of renewable energies into energy grids. This data enables grids to better match energy demand, to the times when for example, the sun is shining or the wind is blowing, and when the energy supply consequently has a higher renewable energies mix. Digitalization, enables the integration of renewable energies production and usage, allowing the analysis of users' granular level data for regional energy infrastructures. For these reasons, the integration of personal data, and the digitalization of the energy grid are seen as critical steps for delivering the European Union 2030 Climate targets and the Green Energy Transition.¹¹³
- Usage of personal data in exchange for digital services, sometimes done with minimal consent on the part of the users, has created concerns.¹¹⁴ Recently, there have been legislative advances in this regard,¹¹⁵ and warnings have been issued about the unsustainability of the existing digital economics, with some proposing that persons be compensated for the use of their personal data, as a solution to this dilemma.¹¹⁶ Some economists assess that the value of the wealth to be transferred from companies to

¹¹¹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0203/> from Anglia Ruskin University, UK, summarising results Giovannetti, E., & Siciliani, P. (2023). *Platform Competition and Incumbency Advantage under Heterogeneous Lock-in effects*. *Information Economics and Policy*, 101031. See also Document 1/367-E from Anglia Ruskin University

¹¹² Ibid. summarising results from Davies, W. E. and Giovannetti, E. (2022). "*Latent Network Capital and Gender in Crowdfunding: evidence from the Kiva platform*". *Technological Forecasting and Social Change*; Volume 182, September 2022 and Davies, W. E. and Giovannetti, E. (2018). *Signalling experience & reciprocity to temper asymmetric information in crowdfunding evidence from 10,000 projects*. *Technological Forecasting and Social Change* Volume 133, August 2018, Pages 118-131

¹¹³ Ibid, citing European Distributed Data Infrastructure for Energy, (2023), EDDIE <https://eddie.energy/about> Accessed on 9 October 2023; Llorca M., Soroush, G., Giovannetti E., Jamasb T., Davi-Arderius D. (2023). "Digitalisation and Economic Regulation in the Energy Sector", forthcoming in the Forsyningstilsynet (Danish Utility Regulator) Anthology on better regulation in the energy sector. IEA (2017), Digitalisation and Energy, IEA, Paris <https://www.iea.org/reports/digitalisation-and-energy>

¹¹⁴ See Shoshana Zuboff, *The Age of Surveillance Capitalism. The Fight for a Human Future at the New Frontier of Power*, Profile Books 2019, and Carissa Veliz. *Privacy Is Power: Why and How You Should Take Back Control of Your Data*, London: Penguin Random House, 2020

¹¹⁵ European Union. General Data Protection Regulation, April 2016. State of California. California Consumer Privacy Act, 2018.

¹¹⁶ J. Lanier. *Who Owns the Future?* Simon & Schuster, 2013

persons, in the event of such compensation coming into force, could amount to as much as 9 per cent of the economy.¹¹⁷

- Personal data can also exert an impact on competition in digital platform markets, as it can be used by service providers to supply improved personalized services that, while improving user experience, also introduce lock-in effects. These lock-in effects can make it more difficult for the owners of the original data to switch to competing providers, and so create new barriers to entry into these markets for possible competitors and innovators¹¹⁸. Personal data¹¹⁹ has also been identified as a possible cause of incumbency advantage since data are fed into algorithms that are used by the platforms to improve their matching ability for users across the different sides of the platform. Typical examples of these advantages are provided by web mapping services, which train their algorithms with information sourced from users' geolocations to provide better-quality services to other users. Similarly, search engines develop centrality metrics based on user queries to build meaningful rankings for search results and targeted advertising. If a user has been a client of a platform for some time, the platform knows his or her tastes and can give more prominence to goods or services that he or she prefers. The platform can also use the data stemming from other users to increase the quality of the service to each of its users¹²⁰. As a result, entrants into this market might have to overcome lock-in effects and this might result in reduced innovation and competition, thus in the long-term leading to economic impacts¹²¹.

3.3 Towards effective data portability for competition in digital platform markets

The key antecedent of today's personal data was a personal telephone number. This was a key personal identifier, allowing its owner to be easily reached by a network of other users, generating positive network externalities¹²². The larger this network, the higher the personal benefits. Hence, the loss of a personal telephone number when moving telephone provider, implied the loss of immediate reachability, and costly information to re-advertise a changed number, with the consequent loss of network benefits. To address these competition problems and to facilitate entry into previously monopolized markets, many countries introduced mandatory number portability. ITU DataHub¹²³ (2022), indicates that nearly 44 per cent of the world countries surveyed are required to introduced fixed number portability (FNP), "a process by which customers may keep their fixed telephone number when changing either service provider, service or location or both." Moreover, 54 per cent of these countries mandate mobile number portability (MNP), "a service that allows a mobile service customer to change telecom carrier and keep the same phone number."

¹¹⁷ E. A. Posner and G. Weyl. *Radical Markets. Uprooting Capitalism and Democracy for a Just Society*. Princeton Univ. Press, 2018.

¹¹⁸ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0203/> from Anglia Ruskin University, citing Klemperer, 1987

¹¹⁹ Ibid. citing Biglaiser et al. (2019)

¹²⁰ Ibid. citing Biglaiser et al. (2019)

¹²¹ Ibid. citing Biglaiser, G., Calvano, E. and Crémer, J. (2019), "Incumbency advantage and its value", *Journal of Economics & Management Strategy*, vol. 28, pp41-48. Giovannetti, E., & Siciliani, P. (2023). [Platform Competition and Incumbency Advantage under Heterogeneous Lock-in effects](#). *Information Economics and Policy*, 101031. Klemperer, P. (1987). "Markets with consumer switching costs". *The Quarterly Journal of Economics*, 102(2), 375-394. OECD (2020), "Consumer Data Rights and Competition - Background note", available at [https://one.oecd.org/document/DAF/COMP\(2020\)1/en/pdf](https://one.oecd.org/document/DAF/COMP(2020)1/en/pdf) and OECD (2021), *Data Portability, Interoperability and Digital Platform Competition*, OECD Competition Committee Discussion Paper, <https://web.archive.org/2022-04-28/576224-data-portability-interoperability-and-competition.htm>

¹²² Ibid. citing Katz and Shapiro (1994)

¹²³ <https://datahub.itu.int/>

However, due to the impact of the Internet, and the technological convergence of ICT markets into multiple digital platform markets, fixed or mobile number portability has become only a small element of the personal data that consumers might need to port to keep their original network benefits while changing provider. In converged markets, the challenges when changing providers, will include the consideration of portability of a full set of personal data, and not just number portability. Hence the scale of personal data portability can affect a consumer's transitions and choices, as a greater scale of portability could reduce the overall "switching costs" due to the losses of network benefits faced by consumers who want to change their provider.

This poses new questions and challenges for regulators that will now need to address the problem of defining the scope of relevant personal data, for portability. An added complication is that the economically relevant attributes of a digital profile, now also include the results of added inferences obtained from proprietary algorithms, and statistical aggregation based on the merging of a single person's data with the entirety of the other users' personal data. For example, location services, browsing histories, site reviews, dedicated advertising, and driving directions are all different tailored services based on algorithmic profiling that rely on personal data gathered through tracking methods, and then integrated with other users' similar data. Therefore, changing platform could entail a deterioration of the quality of these personalized services. Arguably, this new type of 'lock-in effect', due to the quality losses of changing provider, increase with the length of time a customer has been with his or her current provider.

To deal with some of the implications for entry, contestability, and effective competition posed by the competitive value of personal data through algorithms and aggregation, the European Union Digital Markets Act¹²⁴ (DMA) states that once gatekeepers' platforms are identified, they will be prohibited from amalgamating personal data from different services, prevented from using data collected from third-party merchants to engage in competitive practices against them, and obligated to allow users to download apps from rival platforms. Moreover, while platforms might have different roles depending on their network and market relevance, the switching costs that emerge from the use of personal data can be very different for different users. These facts may reflect differences in knowledge, time, and the behaviour of users, when dealing with complex choices across multi-dimensional, personalized contracts and tariffs.¹²⁵

In conclusion, despite considerable efforts of the scientific community and industry, measuring the economic value of data remains a technical and economic challenge. Some have called for consensus on relevant methodologies so as to include the value of data:

- in accounting,
- in the valuation of data-intensive companies,
- in determining compensation for individuals, for the purposes of taxing data¹²⁶, or
- simply for selecting information to feed machine learning models¹²⁷.

¹²⁴ https://digital-markets-act.ec.europa.eu/about-dma_en

¹²⁵ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0203/> from Anglia Ruskin University, UK Giovannetti, E. & Siciliani, P. (2023). [Platform Competition and Incumbency Advantage under Heterogeneous Lock-in effects](#). *Information Economics and Policy*, 101031. And Giovannetti, E. and Siciliani, P. (2020) "The Impact of Data Portability on Platform Competition" [Antitrust Chronicle](#), Fall 2020, Volume 2, Number 2

¹²⁶ "A Tax on Data Could Fix New York's Budget" - Wall Street Journal. "Newsom wants companies collecting personal data to share the wealth with Californians" - Los Angeles Times (latimes.com).

¹²⁷ A. Ghorbani and J. Zou. Data Shapley: Equitable valuation of data for machine learning. In Proc. of ICML'19 (2019).

Similarly, even if the problem of measuring the economic value of personal data was to be addressed, policymakers may wish to consider other relevant policies or regulations for the many complex strategic interaction effects that data ownership brings, as well as their impact on economic competitiveness and innovation in the wider digital sector. The economic value of personal data will therefore continue to be a fertile field of research, bringing together people from a variety of disciplines over the coming years.

3.4 Country experiences and case studies

The objective of the European Data Strategy is to create a single market for data that will allow it to flow freely within the European Union and across sectors for the benefit of businesses, researchers, and public administrations. Central to this development is unlocking data assets and interoperability of data exchange services. In this context, three initiatives originating in the European Union are worth mentioning:

- the International Data Spaces standard;
- the Gaia-X initiative;
- the European Distributed Data Infrastructure for Energy (EDDIE).

Personal information management systems (PIMS) have also appeared in the market in the wake of recent data protection legislation aimed at improving the control of individuals over their personal data.

International Data Spaces

The International Data Spaces¹²⁸ (IDS) standard is a global standard defined by the International Data Spaces Association (IDSA), which groups more than 147 members from 28 countries that "*share a vision of companies able to self-determine usage rules and realize the full value of their data in secure, trusted, equal partnerships*" over a sovereign interoperable ecosystem of data. Member companies include dozens of industry verticals, research institutions, solution developers, data providers, service providers, and data consumers.

According to the reference architecture model¹²⁹, the design ambition is to integrate different platforms, stakeholders, and businesses over the so-called IDS connector¹³⁰. This is the central component that allows enterprise clouds, service providers, on-premise systems, and connected devices to interact with any other party in the international data space, and provides for usage traceability, security, and trust. The architecture specifies five different layers (business, functional, process, information, and system).

Notably, the architecture also defines the IDS information model, a domain-agnostic common language, designed to facilitate interoperability in the IDS connector. The IDS information model, which is being consolidated with the W3C Data Catalogue¹³¹, allows description, publishing, provision, identification, and location of data products and reusable data apps, often referred

¹²⁸ <https://internationaldataspaces.org/>

¹²⁹ IDS Reference Architecture Model. International Data Spaces Association. <https://internationaldataspaces.org/publications/ids-ram/>

¹³⁰ Data Connector Report. International Data Spaces Association. <https://internationaldataspaces.org/download/36320/?tmstv=1707220996>

¹³¹ W3C. Data Catalog (DCAT) v3.0 <https://www.w3.org/TR/vocab-dcat-3/>

to as "digital resources". The IDS information model goes beyond digital resources, and also allows description of participants and components in the ecosystem.

Gaia-X

The Gaia-X¹³² initiative was originally a German proposal launched at the Digital Summit in October 2019. The initiative is intended to develop an open, transparent, and secure digital ecosystem standard where data can be shared and services can be provided in an environment of trust. The high-level requirements for Gaia-X architecture¹³³ deal with interoperability and portability of data and services, sovereignty over data, security, and trust. To achieve this, the Gaia-X architecture follows federation, decentralization, and openness design principles.

Gaia-X defines a "trust framework"¹³⁴, a set of rules to become part of the ecosystem, and foresees verifiable credentials, and linked data representations, as a cornerstone of its future operations. It has already developed an identity component to verifiably identify the participants in the ecosystem. To prevent tampering participants and resources of the ecosystem are described by "self-descriptions", which are machine-readable immutable cryptographically signed statement texts, that are validated through a compliance process before being included in catalogues.

Gaia-X defines a data ecosystem and an infrastructure ecosystem. The data ecosystem deals with data, data services, and data spaces, meaning secure and privacy-preserving infrastructure to pool, access, share, process and use data. The infrastructure ecosystem deals with storage and computing nodes that execute software resources to process data, and interconnection services to ensure secure data exchange between nodes. Gaia-X acknowledges that the open Internet is not capable of fulfilling the requirements of all services, and so defines its own ecosystem of IT infrastructures to support the data ecosystem.

Gaia-X and IDS have some overlapping definitions and are closely related, they both try to build a community of trust around secure sovereign data sharing among organizations in a data space, although they are complementary in a way¹³⁵. The International Data Spaces Association (IDSA) has been an active member of Gaia-X from the beginning of this initiative, and IDS is, according to IDSA, a central element of the Gaia-X data ecosystem.

EDDIE¹³⁶, European Distributed Data Infrastructure for Energy

Considering the shortfalls experienced through the deployment of centralized, inter-dependent and inflexible platforms, Project EDDIE proposes a completely decentralized, distributed, open-source data space solution, aligned with the direction of the work carried out on the 'Implementing Acts on Interoperability' as mandated by Article 24 of Directive (EU) 2019/944 and the European Data Strategy, and is accommodated within the European Data Spaces

¹³² <https://gaia-x.eu/>

¹³³ Gaia-X Architecture Document. <https://docs.gaia-x.eu/technical-committee/architecture-document/23.10/>

¹³⁴ Gaia-X Trust Framework - 22.10 Release. <https://docs.gaia-x.eu/policy-rules-committee/trust-framework/22.10/>

¹³⁵ IDSA. Gaia-X and IDS. Position paper. https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/IDSA-Position-Paper-GAIA-X-and-IDS.pdf

¹³⁶ <https://eddie.energy/news/post/project-eddie-european-distributed-data-infrastructure-for-energy-starts>

Initiative. The main objective is to create a dependable, scalable, and extensible European distributed data infrastructure for energy framework in order to enable streamlining of access to:

- data accessible through data-sharing infrastructure such as grid operators, connection point registries, etc.;
- in-house citizen data; and
- publicly available data (such as price signals from exchanges or information on the current electricity mix available).

Near real-time in-house citizen data is seamlessly integrated in the proposed architecture through the use of open prosumer data interfaces transformed to a common format and managed securely. The EDDIE administrative interface for in-house data access (AIIDA), targets to integrate data from different behind-the-main-meter environments and allows to share that data through an online consent-based mechanism. Edge computing patterns are utilized to provide users insights into their local data, and act efficiently as a data provider to the outside on a higher level under the full control of the user.

The proposed platform will be deployed through open-source components, and will be easily deployable in developer desktops, as well as in cloud-native environments. Communication will be directly from data source to data-driven service, and there will be no need for a central intermediary.

Personal information management systems (PIMS)

Boosted by recent legislative developments, such as the European Union General Data Protection Regulation (GDPR), or the California Consumer Privacy Act (CCPA), personal information management systems (PIMS) have appeared with the purpose of empowering individuals to take back control of their personal information currently being collected by Internet service providers, with little or no consent. The European Data Protection Supervisor released an opinion about these entities¹³⁷, and more recent data marketplace surveys also analyse their business models¹³⁸.

PIMS are platforms that mediate between users (individuals), digital service providers that collect data from these users, and potential data buyers seeking the users' consent to access and make use of their personal information for various purposes. PIMS allow users (individuals) to exercise their data erasure or modification rights as granted by law, and to download their personal data to the platform, to manage permissions of apps to share their data, and to manage cookie settings, etc. In addition, some PIMS platforms seek their users' consent to share their personal information with third parties through the platform, in exchange for a reward.

A number of PIMS platforms implement a form of marketplace functionality allowing users to monetise their personal data¹³⁹. Most users who aim to monetise their personal data, target personal data trading for marketing purposes (e.g., for user profiling and advertisement targeting). These PIMS platforms allow data subjects (as owners of personal information) and data providers, to negotiate fees for consenting access to their data. In this way such PIMS

¹³⁷ European Data Protection Supervisor. EDPS Opinion on Personal Information Management Systems Towards more user empowerment in managing and processing personal data. Opinion 09/2016

¹³⁸ Santiago Andrés Azcoitia and Nikolaos Laoutaris. 2022. A Survey of Data Marketplaces and Their Business Models. SIGMOD Rec. 51, 3 (September 2022), 18-29. <https://doi.org/10.1145/3572751.3572755>

¹³⁹ Stahl, F. and Schomm, F. and Vomfell, L. and Vossen, G. Marketplaces for Digital Data: Quo Vadis? Computer and Information Science, 2017

platforms become personal data brokers, enabling users to monetise their data, and controlling who has access to said data, and for what purposes. Survey PIMS platforms aim to facilitate targeted marketing surveys among their users, leveraging information about their users' profiles to offer an accurately targeted audience, and rewarding their users for participating in the process. Finally, healthcare-related PIMS platforms specialise in managing the healthcare-related information of their users.

The data-for-services dynamic of the Internet, presents a challenge to PIMS platforms that are intended to ensure that the rights of the new data protection legislation are enforced by competent authorities. PIMS platforms must focus on gaining the trust of users in order to build a minimum viable base. The feasibility of PIMS platforms has yet to be proven, and a number of PIMS platforms have ceased operations in recent years. PIMS platforms must battle to gain visibility, by leveraging an increasing concern around privacy on the Internet, and so increase their user base, to gain a critical mass of users that ensures their long-term viability.

Chapter 4 – Other economic aspects/implications of national telecommunication/ICT

4.1 Economic incentives and mechanisms for bridging the digital divide

There are a number of economic incentives and mechanisms aimed at bridging the digital divide. One widespread solution is the implementation of universal service funds (USFs) which allow the use of surplus funds from the provision of telecommunication services in urban areas, to fund programmes to bridge the digital divide in rural and remote areas. In May 2023, in relation to regulatory and economic aspects of USFs, ITU-D Rapporteur Groups on Question 4/1 and Question 5/1, conducted a joint workshop on "challenges and opportunities of the use of universal service funds for bridging the digital divide¹⁴⁰." The main conclusions from this workshop are presented in Annex 1 of this report. In addition, based on the results of this event, both ITU-D Rapporteur Groups developed a joint deliverable that comprises materials from the workshop, such as data from ITU-D members' contributions, and shares insights for ITU Member States to consider to ensure that the USFs in each country play an effective funding role in the quest to bridge digital divides.¹⁴¹

Other economic solutions to bridging the digital divide include for example voucher schemes. Voucher schemes work by pooling together households and businesses in a specific geographic area, into a single project proposal, by an eligible broadband supplier. This broadband supplier then receives the 'voucher scheme' funding directly. By pooling together households and businesses, voucher schemes help overcome the potential limitations of a single user trying to request connectivity in a way that may not be feasible as a business model in isolation, by aggregating demand in a geographic area.

A voucher scheme is employed in the United Kingdom as part of Project Gigabit¹⁴². Project Gigabit was launched by the Government of the United Kingdom in 2021, to meet a target of 85 per cent gigabit-capable coverage by 2025, followed by nationwide coverage by 2030, and is expected to comprise in excess of 99 per cent of premises.

Each voucher (per premise, as of late 2022/early 2023) is a one-off contribution worth up to GBP 4 500, and over 215 broadband suppliers are registered with the voucher scheme, supporting a broad and diverse communications market within the United Kingdom. By September 2023, over 100 000 vouchers had been used to fund new gigabit-capable broadband connections to household and business premises¹⁴³.

¹⁴⁰ <https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/joint-session-Q4-1-Q5-1-may23.aspx>

¹⁴¹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0333/> from Rapporteur for Question 4/1 and Co-Rapporteurs for Question 5/1

¹⁴² <https://www.gov.uk/guidance/project-gigabit-uk-gigabit-programme>

¹⁴³ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0246/> from United Kingdom

Examples of funding for non-technical forms of digital divide, include the Women in the Digital Economy Fund (WiDEF)¹⁴⁴, a USD 60.5 million global effort that identifies, directly funds, and accelerates investment in proven solutions to close the gender digital divide. WiDEF includes women-led solutions, products, and tools to improve women's livelihoods, economic security, and resilience. While the rapid development and adoption of digital technology is transforming how people around the world gain access to information, and goods, and services, access is unequal and significant gender gaps remain.

The WiDEF was jointly launched by USAID and the Bill & Melinda Gates Foundation in March 2023, to accelerate progress on closing the gender divide by identifying, funding, and accelerating evidence-based solutions. The WiDEF aims to provide millions of women with access to the Internet in order to transform both the lives of women and girls worldwide, and the global economy as well.

The first global round of WiDEF, offering a two-week open questions window, and three informational webinars to support the applicants, received over 1 300 applications for funding. The second round closed on 12 September 2024, and provided selected private sector partners, with bespoke technical assistance, to unlock opportunities that significantly close the digital gender divide. A third round, focusing on India, launched in November 2024.

The inaugural WiDEF round was announced in early 2024, and awarded grants to locally-involved organizations focusing on, among other aspects: information and communications technology (ICT) access, ICT training, digital financial services (DFS) access, and DFS literacy training. Round 2 of WiDEF, in an effort to fill in gaps in these areas discovered by Round 1, awarded bespoke technical assistance in areas including research, evaluation, user testing/design, product adaptation/iteration, and business modelling. WiDEF awards for both rounds were focused on three key work streams:

- Accelerating progress to reduce gender digital inequities through a series of rounds, awarding grants and/or technical assistance to both nonprofit and for-profit organizations working on gender digital equality.
- Facilitating partnerships with, and across, diverse stakeholders. One key partnership is the WiDEF Community of Practice CoPlanned in March 2024, during the 68th Commission on the Status of Women. The Community of Practice is a collaborative project between USAID and ITU under EQUALS, the global partnership for gender equality in the digital age. It brings together the partners of the WiDEF and key stakeholders engaged in closing the gender digital divide. The Community of Practice aims to support and grow partnerships, to foster knowledge-sharing, and to advance greater collaboration and coordination among stakeholders.
- Building and sharing knowledge on solutions to the gender digital divide.

4.2 Analysis of the economic impact of the COVID-19 pandemic

The United States has conducted some measures related COVID-19, including increased spectrum efficiency 42 times since 2010, handling significantly more data traffic per megahertz of spectrum. It was possible due the quick allocation of additional spectrum resources – up to 100 megahertz, a nearly 14 per cent increase in low-band spectrum availability – to boost capacity in key regions of the country¹⁴⁵.

¹⁴⁴ ITU-D <https://www.itu.int/md/D22-SG01-C-0424/> from United States

¹⁴⁵ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0245/> from United States

Also it is necessary to mention some valuable insights found in Final Report of Question 4/1 on the previous ITU-D study period (2018-2022)¹⁴⁶.

4.3 Economic aspects/implications of digital transformation

5G networks are being combined with artificial intelligence (AI), and other technological innovations to empower the development of manufacturing industry. Telecommunication operators, in collaboration with manufacturing companies, are using 5G technology to help improve efficiency and economic value in some key production scenarios.

4.4 Country experiences and case studies

Investment commitments for bridging the digital divide – Brazil experience¹⁴⁷

For over 15 years, investment and coverage commitments in telecommunications networks established by Anatel, the Brazil regulatory authority for telecommunications, have been adopted, to bridge the digital divide and improve broadband coverage. During this period, some regulatory instruments have been used to achieve investment and coverage goals, such as:

- Terms of Conduct Adjustment agreement;
- Obligations to do;
- General target plans for the universalization of fixed telephone service provided in the public regime;
- Spectrum auctions.

These regulatory instruments are outlined in this section.

Terms of Conduct Adjustment

The Terms of Conduct Adjustment agreement is governed by a regulation for the execution and monitoring of the Terms of Conduct Adjustment Commitment (RTAC), approved by Anatel Resolution No. 629, on 16 December 2013. In addition to agreements to adjust irregular conduct, operators also sign commitments concerning the expansion of telecommunication network infrastructure in the following categories: a) Structuring projects: may be related to the expansion of network infrastructure; and b) Additional commitments: these are always linked to the execution of infrastructure projects, which present a negative net present value (NPV), selected from a list of options established in an Act edited by the Anatel commissioners.

Commitments to structuring projects that have already been signed comprise several initiatives, such as: a) provision of 4G coverage; b) coverage and capacity expansion of 4G networks; c) improvements in critical cities; d) implementation new control elements to improve network resilience; e) deployment of additional network core elements to improve network latency; and f) deployment of fibre optic backhaul.

¹⁴⁶ Annex 7 to the Final Report of Question 4/1 on the previous ITU-D study period (2018-2022) <https://www.itu.int/hub/publication/d-stg-sg01-04-2-2021/>

¹⁴⁷ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0206/> from Brazil

Additional commitments concern projects to: a) expand the national fibre optic backbone; and b) provide 4G network coverage in unserved populated areas.

Obligations To Do

A total of ten 'obligations to do' sanctions related to non-compliance procedures have been agreed. These 'obligations to do' concern the installation and maintenance of 4G enhanced radio bases and high-capacity fibre optic backhaul.

The total reference values associated with the entirety of the 'obligations to do' sanctions, effectively imposed by Anatel, are estimated to be in excess of BRL 180 million.

Spectrum auctions

Over the years in Brazil, spectrum auctions have been accompanied by a number of wide-ranging commitments, related to the deployment of infrastructure and provision of services in cities and localities. Historically, Anatel imposed coverage commitments associated with radio frequency tenders. These commitments, when onerous, were discounted from the economic value of the frequency range, reducing the minimum price of the auction.

In 2021, the Brazil regulator awarded spectrum in four different bands: 700 MHz, 2.3 GHz, 3.5 GHz, and 26 GHz. This auction was characterized by prioritizing investment in telecommunications infrastructure, rather than having a fundraising bias. Each radio frequency band tendered, resulted in a series of investment commitments in telecommunications networks, designed to promote the expansion of access, network reliability, and a gradual increase in the density of transmitting stations.

One of the main goals of the auction was to enhance investments in broadband infrastructure, by designing coverage and investment commitments that winning bidders would be obliged to comply with. According to a decision of Anatel commissioners, at least 90 per cent of the economic value of the spectrum auction should be assigned to investment projects, which include projects to:

- provide unserved (or underserved) cities, villages and federal highways with 4G coverage;
- provide unserved cities with optical fibre-based backbone transport networks;
- provide specific cities with 5G standalone technology;
- improve connectivity in public schools.

Final coverage and investment obligations are valued at over BRL 42 billion, with the winning bidders committed to spending BRL 47 bn (USD 9.05 bn), a sum that comprises spectrum fees, coverage and investment commitments.

Use of spectrum auctions to bridge the digital divide – Colombia experience¹⁴⁸

On 20 December 2023, the Colombian Minister of Information and Communication Technology (MinTIC), with the goal of bridging the digital divide through the implementation of modern telecommunication/ICT services and networks, held a successful spectrum auction. This spectrum auction permitted the entry of a new operator, while awarding 83 per cent of available spectrum to bidders for the 3.5 GHz band as well as the 2.5 GHz band, for the sum of COP 1.5 billion

¹⁴⁸ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0358/> from Colombia and United States

(approximately USD 360 000). The key element of the auction was a multi-stage competition for the 5G spectrum, of which "base blocks" were auctioned ensuring a minimum level of spectrum for winners, so that they would not end up with a sub-optimal amount of spectrum. The auction design also introduced the possibility of purchasing additional spectrum if any of the base blocks were unsold. As spectrum should be contiguous for an efficient allocation, there was an assignment stage whereby the specific, contiguous frequency ranges blocks would be identified for each winner. Each base block was assigned in-kind obligations in a manner that sought to promote additional competition for the individual blocks.

The inclusion of in-kind obligations was motivated by a number of studies that suggested that a goal of maximizing spectrum fees alone, results in lower investment in the sector. Another factor leading to their inclusion was the successful experience in the latest generation of auction designs, which embedded in-kind obligations into the bidding process.

Other crucial outcomes include the securing of in-kind obligations for new fixed Internet connections in approximately 1 200 schools benefiting 73 000 children and expanded 4G coverage along 700 km of roads in Colombia. The spectrum auction represented the first of its kind in Colombia to enable spectrum auction bidders to offer in-kind obligations for improved connectivity in schools, and along roads, to offset a portion of their payments for spectrum rights.

In addition to the in-kind obligations, the 3.5 GHz spectrum allocations will comprise requirements to roll-out services to commercially viable population centres, according to defined and accelerated timetables. Unlike the in-kind obligations, these coverage obligations are designed to ensure timely roll-out in commercially viable localities. In other words, no net cost (loss-making) is anticipated for the fulfilment of these coverage obligations.

Following the 5G auction in Colombia, from February 2024, the successful bidders began rolling out the new 5G technology infrastructure.

Increasing digital inclusion through economic methods – Senegal experience¹⁴⁹

Digital inclusion, as a lever for economic and social development, as well as a central pillar of the digital transformation of the country, has recently become a strategic issue for Senegal. In this context, in August 2024, the Regulatory Authority for Telecommunications and Posts (ARTP) initiated a consultation with all stakeholders in the digital ecosystem, to address the theme of "enhancing digital inclusion".

The consultation led to the identification of consolidated recommendations in four main areas:

- The economic model of universal service
- Affordability of rates
- Digital inclusion
- Universal access and opening-up of digital opportunities

Economic model of universal service - recommendations

- Organize a workshop on the issue of universal service. The complexity of this issue calls for in-depth reflection involving all the players involved, including the regulator, operators,

¹⁴⁹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0392/> from Senegal

civil society, and the Universal Telecommunications Service Development Fund (FDSUT). A workshop could precede a detailed analysis of current challenges.

- Call for tenders for the deployment of universal service sites. The aim of this measure is to accelerate the deployment of infrastructure in areas without coverage, with clear prioritization and a transparent selection process.
- Enable operators to deploy in universal service areas in return for their contributions to the FDSUT. This recommendation could encourage operators to invest in unprofitable areas. An evaluation of the Universal Access Priority Programme¹⁵⁰ (2PAU), and an adaptation of the regulatory framework are needed to provide a framework for this mechanism.
- Define clear criteria for sites eligible for universal services. The selection of universal service areas should be based on objective criteria, such as population density, and network coverage. These criteria need to be reassessed regularly to remain relevant.
- Abolition of frequency fees for universal services. This measure would reduce costs for operators in less profitable areas, but it must be accompanied by strict control to prevent abuse.
- Increase transparency on the use of FDSUT funds. The credibility of universal service is based on regular reports, monitoring by a committee including civil society, and independent audits.

Affordability of rates - recommendations

- Facilitate unlimited offers. In order to encourage offers that are more advantageous to consumers, there is a need for analysis of the effects on quality of service (QoS) and regulation to avoid anti-competitive practices.
- Reduce operators' costs. Reducing taxes and fees can help lower prices for consumers, but this requires negotiations between the Government, the regulator, and operators.
- Ease the tariff framework to allow for targeted offers. Greater flexibility in tariffs would allow for greater adaptation to consumer needs, while protecting against abusive discrimination.

Increasing the affordability of user devices to bridge the digital divide - Zambia experience¹⁵¹

Access to affordable electronic devices in Zambia has been hindered by complex supply chains, and by the absence of local suppliers, making technology a luxury for many. This gap perpetuates poverty and limits the overall digital and economic growth of Zambia. Morey Electronics, a Zambia-based initiative, focuses on bridging the digital divide by making essential electronic devices, such as smartphones and laptops, more affordable and accessible to low-income individuals, particularly in rural areas. Launched in 2024, Morey Electronics offers a solution by connecting retailers and consumers in Zambia with international suppliers, and so reducing device prices. Research shows that affordable ICT access can boost socioeconomic development and expand opportunities for rural communities (Broadband Commission, 2020). The Morey Electronics marketplace is the first in Zambia to offer instalment-based payments for electronics, benefiting both individual consumers and retailers. Through direct partnerships with Chinese suppliers, Morey Electronics offers flexible payment options, such as 'buy now, pay later' (BNPL), LayBy, and government-backed credit lines for Government employees. These options allow customers to spread the cost of expensive devices, making technology affordable and empowering citizens to participate in the digital economy. Morey Electronics currently serves over 150 users and partners with three outlets for bulk purchases.

¹⁵⁰ <https://fdsut.sn/projet-dacces-universel-fdsut/>

¹⁵¹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0416/> from Huawei Technologies Corporation, China

Economic impact of digital transformation – China experience

5G empowering intelligent manufacturing¹⁵²

5G technology can provide highly reliable wireless network connections. In the case of automated guided vehicles (AGVs), 5G deterministic network technology can overcome problems related to traditional WiFi, such as unstable operating, latency delays and rates, insufficient positioning accuracy, and reliability issues. 5G network technology reduces the network delay of AGVs by 30 per cent, and controls jitter to within 1 millisecond.

5G AGV technology can improve factory operation and efficiency. According to the shared practices of medium-sized packaging enterprises and a telecommunication operator, overall enterprise warehousing efficiency increased by 15 per cent, and labour costs were reduced by 15 per cent.

Industrial machine vision application cases¹⁵³

- **Machine vision for automated industrial quality inspection:** A traditional automobile production quality inspection of a wheel hub relies on manual inspection, as the inspection requires moving and rotating the wheel frequently. This inspection involves a high work intensity and is prone to error. The wheel hub vision inspection solution, developed by China Mobile, adopts 'machine vision' technology to identify defects in multiple areas of the wheel hub. Following the application of industrial machine vision, a production line that previously required 12 quality inspectors was able to reduce the team to 3 quality inspectors. When labour costs, calculated at CNY 5 000 per month for each quality inspector, are considered, a single production line reduced company labour costs by a total of CNY 540 000 per year.
- **Machine vision for UAV inspection:** A traditional unmanned aerial vehicle (UAV) inspection mainly relies on a global positioning system (GPS) signal to confirm the location of an image, and is subject to the impacts of route planning errors, and field gusts in the environment, resulting in inaccurate positioning. At the same time, the traditional cameras cannot take clear images at a safe distance, which limits the applications of UAV inspections. Confirming the position of the UAV through machine vision can improve positioning accuracy. In addition, when AI is used for image processing the sharpness of the image can be improved. The new scheme using machine vision for UAV inspections, reduces manpower costs by more than 30 per cent by simplifying route planning, and saves more than 20 per cent in inspection time by reducing UAV inspection hover points.

The application of ICTs in logistics¹⁵⁴

- **Integrated sensing and communication technology for unmanned delivery services:** Traditional unmanned delivery provides vehicle and road information through real-time video, but the video is not clear, cannot be viewed at long distances, and speed and safety are difficult to guarantee. A traditional unmanned delivery scheme also comprises a high computing cost. Integrated sensing and communication technology integrates perception ability into the communication system, and acquires vehicle and road information at a low computing cost. Integrated sensing and communication technology reduces the computing power cost by building a computing network. A company in Beijing is using the technology in unmanned delivery. In this case, the UAV speed has been increased from

¹⁵² ITU-D Document <https://www.itu.int/md/D22-SG01-C-0220/> from People's Republic of China

¹⁵³ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0234/> from China Mobile Communications Corporation, China

¹⁵⁴ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0233/> from China Mobile Communications Corporation, China

12 km/h to 25 km/h, and the cost of single vehicle computing power has been reduced by 30 per cent.

- **5G and multi-technology for port transportation:** Traditional port container terminal transportation relies heavily on labour, with attendant high costs and low efficiency, and difficulties in matching the needs of trade development. In China, one of the world's busiest ports combines 5G technology, and mapping capabilities, to form an unmanned driving, and 5G remote control system, enabling dynamic planning and speed guidance for port container handling vehicles. This system ensures efficiency and safety in multi-vehicle collaborative working. Compared with a traditional automated container terminal of the same scale, investment costs are reduced by 30 per cent, linkage errors are reduced by 50 per cent, and energy consumption is reduced by more than 17 per cent. Port personnel requirements are also reduced by 60 per cent, and 100 per cent self-sufficiency in green power functions can be achieved.
- **Big data analysis for inventory management:** Traditional logistics planning work is characterized by a lack of flexibility, and whenever there is a disconnect between cargo scheduling and production, this can easily lead to waste. Complete amalgamation of warehousing, goods, transportation, sales, production, and other data aspects can achieve a precise management of inventory, reducing redundant inventory, and increasing necessary materials supply, to ensure that material supply and production plans are correctly matched. In an example of the use of big data analysis used for inventory management, the demand forecasting and replenishment plan of a household appliance brand, including sales-forecasting and material reserve stocks, was conducted through big data analysis. The results showed a reduction in inventory allocation costs of 15 per cent, and established the ability of flexible supply chain management to improve the ability of companies to cope with changing market environments.

The application of ICTs in modern energy systems^{155 156}

- **ICTs for security, driving and inspections in energy production.** In the coal mining industry, "5G+ driverless" technology enables unmanned transportation of raw coal, reduces labour costs by reducing the number of on-site operators, and improves operational safety. In a large coal mine in China, with an annual output of 150 million tons, the production efficiency of this technology has attained 90 per cent gains on the traditional manual driving production. This efficiency gain ensures labour costs savings of CNY 7.5 million per year, while avoiding safety-related accidents in the production process.

ICTs are also being utilized in other energy applications such as solar power stations. Most new solar power stations are located in mountainous areas, deserts, and other remote regions. Solar power arrays may be widely dispersed, and encompass large tracts of land and often complex terrain. In such areas, carrying out operation and maintenance tasks can be difficult and hazardous. A digital integrated 5G and AI technology platform, can perform intelligent diagnosis, automatic unmanned aerial vehicle inspections, and safety management for solar power stations, improving the fine management level of the solar power station, and achieving cost reductions and increased efficiencies in operation and maintenance tasks. In one example of a large solar power station with an installed capacity of 550 MW, the technology has increased the operation and maintenance efficiency of the solar power station by 46.7 per cent, reduced the equipment operation and maintenance costs by over 28.3 per cent, increased power generation by 2.1 per cent, and increased the overall economic benefit by CNY 5.9 million per year.

- *Changzhi case study:* Changzhi City, in Shanxi Province, has successfully built a 5G VONR-based (Voice over New Radio) private management network for mines,

¹⁵⁵ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0227/> from China Mobile Communications Corporation, China

¹⁵⁶ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0226/> from Beijing University of Posts and Telecommunications, China

replacing the single data transmission capability of the traditional 5G private network and providing mining industry customers with free 5G coverage in the mines. At the same time, relying on the ZhiMinTong 5G core network, the customer does not need to build a new core network locally, which greatly reduces the cost of construction of the 5G private network for the mines. The number of personnel at the intelligent general mining face has been reduced from 24 to 17, and when taking into account shift breaks, the actual reduction in labour force is 19. General mining efficiency has been improved by 25 per cent. The number of personnel on a shift at the intelligent digging face has been reduced from 13 to six or seven, and the digging efficiency has been improved by 30 per cent. The deinstallation and dismantling of the sensing wireless transmission system has been made simpler, and maintenance costs have been reduced by 20 per cent. The management platform has saved two hours on average off operation and maintenance tasks. Intelligent identification and inspection robots have helped to realize the integration of equipment and the working environment. Intelligent inspection robots can perform equipment and working environment abnormal state detection operations in the central substation and fixed bunker room, reducing the number of inspectors required to two. Inspection efficiency increased by 40 per cent, helping to ensure the safety and reliability of production operations. The intelligent management and control platform extends to the control of mining, excavation machinery, transportation, communication, and other systems, and comprises real-time data collection, a unified display and dynamic updating, to achieve an efficient production chain. In addition to the benefits in mine management, the system reduces the number of personnel in underground hazardous posts by about 25, reduces labour costs by approximately CNY 5 million per year, and improves industrial efficiency by approximately CNY 3.5 million per year.

- **ICTs for efficient energy consumption in industry.** The development of digital technologies has boosted the coordinated transformation of energy consumption towards digitalization and sustainability. In the industrial production field, digital technology has achieved significant improvements in energy utilization efficiency through intelligent management and optimization of green product design, production process optimization, energy management, process coordination, and resource scheduling. Industrial Internet and big data technology are used to collect and analyse the energy utilization data of each link of the industrial production process flow. The optimum operating parameters of the process flow can be obtained through model calculation, in order to achieve energy savings and efficiency increases in the production process. In the transformation of a large machining enterprise in China, the introduction of digital technologies increased the operating efficiency of the production equipment by 27 per cent, the production energy efficiency also rose by 21 per cent, and the energy savings rate reached 6 per cent.
- **ICTs for development of new energy storage.** New energy storage plays a key role in the rapid development of new energy. With the continuous growth of the application scale of new energy storage, bottlenecks linked to safety, economy, reliability, and universality issues have gradually emerged. Reconfigurable battery network technology based on big data, AI, and edge computing can flexibly control batteries and reduce the life cycle costs of the battery system. In a large energy storage power station in China, ICTs perform the integrated management of different grades of batteries, reducing capital expenditure by 30 per cent. The technology manages the charging and discharging of the energy storage batteries, prolongs by up to four times the life of the energy storage system, and reduces the operating costs of the energy storage power station by more than 50 per cent. The technology can also enable the energy storage system to be partially replaced at any time when the effective capacity of batteries reach a minimum level, without the need for a complete shutdown and complete system reconstruction, further increasing efficiency and reducing costs.

Use of datasets in vehicle insurance¹⁵⁷

¹⁵⁷ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0228/> from China Unicom, China

Currently, vehicle insurance pricing in China is based on vehicle type pricing, taking into account a number of factors such as the no-claims bonus factor, independent underwriting factors, distribution factors, and traffic violation factors to finalize the pricing. Pricing factors mainly include vehicle type, purchase price, vehicle age, usage nature, accident history, and traffic violation frequency, etc. Based on these factors, a number of vehicle insurance analysis model products have been created by China Unicom, such as a truck risk assessment model, a passenger car risk assessment model, and a dynamic tracking of vehicle driving behaviour model. These models help insurance companies overcome pain points in the operation process and help vehicle insurance enterprises embark on "big data +" development fast tracking.

The vehicle insurance analysis model is a vehicle insurance analysis product, and its complete solution is based on the integration of historical vehicle traffic data, and historical vehicle insurance claims data. The model integrates multiple dimensions of state-owned transportation big data, such as vehicle static information, and high-speed dynamic driving data, and uses advanced machine learning to screen business and non-business vehicle risks in a three-dimensional manner. The main innovations of the vehicle insurance analysis model are reflected in that it:

- supplements the dynamic risk dimension that is not reflected in traditional car insurance, accurately assessing the risk level, and helping vehicle insurance-related companies to quickly identify and distinguish between operational and non-operational vehicle underwriting risks;
- establishes a mechanism for regular model adjustment with insurance companies, with customized risk factors based on the needs of insurance companies, provides historical data support for partner insurance companies, helps insurance companies improve their model differentiation, and provides a new multi-dimensional scoring model for insurance companies based on complete data; and
- promotes the opening, circulation, and application of state-owned data, on the premise of ensuring that state-owned data is not exported, and innovatively achieves efficient preservation and appreciation of state-owned data assets.

The vehicle insurance analysis model accurately assesses the risk level of vehicles and generates a "1-10" risk score. The higher the score, the higher the risk of compensation. This model can be applied to insurance pricing, risk screening and other scenarios for vehicle insurance, with a coverage rate of over 95 per cent. Insurance companies only need to provide the licence plate number or vehicle chassis number to obtain the risk score of the vehicle. Since its launch in 2022, the vehicle insurance analysis model has been widely recognized and has been selected as an excellent case for typical application scenarios of data elements by the National Industrial Information Security Development Research Centre. The model has been included in a procurement pool by a number of insurance companies.

ICTs for agriculture¹⁵⁸

The China Academy of Agricultural Mechanization (SINOMACH), has developed and constructed a cloud service platform for the informatization management of mechanized agricultural operations. This is the first cloud management service platform for an entire mechanized agricultural process in China. SINOMACH has innovatively developed a monitoring technology and system for an entire mechanized agricultural process from plowing, to planting, to management and harvesting, and has created a "five senses" system for agricultural machinery.

¹⁵⁸ ITU-D Document <https://www.itu.int/md/D22-SG01.RGQ-C-0226/> from Beijing University of Posts and Telecommunications, China

SINOMACH has developed an "Internet + intelligent agricultural machinery" mode for online inspection of agricultural machinery operational quality, with remote supervision of operations quantity, and online issuance of operation subsidies. To date, services have been opened in 22 provinces, including Jilin, Inner Mongolia and Shandong, and the SINOMACH cloud service platform has become the official platform of Jilin Province, Qingdao City, and others. The cloud service platform has generated more than 100 000 operational dailies, operates in an area of more than 17 334 km², and manages subsidy funds of more than CNY 280 million. The cloud service platform has improved the efficiency of agricultural production management by more than 50 per cent. Examples of applications are outlined below¹⁵⁹:

- **ICTs supporting smart farming for precision planting, enhancing capacity and efficiency:** The application of 5G communication technologies in agriculture, particularly in the agricultural plains, primarily involves precision farming in extensive fields. This is achieved through the use of satellite remote sensing, the BeiDou navigation satellite system (BDS), and artificial intelligence algorithms, employing smart agricultural equipment such as intelligent farm machinery, and integrated water and fertilizer systems, to conserve resources and enhance crop growth and yields. By deploying various sensors in the fields to monitor soil, weather, and pest conditions, as well as crop status, the collected data can be integrated with crop demand models, and pest identification technologies, to formulate precise planting strategies. New equipment, such as automatic water-fertilizer systems and plant protection drones, enable the implementation of a smart production model. In a grain-producing area in Shandong, the use of the new production strategies led to an over 70 per cent reduction in labour costs, a 10 per cent increase in yield, 20 per cent water savings, and 30 per cent fertilizer savings.
- **ICTs facilitating marine ranching, expanding agricultural production space, and promoting the marine economy:** The integration of 5G communication technologies, with relevant digital technologies, supports remote and unmanned intelligent production methods, thereby expanding production space, and creating structural development opportunities. Taking a marine ecological ranching project as an example, this project combines 5G technology with machine vision, remote diagnostics, and intelligent breeding equipment, enabling smart fish breeding underwater. Sensors deployed underwater can identify environmental information such as water temperature, flow, salinity, and oxygen levels, guiding automatic feeding systems. In this process, 5G technology provides precise positioning for feeding operations, significantly reducing feed waste, and minimizing the need for personnel to work underwater, thus saving labour costs and reducing operational risks. Additionally, underwater cameras capture fish conditions and supported by the 5G network, can transmit clear and timely data to a fish disease expert consultation system, allowing for remote diagnoses and timely guidance, which effectively increases survival rates. Current operational data from this project indicate an 80 per cent reduction in feed loss, a 60 per cent saving in labour costs, and a 98 per cent aquaculture survival rate.

¹⁵⁹ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0405/> from China Mobile Communications Corporation, China

Chapter 5 – Best-practice guidelines

5.1 Guidelines on Chapter 1

New types and modes of investment have been identified and should be considered by Member States to foster investment in telecommunications/ICTs helping to achieve SDGs:

- **Blended Investment:** Capital from public or philanthropic sources incentivizes private sector investment in sustainable development projects. Public capital allows risk to be mitigated and facilitates financing for private sector-led projects. Blended investment programmes also allow for co-creation and so ensure that insights and feedback will be obtained from those receiving the funds. This helps to maximise the impact of the investment. Blended investment programmes impact SDGs 8, 9, 11 and 17. Based on reported examples, key lessons for policy-makers in developing countries on successful implementation of blended investment models for telecommunications and ICTs include the following:
 - **Targeted projects:** Investing in clearly-defined projects to boost investment confidence. Clear business cases can help attract investment that leads to broader economic impact.
 - **Technical assistance and capacity building:** Providing technical assistance and capacity-building along with funding can enhance implementers' ability to scale and succeed.
 - **Co-creation and stakeholder engagement:** Engaging with local stakeholders through co-creation processes can lead to more effective and sustainable solutions.
 - **Focus on social impact:** Aim to generate positive social outcomes, such as increased Internet access, financial inclusion, and gender equity.
 - **Regulatory support and enabling environment:** Creation of a supportive regulatory environment is crucial for attracting private investment and fostering innovation. Policy-makers should implement regulatory frameworks that encourage investment and support the growth.
- **Online crowdfunding:** Online crowdfunding platforms provide a powerful alternative for addressing financing gaps, particularly for microentrepreneurs in countries with emerging economies who might face high barriers to access credit or financing through traditional financial channels. Crowdfunding can also address gender and other biases in access to financing. Crowdfunding mechanisms can help policy-makers address digital inclusion issues and foster a vibrant and diverse ICT sector within a country. This, in turn, can drive broader economic growth and development, benefiting society as a whole.

5.2 Guidelines on Chapter 2

Econometric studies proved the positive impact of increasing telecommunication/ICT penetration on national GDP, especially for low-income countries where ICT could be a significant economic growth driver. This leads to the recommendation for developing countries to empower investment in the ICT sector (spend money to make money).

5.3 Guidelines on Chapter 3

General principles of personal data as an economic asset

It is important to recognize that personal data is a key economic factor, with unique economic characteristics. Regulators should therefore promote transparency in data collection, analysis, and economic valuation.

Data sharing entails both positive and negative aspects

Data sharing enhances business visibility and competitiveness, while enabling the formation of digital identities and improving market decisions. Data sharing also supports planning and management of digital infrastructure, such as smart energy grids. However, regulators should be aware of the potential for exploitation leading possibly to lock-in effects, reducing competition in digital markets and it may eventually lead to monopolization and incumbency advantages for large platforms.

Data portability for market competition

These risks can be addressed by establishing clear policies to ensure the portability of personal data across platforms. Reduce switching costs for consumers by allowing seamless data transfer. Address the challenge of retaining data-driven personalization after switching provider and prevent anti-competitive behaviour as well, assess impact for differential segments of users.

Economic valuation of personal data

Adopt diverse economic valuation of personal data and ensure fairness in data pricing by improving market transparency.

Data markets and new business models

Encourage federated and distributed platforms, promote niche marketplaces that specialize in industry-specific data trading. Support initiatives such as International Data Spaces, Gaia-X, and EDDIE to create standardized and secure data-sharing frameworks.

ITU should gather evidence on the above topics, through additional questions to be added to its ICT Regulation and Tariffs Policy Surveys, as detailed in the Annex 3.

5.4 Guidelines on Chapter 4

ICT gains greater significance when use is developed in line with digital transformation processes. To advance the benefits of digitalization and ICTs it is recommended for developing countries to:

- identify areas of ICT implementation, such as healthcare, education, agriculture, etc.;
- address digital divide and ICT usage issues, which could prevent or hinder successful ICT implementation;
- evaluate the necessary investments needed for bridging the digital divide and for ICT implementation in traditional branches of the economy, as well as potential benefits;
- prepare a transparent digital development strategy with feasible economic and development targets, considering the implementation of applicable economic mechanisms;
- contribute to ITU publications and events to use the best practices from abroad and share your own experience.

Chapter 6 – Conclusion

Work undertaken in the ITU-D study period 2022-2025, has underlined the ongoing importance of the consideration of economic aspects in national telecommunications/ICT, and this work is expressed in a significant increase in Question 4/1 topics.

Of the 16 topics which were set by the World Telecommunication Development Conference (WTDC), this report contains useful information on new types and forms of investment (Chapter 1), the impact of telecommunication/ICTs on national economy/GDP (Chapter 2), the economic value of personal data usage (Chapter 3), economic incentives for bridging the digital divide (Chapter 4), economic impacts of the COVID-19 pandemic in the scope of telecommunication/ICT (Chapter 4), and economic aspects of digital transformation (Chapter 4).

Together with the previous report on Question 4/1 for ITU-D study period 2018-2021¹⁶⁰ (revised in 2025, by adding new information based on contributions received during ITU-D Study period 2022-2025¹⁶¹), which concentrates on topics of cost models for services provided over NGN networks (Chapter 1), national aspects of significant market power (SMP) (Chapter 1), infrastructure and spectrum sharing (Chapter 2), consumer price and tariff evolution (Chapter 3), and development of mobile virtual network operators (MVNO) (Chapter 4), both deliverables provide telecommunications/ICT economic-related information, useful for developing countries.

¹⁶⁰ <https://www.itu.int/hub/publication/d-stg-sg01-04-2-2021/>

¹⁶¹ https://www.itu.int/hub/publication/d-stg-sg01-04_rev_ed-2025/

Annex 1 – Question 4/1 and Question 5/1 joint deliverable and workshop on Challenges and opportunities of the use of Universal Service Funds for bridging the digital divide

There are several critical challenges that need to be resolved to bridge existing digital divides and this cannot happen without universal access to telecommunications. Therefore, universal service funds (USF) are a powerful tool used by countries to bridge the digital divide.

To explore the extent to which USFs can assist in bridging the urban-rural digital divide, and the models that can make USFs more effective, ITU Study Group 1 Rapporteur Groups for Question 5/1 on *Telecommunications/ICTs for rural and remote areas*, and Question 4/1 on *Economic aspects of national telecommunications/ICTs*, held a joint workshop on the *Challenges and opportunities of the use of USFs for bridging the digital divide*, on 15 May 2023¹⁶². The objectives of the workshop were as follows:

- To discuss strategies for expanding rural and remote infrastructure using USF mechanisms.
- To explore how USFs can be used to promote digital inclusion and bridge the digital divide.
- To share national experiences and best practices.
- To understand sustainable and cost-effective solutions for enhancing broadband and digital infrastructure in rural and remote areas.

As a result of the workshop, Question 4/1 *Economic aspects of national telecommunications/ICTs*, and Question 5/1 *Telecommunications/ICTs for rural and remote areas*, prepared an annual joint deliverable summarising the *Challenges and opportunities of the use of USF for bridging the digital divide*¹⁶³. The document addresses the following aspects:

- National economic strategies on expanding rural and remote infrastructure to bridge the digital divide using USF mechanisms.
- Sources of funding and focus of USFs.
- Governance models and implementations.
- Disbursement models for USF.
- Universal service programmes to bridge the digital divide.
- Considerations when selecting USF business models and case studies on economic strategies.
- Cost modelling for USF.
- Resources provided by the Telecommunication Development Bureau (BDT) of ITU on USF.

The document concluded with the following main considerations that countries should take when devising and implementing USFs:

- To have a consistent collaboration and knowledge-sharing to address the digital divide.
- To move from universal ICT access only policies to universal access and use policies.

¹⁶² <https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/joint-session-Q4-1-Q5-1-may23.aspx>

¹⁶³ ITU- D Document 1 <https://www.itu.int/md/D22-SG01-C-0333/> from Rapporteur for Question 4/1 and Co-Rapporteurs for Question 5/1

- To develop innovative financing mechanisms for digital infrastructure development and digital services.
- To ensure transparency, accountability, and efficiency in USF programmes.
- To ensure the presence of a robust and reliable broadband infrastructure to support digital development.
- To focus on digital Inclusion for achieving the Sustainable Development Goals.
- To have an integrated ICT access and ICT use policy framework with insights into USF and affordability of service.
- To undertake digital skilling through USFs.
- To identify new universal service funding mechanisms.
- To use USF effectively.

Annex 2 – Question 4/1 and Question 6/1 joint workshop on Personal data usage: regulatory and economic aspects

The economic value of personal data has become very important in recent years with the development of artificial intelligence and the uncovering of such data for commercial use.

For this reason, ITU-D Study Group 1 in ITU-D Study period 2022-2025 decided to arrange a Joint Question 4/1 and Question 6/1 workshop entitled *Personal data usage: regulatory and economic aspects*¹⁶⁴.

Economic considerations were discussed and differing views on the issue were presented. While some views concentrated on competition aspects, and the need for freedom of users to provide, store and utilize personal data, as well as the market potential of such data, other views underlined the relatively low cost of personal data per person, which could be monetized in terms of social returns, while enabling proper and protected utility. Controversies inherent in the discussion revealed an understanding that, at least for now, there is no "right" answer to the question – Should users be monetarily compensated for the use of their personal data? More information is available in the report of the event¹⁶⁵.

¹⁶⁴ https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/workshop-personal-data_april24.aspx

¹⁶⁵ ITU-D Document <https://www.itu.int/md/D22-SG01-C-0326/> from Rapporteur for Question 4/1 and Co-Rapporteur for Question 6/1

Annex 3 – Proposed additional questions to ITU surveys on ICT regulation and tariff policies

Addressing data portability, interoperability, and open access to data held by gatekeepers

Section A: Data portability policies

1. Does your country have specific regulations mandating data portability across digital platforms?
 - a. If yes, which sectors are covered (e.g., finance, telecommunications, e-commerce, energy)?
 - b. If no, what barriers prevent the adoption of data portability laws?
2. What mechanisms exist to ensure seamless data transfer between service providers while maintaining user control and privacy?
3. Are there any financial or technical support systems in place to help smaller businesses comply with data portability requirements?
4. Does your country enforce portability of all relevant personal data, including inferred data (e.g., algorithm-based recommendations, personalized settings)?
5. How do you assess the impact of data portability on competition and innovation in your country's digital markets?

Section B: Interoperability of data exchange

6. Are there national or sector-specific standards for interoperability of digital platforms and data exchanges?
 - a. If yes, are these standards aligned with international frameworks such as **International Data Spaces (IDS), Gaia-X, or other regional initiatives**?
 - b. If no, what are the key challenges to adopting interoperability standards?
7. Does your country have a governance framework for ensuring secure and privacy-preserving data interoperability?
 - a. If yes, how is compliance monitored and enforced?
 - b. If no, are there plans to implement such frameworks?
8. What measures are in place to encourage collaboration between private sector companies and public institutions for data-sharing interoperability?

Section C: Open access to data held by gatekeepers

9. Does your country enforce regulations that require large digital platforms (gatekeepers) to provide open access to certain types of data for competition and innovation?
 - a. If yes, how are these regulations structured (mandatory access, voluntary compliance, licensing models)?
 - b. If no, are there ongoing discussions or initiatives to introduce such measures?
10. How do existing regulations prevent dominant platforms from using exclusive data access as a competitive advantage over smaller businesses and startups?
11. Are there any mandatory data-sharing requirements for digital platforms in sectors critical for public interest (e.g., health, finance, energy, transportation)?

12. Does your country have a mechanism for resolving disputes related to data access between gatekeepers and third-party service providers?

Annex 4 – Materials from the Regional Economic Dialogues (REDs) related to the topics of this report

During ITU-D Study period 2022-2025, BDT conducted three Regional Economic Dialogues (REDs), with the active involvement of the Question 4/1 management team.

ITU Policy and Economics Colloquium (IPEC-22) – Regional Economic Dialogue (RED-AMS), Mexico City, Mexico, 22-26 August 2022

The IPEC-22 was divided into two main events, and included the participation of 289 delegates from 16 countries:

- the ITU Digital Regulation Training Course, and
- the Regional Economic Dialogue (RED-AMS).

The Regional Economic Dialogue (RED-AMS) focused on regulatory and economic challenges to achieving digital transformation; economic incentives to foster affordable access; financing the investment for effective deployment of digital infrastructure; and innovative policy and regulation for future emerging technologies¹⁶⁶.

- In the Latin America region, digital transformation faces challenges related to cybersecurity, data protection, public procurement regulations, and outdated labour laws.
- Collaborative and flexible regulatory approaches are needed to support e-commerce, fair competition, and infrastructure deployment.
- From an Internet regulation perspective, a debate continues in the Americas region on co-regulation involving governments, digital platforms, and civil society.
- Regarding economic incentives to foster affordable access, this issue underscored the need for innovative financing, and other issues such as regulatory flexibility, and public-private partnerships to enhance connectivity, were considered.
- The importance of modernized regulations is essential for supporting network expansion, simplifying infrastructure deployment, promoting innovation, and ensuring spectrum availability.
- Regarding innovative policy and regulation for emerging technologies, the strategies for spectrum management, and advancing digital infrastructure were discussed.
- Discussions were held on the need for clear policy frameworks, regulatory balance, and infrastructure sharing to enable 5G deployment and bridging of the digital divide.
- Discussions on industry trends introduced concepts such as immersive extended reality, high-fidelity mobile holograms, and private networks, highlighting their potential for enhanced security, coverage, and mobility.

ITU Policy and Economics Colloquium (IPEC-23) – Regional Economic Dialogue (RED-AMS), San José, Costa Rica, 25-29 September 2023

The IPEC-23 comprised three main events, and included the participation of 192 delegates from 16 countries:

- **Regional Economic Dialogue (RED-AMS);**

¹⁶⁶ All the presentations and material are available: <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2022/IPEC-2022.aspx>

- [Business Planning for Infrastructure Development applying 5G Networks Masterclass and results for the Americas Region](#) ;
- [ITU-T Study Group 3 Regional Group for Latin America and the Caribbean \(SG3RG-LAC\)](#) meeting.

The [Regional Economic Dialogue \(RED-AMS\)](#) focused on the opportunities and challenges to achieve digital transformation in the Americas region, focusing on fixed and mobile networks as a means to promoting affordable adoption¹⁶⁷.

- A specific session on the advances in regulatory costing and pricing strategies was the occasion to discuss the different practices in the Americas region, including some country experiences.
- Good practices in the field of economic policies and regulation, assessment of ICT infrastructure and services requirements, and financing mechanisms and investment in the Americas region were explored.
- National and regional coordination on the activities of the ITU-D Study Group 1 Question 4/1 on economic aspects of national telecommunications/ICT was addressed. The ITU-T Focus Group on cost models for affordable data services was also presented. Costa Rica, Brazil, Trinidad and Tobago, and United States shared their experiences on regulatory costing and pricing strategies applied.
- Meeting focused on dissemination of actions, best practices guidelines, and sharing of experiences to bring more effectiveness to achieving digital transformation in the Americas region.
- The Americas region regulatory associations meeting (RAs) focused on the ITU Digital Regulation Network (DRN) initiative, including representatives from: COMTELCA, CTU, ECTEL, REGULATEL.
- Representatives of regional regulatory associations (RAs) were consulted on the activities implemented and their priority areas in the region, including issues such as gender parity (gender gap and gender equity), devices theft, accessibility and inclusion for vulnerable groups, and costing of services including spectrum prices, etc.

ITU Policy and Economics Colloquium (IPEC-24) - Regional Economic Dialogue (RED-AMS)

Lima, Peru, 2-6 September 2024

The ITU Policy and Economics Colloquium (IPEC-24) for the Americas took place in Lima, Peru, from 2 to 6 September 2024, and included the participation of 150 delegates from 21 countries. IPEC-24 included the following five main events:

- **ITU-D Regional Economic Dialogue (RED) (including a session on ITU-D Study Group 1 Question 4/1: Economic aspects of national telecommunications/ICT);**
- [ITU-R Economic aspects of spectrum management workshop](#);
- Meeting of [ITU-T Study Group 5 Regional Group for Latin America \(SG5RG-LATAM\)](#) and events related to the environment, climate change and circular economy;
- Meeting of ITU-T Study Group 3 Regional Group for Latin America and the Caribbean (SG3RG-LAC);
- [ITU-D Colloquium on New Technologies and the Internet IPEC-24](#) 6 September 2024.

¹⁶⁷ All the presentations and material are available at: <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2023/IPEC-2023.aspx>

The Regional Economic Dialogue (RED-AMS)¹⁶⁸ focused on several key issues, including:

- The role of governments and regulators in developing a coherent approach to maximize digital opportunities in the Americas region.
- Policy and regulatory measures to promote inclusive and affordable access to smart devices, and regulatory tools that create a safe space for digital innovation.
- Discussions aimed to enhance collaboration and develop effective frameworks to support digital transformation and equitable access to technology.
- Session with RAs on maximizing the digital opportunities in the Americas region, focused on the role of governments, regulators and RAs in providing a coherent approach to complex challenges, the main activities that RAs are implementing, and how the Digital Regulation Network (DRN) initiative could support them.
- Session on the national and regional coordination of activities of the ITU-D Study Group 1 Question 4/1 on economic aspects of national telecommunications/ICT, focused on cost modelling and pricing strategies for better coverage and quality. Country cases in the Americas region, focused on:
 - Brazil: Cost modelling and pricing strategies.
 - Republic of Honduras: Tariff reforms and ICT service cost determination.
 - Peru and Costa Rica: Infrastructure sharing and connectivity.
 - Cuba: Innovative, viable, and sustainable business models for inclusive Internet access.
 - Dominican Republic and Eastern Republic of Uruguay: Strategies to reduce the financing gap for inclusive digital development and investment.
 - Trinidad and Tobago: Addressing the financing gap in LAC-SIDS to secure investments and ensure sustainable digital development.
- Contribution [1/450-E](#) containing a summary of the main outputs from this session was presented to Question 4/1 for the third meeting of the ITU-D Study Group 1 (Geneva, 4-8 November 2024).

¹⁶⁸ All the presentations and material are available at: 2024 ITU IPEC AMERICAS <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2024/IPEC-2024.aspx>

Annex 5 – BDT activities related to realization of the ITU-D global and regional projects, related to topics of this report

The following list presents information on BDT activities related to the Question 4/1 topics.

2022

- The **Universal Service Financing Efficiency Toolkit**¹⁶⁹ is a practical guide for impactful and sustainable universal service implementation, providing analytical tools and lessons learned from country experiences to help policymakers, regulators and universal service fund administrators, to navigate the common questions and challenges they face when using public funds to design, implement and finance ICT programmes and projects.
- The toolkit complements the **Financing universal access to digital technologies and services report 2021**¹⁷⁰ (available in six languages) developed to contribute to reviewing and rethinking funds as a concept, exploring alternative models using a combination of monetary and non-monetary contributions, and implementing innovative risk-mitigation mechanisms.
- The new **ITU DataHub**¹⁷¹ is the leading provider of timely and comprehensive telecommunication/ICT indicators, as well as regulatory and tariff policies statistics, profiles and trends, featuring hundreds of indicators on connectivity, markets, affordability, trust governance, and sustainability.
- The **economic and fiscal incentives to accelerate digital transformation**¹⁷² were discussed during the ninth ITU Economic Experts Roundtable. The Outcome Report provides high-level recommendations, suggested by economic experts, on the incentives to stimulate deployment of digital technologies in rural and isolated areas.
- The current digital transformation is changing economies at high speed and at scale. The ITU series on **the economic contribution of broadband, digitization and ICT regulation**¹⁷³ examines this revolution from a data and strong evidence-based expert research perspective. It quantifies the impact of broadband, digital transformation, and the interplay of ICT regulation on national economies, by applying econometric modelling techniques. It also considers the analysis of the **impact of regulation, public policy, and institutions on the performance of the telecommunication/ICT sector**¹⁷⁴, that demonstrates that positive market signals, and flexible approaches, are necessary conditions for telecommunication/ICT industry to thrive and maximize network investment and deployment, and so benefit consumers and society.
- ITU organized the **ITU Policy and Economic Colloquium for the Americas (IPEC 2022)**¹⁷⁵ and the **Regional Economic Dialogue (RED)** in Mexico City from 22 to 26 August 2022.

2023

- The **Universal Service Financing Efficiency Toolkit** self-paced course¹⁷⁶.
- The **Global Symposium for Regulators (GSR-23)**¹⁷⁷ held in Sharm el-Sheikh, Egypt, from 5 to 8 June 2023, under the theme *Regulation for a sustainable digital future*, saw

¹⁶⁹ <https://www.itu.int/itu-d/reports/regulatory-market/usf-financial-efficiency-toolkit/#:~:text=This%20toolkit%20helps%20to%20navigate%20the%20multitude%20of,and%20targets%20related%20to%20and%20facilitated%20by%20digitalization.>

¹⁷⁰ https://www.itu.int/hub/publication/D-PREF-EF-2021-ECO_FIN/

¹⁷¹ <https://datahub.itu.int/>

¹⁷² <https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Events2022/EconomicRoundTable2022.aspx>

¹⁷³ <https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Economic-Contribution.aspx>

¹⁷⁴ <https://www.itu.int/en/myitu/Publications/2021/02/05/14/37/The-impact-of-policies-and-regulation-on-ICT>

¹⁷⁵ <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2022/IPEC-2022.aspx>

¹⁷⁶ <https://academy.itu.int/training-courses/full-catalogue/universal-service-financing-efficiency-toolkit-0>

¹⁷⁷ <https://www.itu.int/itu-d/meetings/gsr/gsr-23/>

the adoption of the **GSR-23 Best Practices Guidelines**¹⁷⁸ on *Regulatory and economic incentives for an inclusive sustainable digital future* focusing on the deployment of digital infrastructure everywhere, in particular in rural, unserved and underserved areas.

- The **ITU Policy and Economics Colloquium (IPEC-23)**¹⁷⁹ for the Americas was held from 25 to 29 September 2023, in San Jose, Costa Rica. The IPEC-23 included the Regional Economic Dialogue (RED), a "masterclass" from the business planning for 5G infrastructure development training course, and the meeting of the ITU-T Study Group 3 Regional Group for Latin America and the Caribbean (SG3RG-LAC). The results from the **Q4/1 and Q5/1 joint workshop on challenges and opportunities of the use of USF for bridging the digital divide**¹⁸⁰ and a "joint deliverable" were presented.

2024

- The **GSR-24 Best Practice Guidelines**¹⁸¹ on *"Helping to chart the course of transformative technologies for positive impact"* are available in six languages.
- The **ITU Policy and Economic Colloquium for the Americas IPEC-24**¹⁸² took place in Lima, Peru, from 2 to 6 September, 2024. The IPEC-24 included the following events:
 - ITU-D Regional Economic Dialogue (RED)¹⁸³ including a session on ITU-D Study Group 1 Question 4/1: Economic aspects of national telecommunications/ICT,
 - ITU-R Economic aspects of spectrum management workshop¹⁸⁴,
 - Meeting of ITU-T Study Group 5 Regional Group for Latin America¹⁸⁵ (SG5RG-LATAM) and events related to the environment, climate change and circular economy,
 - Meeting of ITU-T Study Group 3 Regional Group for Latin America and the Caribbean¹⁸⁶ (SG3RG-LAC), and
 - the ITU-D Colloquium on New Technologies and the Internet ITEC-24¹⁸⁷.

¹⁷⁸ <https://www.itu.int/itu-d/meetings/gsr-23/consultation/>

¹⁷⁹ <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2023/IPEC-2023.aspx>

¹⁸⁰ <https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/joint-session-Q4-1-Q5-1-may23.aspx>

¹⁸¹ <https://www.itu.int/itu-d/meetings/gsr-24/consultation/contributions/>

¹⁸² <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2024/IPEC-2024.aspx>

¹⁸³ https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Events2024/IPEC-24/RED-24_Agenda.aspx

¹⁸⁴ https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Events2024/IPEC-24/ITU-R_Workshop.aspx

¹⁸⁵ <https://www.itu.int/en/itu-t/regionalgroups/sg05-latam/Pages/default.aspx>

¹⁸⁶ <https://www.itu.int/en/itu-t/regionalgroups/sg03-lac/Pages/default.aspx>

¹⁸⁷ <https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Pages/EVENTS/2024/ITEC-2024.aspx>

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