



# State of India's Digital Economy

2025



## **State of India's Digital Economy (SIDE) Report, 2025**

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# Glossary

<b>5G</b>	Fifth-generation technology standard for cellular networks	<b>ID</b>	Identity Document
<b>AI</b>	Artificial Intelligence	<b>IDI</b>	ICT Development Index
<b>AIPI</b>	Artificial Intelligence Preparedness Index	<b>IMF</b>	International Monetary Fund
<b>AR/VR</b>	Augmented Reality/Virtual Reality	<b>IMPACT</b>	International Multilateral Partnership Against Cyber Threats
<b>CAGR</b>	Compound Annual Growth Rate	<b>IoT</b>	Internet of Things
<b>CHIPS</b>	Connect-Harness-Innovate-Protect-Sustain framework	<b>IT</b>	Information Technology
<b>CODES</b>	Coalition for Digital Environmental Sustainability	<b>ITU</b>	International Telecommunication Union
<b>DeFi</b>	Decentralized Finance	<b>LLM</b>	Large Language Model
<b>DPI</b>	Digital Public Infrastructure	<b>LLMOps</b>	Large Language Model Operations
<b>eKYC</b>	Electronic Know-Your-Customer	<b>Mbps</b>	Megabits Per Second
<b>EGDI</b>	E-Government Development Index	<b>MeitY</b>	Ministry of Electronics and Information Technology
<b>EMDEs</b>	Emerging Markets and Developing Economies	<b>MSCI</b>	Morgan Stanley Capital International
<b>Fintech</b>	Financial Technology	<b>NRI</b>	Network Readiness Index
<b>G7</b>	Group of 7 countries, an intergovernmental forum	<b>OTT</b>	Over-the-top services/platforms
<b>G20</b>	Group of 20 countries, an intergovernmental forum	<b>PPP</b>	Purchasing Power Parity
<b>G32</b>	Group of 32 countries, as classified in SIDE 2025 Report	<b>R&amp;D</b>	Research & Development
<b>GB</b>	Gigabyte	<b>RoW</b>	Telecommunication Right of Way Rules
<b>GDP</b>	Gross Domestic Product	<b>SHG</b>	Self-help group
<b>GNI</b>	Gross National Income	<b>SIDE</b>	State of India's Digital Economy Report
<b>GPU</b>	Graphic Processing Unit	<b>SLM</b>	Small Language Model
<b>GSMA</b>	Global System for Mobile Communications Association	<b>UPI</b>	Unified Payment Interface
<b>HIC</b>	High Income Countries	<b>USD</b>	United States Dollar
<b>ICT</b>	Information and Communications Technology	<b>VC</b>	Venture Capital



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***All errors remain our own.***



# Executive Summary

## Digitalisation in the AI age cannot be measured with traditional metrics

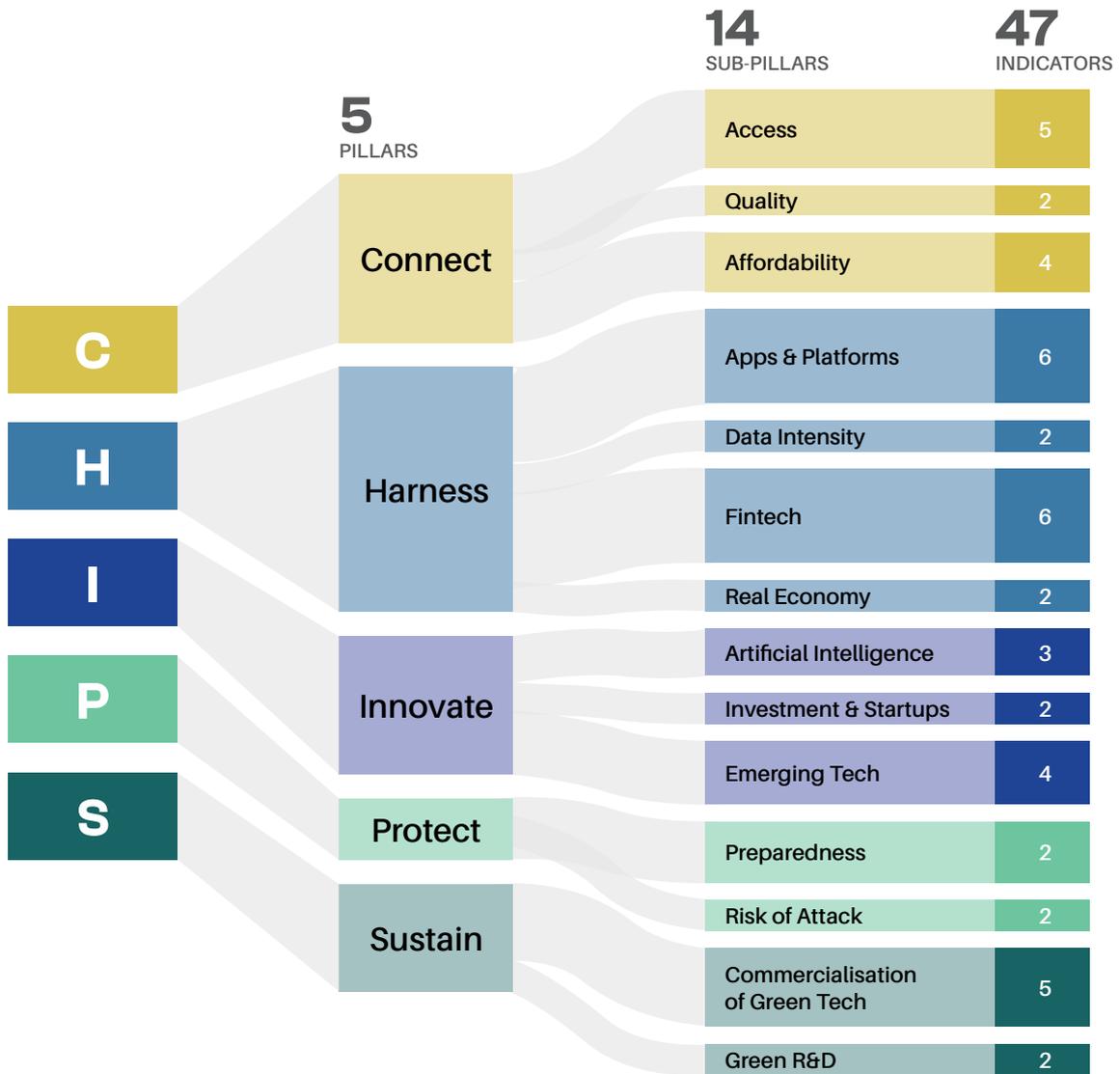
Many global indices on digitalisation have consistently underestimated the digital potential of large emerging markets. For example, IMF's Artificial Intelligence Preparedness Index (AIPI), ITU's ICT Development Index (IDI), United Nation's E-Government Development Index (EGDI) and Portulans Institute's Network Readiness Index (NRI) have maintained that the developed countries including European countries are digitally more advanced than emerging markets such as Brazil, China, India and Indonesia. With Deepseek in China, Aadhaar, world's largest digital identity program in India, Pix, an interoperable real time payments system in Brazil, digital wallets in Indonesia and neobanking in Nigeria, developing countries are not only moving from the margins to mainstream of digital innovation, they now accounting for the global majority of internet and smartphone users, making them an integral part of the global digital economy.

While digitalisation has altered the ways in which nations produce and consume, pathways to greater digitalisation have varied across countries. Global indices that often rely on the approaches adopted by developed countries, overlooking the unique pathways chosen by the developing world. The Connect-Harness-Innovate-Protect-

Sustain (CHIPS) framework introduced in the State of India's Digital Economy (SIDE) 2023 report, and fine-tuned in the SIDE 2024 report, provides a realistic assessment of the global digital landscape (see Figure ES 1). Through a multi-layered structure, it better captures elements that define the breadth and depth of digitalisation than that of traditional global indices.

In this edition of SIDE, we make two important improvements. First, we merge the two indices introduced in SIDE 2024 - CHIPS Economy and CHIPS User - to produce CHIPS Combined, which provides a single measure of the state of digitalisation of a country. CHIPS Economy measures digitalisation at an aggregate level and CHIPS User measures digitalisation at the level of a representative unit. CHIPS Economy is akin to the idea of measuring a country's GDP and provides an estimate of the scale (breadth) of digitalisation. CHIPS User can be understood as equivalent to measuring the per capita income, assessing the intensity (depth) of digitalisation at the unit level. CHIPS Combined accounts in equal proportion for both, scale economies, as well as user-level outcomes. Second, we expand the list of countries to 32 from the 19 analysed in SIDE 2024.

Figure ES 1 The CHIPS 2025 Framework



Source: ICRIER-Prosus Centre (IPCIDE)

## India continues to be the third largest digitalised economy in the world

Based on aggregate levels of digitalisation, as measured by CHIPS Economy, India ranks as the third largest digitalised country in the world, behind China and the US, and ahead of South Korea, UK, and Singapore. India's high rank should not come as a surprise to the close observer of its digital economy. It has the world's second largest mobile and internet network by number of users. Few countries see data traffic per smartphone as high as in India. The country has rolled out 5G faster than in other countries, albeit from a low base. India is also the global leader in terms of the volume of digital transactions and export of ICT services.

The rise of India in the ranking table is part of a larger story of the rise of the Global South in the world's digitalisation map. China, a close second to the United States, is the second most digitalised country in the world, when measured by CHIPS Economy. Brazil and Thailand are ranked 10th and 12th respectively, and Nigeria is the 18th largest digitalised nation in the world, overtaking many G7

countries. Many of these countries enjoy the same advantage as India in terms of having a relatively higher GDP and larger population, though none to the extent India does. An exception to the scale explanation is Singapore, which despite its modest population, emerges as sixth largest digitalised nation in the world, largely on back of an affordable, high quality, innovative and secure digital ecosystem.

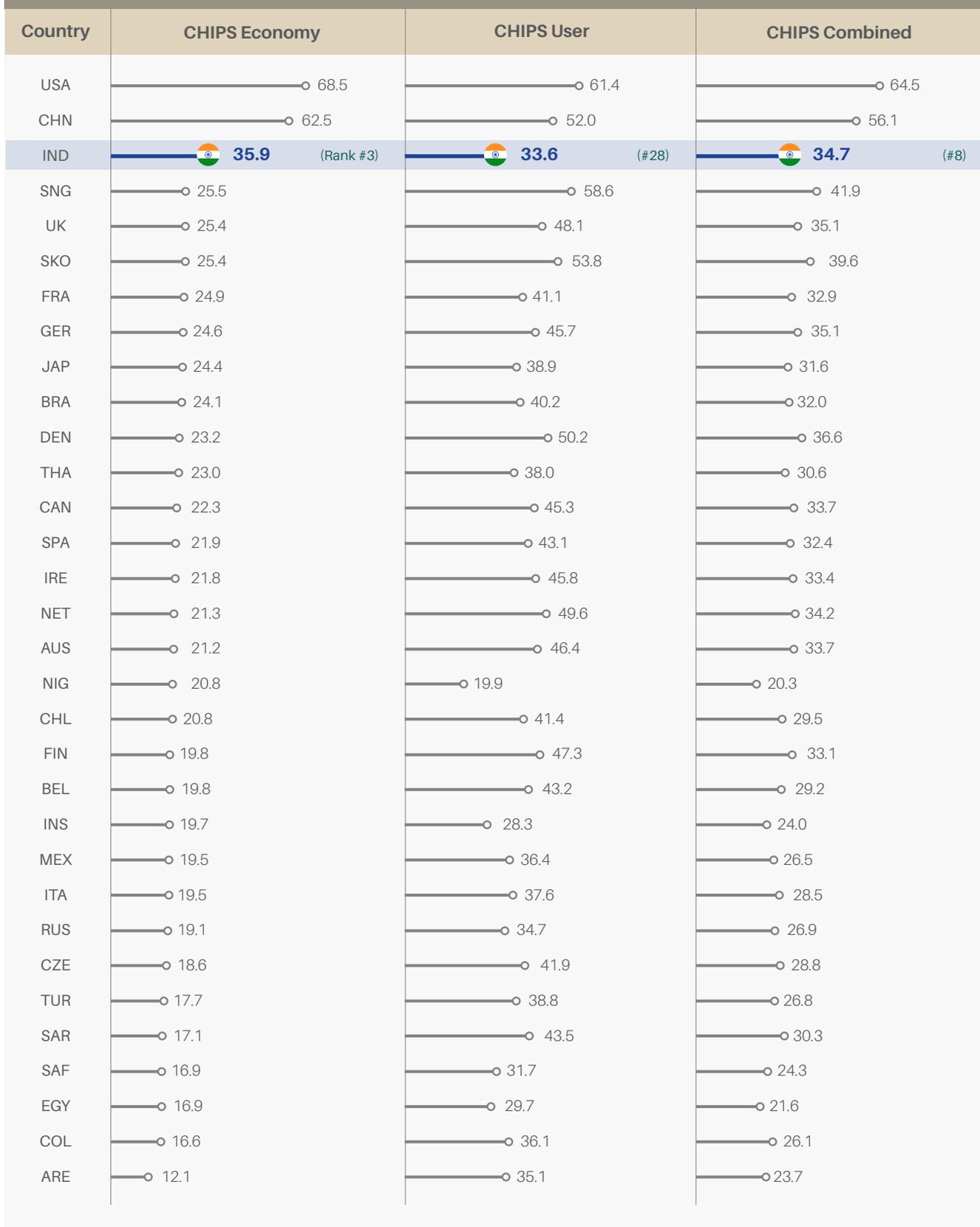
India's rank however precipitously falls to 28th position on the relative scale, i.e., CHIPS User. This means while India as a country has achieved high level digitalisation at the aggregate level, the level of digitalisation for the average Indian remains fairly modest. On the flip-side, it implies that India has the potential to sharply increase its user-level ranking given its large under-connected population and a rapidly growing digital economy. In fact, India's digital economy is growing at twice the rate of its overall economy, and is expected to become one-fifth of the economy by 2029.

## India is placed eighth in the combined CHIPS ranking

India emerges as the eighth most digitalised nation among the G32 for CHIPS Combined. The top seven countries that are ahead of India are United States, China, Singapore, South Korea, Denmark, United Kingdom and Germany (see Figure ES 2). The ranking of countries using CHIPS framework varies considerably from what one would see in the traditional indices, as it includes a combination of countries that enjoy significant scale (breadth)

effect, such as China, US and India, with those that have strong intensity (depth) effect, namely, Singapore, Korea and Denmark. Several large emerging markets and developing economies (EMDEs) such as Brazil, Nigeria, and Indonesia, which performed well on CHIPS Economy, saw their ranking slide in CHIPS Combined, for the same reason as that of India's.

Figure ES 2 India ranks third at the economy level, but eighth overall



Source: ICRIER-Prosus Centre (IPCIDE)

## **Connect:** The need for another Big Push

Despite considerable effort and investment, the Connect pillar remains India's Achilles heel ranking 18th among 32 countries in our sample (see Figure ES 3). A true picture of contrast, India's second largest network of internet and smartphone users globally, coexists with over 40 percent non-users of internet and over 50 percent without smartphones. Being the country with the largest population gives it unprecedented scale, but having the lowest per capita among G32 burdens it with a large share of unconnected population. However, things are looking up and are expected to improve significantly in the coming years. Data from the recent ICUBE survey finds that the growth of rural internet users is twice that of urban internet users, and that for smartphone it is about 1.5 times, showing a narrowing of digital divides.

While developing countries generally rely on mobile based internet networks as compared to the predominance of fixed line in developed countries, in case of India, the imbalance between mobile and broadband networks seems unusually high. In fact, India is the only country, other than Nigeria (in our sample) where the traffic flow on mobile networks is higher than the fixed network. While a mobile-first network has helped accelerate adoption of internet in India, the lack of a complementary fibre backbone risks resiliency and can adversely affect the country's digital ambition. With some of the recently announced policy steps, India's communications network is likely to rebalance in favour of fixed line infrastructure.

## **Harness:** The rise of the global south

Harness is India's strongest pillar and it ranks third, following China and the US (see Figure ES 3). In Harness, India's highest score comes from the Real Economy sub-pillar. This is on account of its high ICT services export and the third-highest market capitalisation of its IT sector, following US and China. Overall, India's strong performance in Harness is explained by its large and young population, that is eager to adopt new technologies, increasing penetration of mobile internet, and successful rollout of digital public infrastructures (DPIs) such as Aadhaar, Unified Payment Interface (UPI) and Digilocker. See Annexure 5 for survey results on adoption of digital technologies by India's youth. Besides being a huge consumer of digital technologies and services, India is also a large producer – strong domestic foundations of an

IT services industry and the second largest exporter globally, after Ireland.

Other emerging economies also perform relatively well in Harness - Brazil ranks fourth in the apps and platform sub-pillar, Saudi Arabia is placed second in data intensity, Nigeria ranks third in fintech and Chile is among the top ten countries, both for apps and platform as well as data intensity. Users of digital technologies in developing countries far outnumber those in advanced economies. In the last twelve months, for G20 countries, the number of users for e-commerce, video-on-demand, food delivery and digital health in developing countries grew by 10.7 percent compared to 7.1 percent in developed countries.

## **Innovate:** Towards a global duopoly?

Home to the world's tech giants, US remains the undisputed leader in digital innovation with a score that is twice as high as the next in line, China. The latter is rapidly evolving from being an imitator to becoming a lead innovator for frontier technologies. Both countries have also taken a decisive lead in Artificial Intelligence (AI), compared to the rest of the world. They account for 70 percent of the valuation of unicorns and 80 percent of venture capital (VC) investments in AI across 32 countries in our sample. US and China are also the leading adopters of several emerging technologies - internet of things (IoT), metaverse, augmented and virtual reality (AR/VR).

India ranks 9th in the Innovation Pillar, which is impressive given that it is the country with the

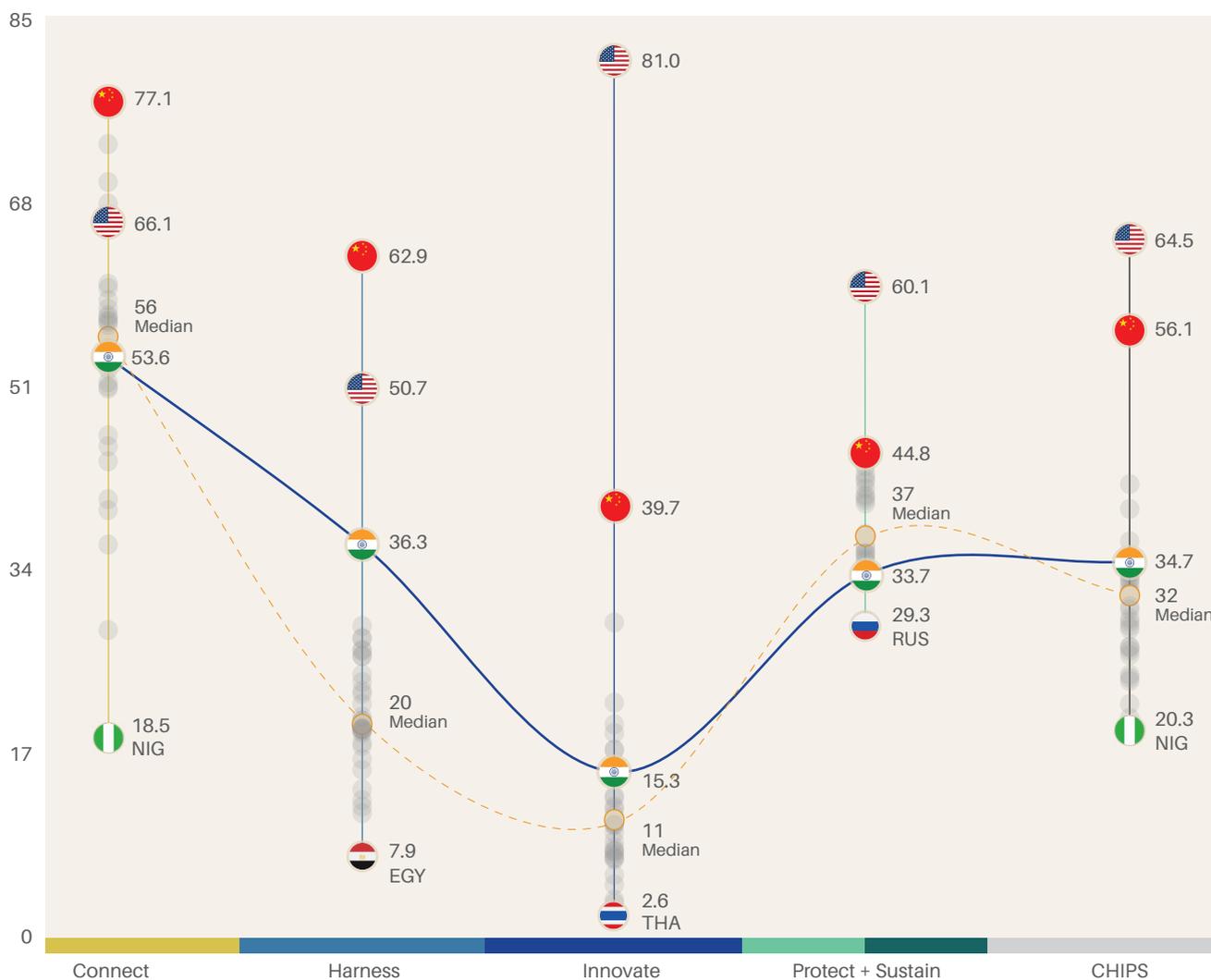
lowest per capita income in the group (see Figure ES 3). India performs particularly well (rank 4th) on investments and startups, reflecting its status as home to the third largest number of unicorns in the world, and continues to receive fairly large sums of venture capital funds. India is also a large consumer of decentralised finance (DeFi), but lags in adoption of other emerging technologies such as Consumer IoT. Particularly worrying is the finding that India lags in the AI sub-pillar (rank 13th) resulting from low infrastructure availability and lack of competing deep tech research. With the government's focus on the IndiaAI mission and several other complementary policies, the country has an opportunity to truly own and power indigenised AI models that can compete in global markets.

## **Protect and Sustain:** Lurking threats to gains from digitalisation

A quick look at the combined scores for Protect and Sustain (PS) Pillar suggest that the difference in the performance among countries is not as high as we saw in the previous three pillars (Figure ES 2). That's the result of two opposing forces, with developed countries scoring high on Protect and developing countries performing better on Sustain. Developed countries with their longer history of digitalisation are not only more prone to cyberattacks, they have also invested relatively more in safeguarding their networks. On the other hand, developing countries that are in the process of building digital infrastructure have the opportunity to invest in many new technologies that support greening of digitalisation, including the adoption of life cycle assessments that rationalise e-waste and energy consumption.

India however performs poorly on both pillars. In fact, PS is India's poorest performing pillar in the CHIPS framework (see Figure ES 3). The overall rank for India is 25th, and the lowest ranking sub-pillar is Preparedness (26th), followed by Green R&D (23rd). India's large population gives it the advantage of scale but also creates risk of cyber threats and environmental degradation due to rapid digitalisation. Concerted policy efforts will be necessary to safeguard India's digital ecosystem from both these risks.

Figure ES 3 Unpacking CHIPS Score by Pillars



Source: ICRIER-Prosus Centre (IPCIDE)

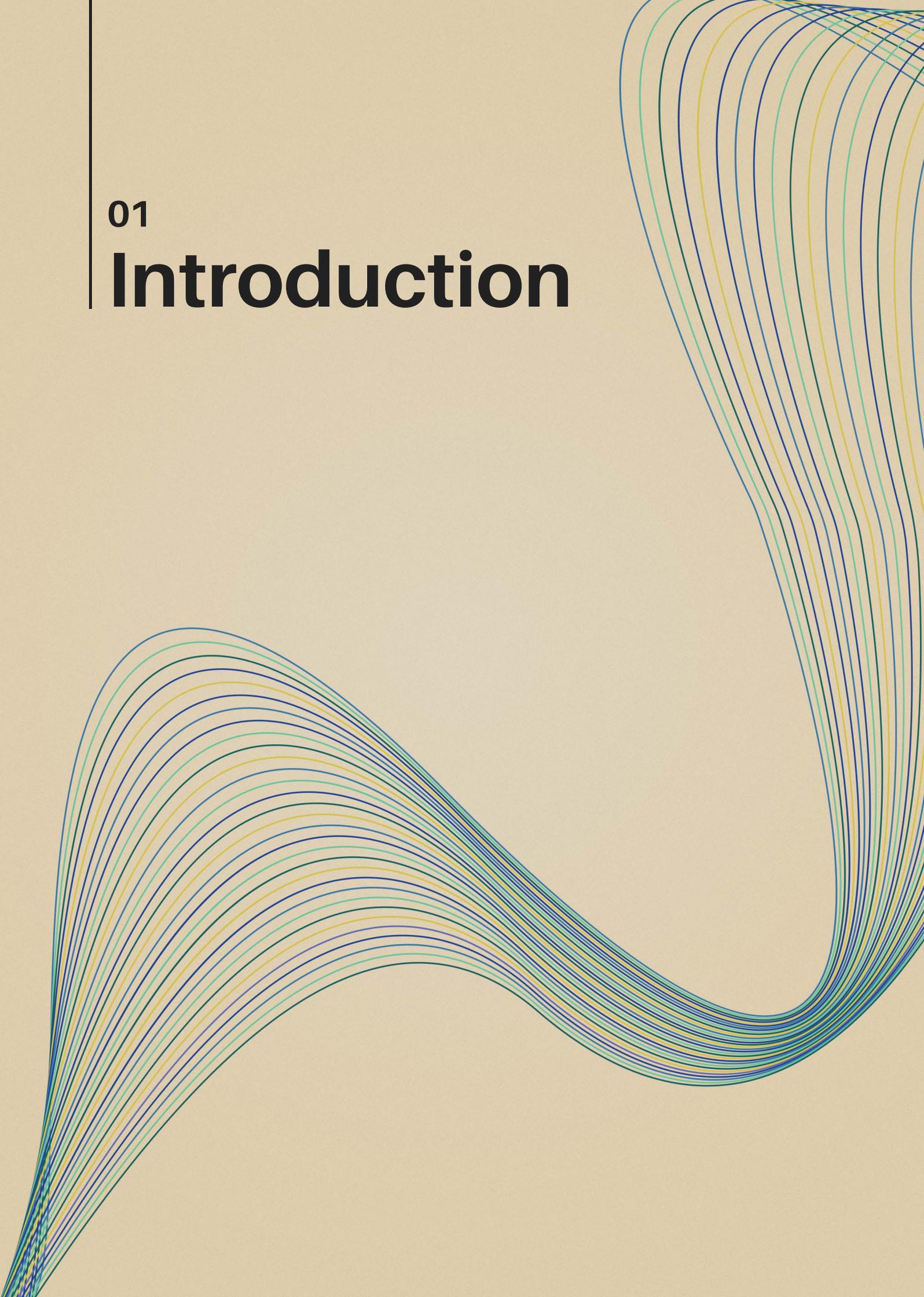
## CHIPS as a Policy Tool

CHIPS is not just a framework for measuring digitalisation and ranking countries (or states, in a sub-national context) on their relative performance, it can be a useful diagnostic tool for policymakers to identify gaps and design interventions. In a macro sense, the framework helps benchmark a country to world frontiers and world averages. Comparison is

also possible within different country groupings – G20, BRICS, European Union and notable countries from ASEAN, Latin America and Africa. In the report, we provide illustrative examples of how CHIPS can be used as a diagnostic tool using Digital Heatmaps, Digital Diffusion Pyramids and Digital Drill Downs.

01

# Introduction



# New Digital Paradigm, New Digital Metrics

## 1.1. Digitalisation in the AI age cannot be measured with traditional metrics

Digital potential of developing markets is missing in popular global indices. In mid-2024, the International Monetary Fund (IMF) released their Artificial Intelligence Preparedness Index (AIPI) that assessed the level of AI readiness across 174 countries. It ranked China at 30, while placing seven developed countries in the top 10 - Denmark (2), Netherlands (4), Estonia (5), Finland (6), Switzerland (7), Germany (9) and Sweden (10).<sup>1</sup> No wonder when news broke that Deepseek, a Chinese AI startup, had launched an affordable AI chatbot that matched OpenAI's ChatGPT, the world went into a meltdown.<sup>2</sup> Many global indices on digitalisation like the one from the IMF have consistently underestimated the digital potential of large emerging markets such as Brazil, China, India and Indonesia, while maintaining that the developed countries including European countries are digitally more advanced. Metrics developed for measurement in the early days of telecom and internet - the ICT Development Index (IDI) by International Telecommunication Union (ITU), E-Government Development Index (EGDI) by United Nations, and Network Readiness Index (NRI) by the Portulans Institute (formerly World Economic Forum) - despite their periodic revisions, continue to drive the perception that high-income-countries (HICs), including Small HICs are digitally ahead and contribute more to global digital innovation.<sup>3</sup>

The methodological flaws in these rankings were discussed in SIDE 2024.<sup>4</sup> These include: (i)

overlooking the network or aggregate effect of digitalisation, thereby overlooking the economies of scale that large developing countries enjoy with regard to internet users, volume of transactions and data; (ii) focusing on selective aspects of digitalisation and lacking a comprehensive view of digitalisation that includes not only harnessing technology for development, but also protecting users from digital harms and building sustainable digital networks; and (iii) suffering from double counting, namely including both outcomes and inputs (enablers) of digitalisation in the index, thereby amplifying the difference between strong and weak performers.

With developing countries moving from the margins to mainstream of digital innovation, indices that put Global North at the top, can be said to be, behind times. India, South Africa and other developing countries are leveraging the Airfibre technology that relies on wireless radio frequency signals to transmit data through the air. It is cheaper than laying down fibre and provides flexible solutions for connectivity in remote areas.<sup>5</sup> Developing countries like India with their Unified Payments Interface and the upcoming Unified Lending Interface, Brazil with Pix and Nigeria with their neo-banking solutions, are all examples of ground-up innovation to address the challenge of financial exclusion.<sup>6</sup> Deepseek, mentioned above, is a Large Language Model (LLM) that uses significantly lower compute power, but matches the accuracy of top of the

<sup>1</sup> International Monetary Fund. (2024). *AI Preparedness Index (AIPI)*.

<sup>2</sup> Ng, K., Drenon, B., Gerken, T., & Cieslak, M. (2025, February 04). *DeepSeek: The Chinese AI app that has the world talking*. BBC.

<sup>3</sup> EGDI was first published in 2001 NRI was launched in 2002. The first edition of IDI dates back to 2009. While these indices have been redesigned subsequently, their approach to measuring digitalisation continues to be narrow and overlooks technological innovation that enable developing countries to leapfrog

<sup>4</sup> Mishra, D., Kedia, M., Reddy, A., Ramnath, K., & Manish, M. (2024, February 16). *State of India's Digital Economy 2024*. ICRIER.

<sup>5</sup> All Tech Magazine. (2024, April 06). *What is Air Fiber Internet Technology and How it Works?*

<sup>6</sup> Chandra, K., Jayakrishnan, A., Fernandes, R B., Paulo, C B., Boechat, P., & Kashyap, S. (2024, September 20). *From Brasilia to Bombay: The unlikely twins leading a global open finance revolution*. Centre for Digital Public Infrastructure.

table LLM enabled chatbots provided by American tech companies. Along with important innovation breakthroughs, developing countries now account for majority of internet users, smartphone owners, and social media consumers, making them an integral part of the global digital economy.

Technological advancements have helped developing nations leapfrog and challenge well-understood growth trajectories. While digitalisation

has altered the ways in which nations produce and consume, the approach to digitalisation has also varied by countries. These non-linearities are often missing in computation of global indices which rely more on the approaches adopted by developed countries. Mario Draghi's recent report highlights the declining competitiveness of European businesses and explains how many factors that supported growth in the past are unlikely to provide momentum to their economies in the future.<sup>7</sup>

## 1.2. A new way to measure digitalisation: The CHIPS framework

The Connect - Harness - Innovate - Protect - Sustain (CHIPS) framework introduced in the State of India's Digital Economy (SIDE) 2023 report, provides a comprehensive assessment of the digital ecosystem. Through a multi-layered structure (see Figure 1.1) it captures elements that define the breadth and depth of digitalisation. The five pillars measure the entire spectrum of digital transformation. The 'Connect' pillar measures all aspects of meaningful connectivity - access, affordability, and quality, as defined by the ITU.<sup>8</sup> The 'Harness' pillar captures how digital technologies are being used and leveraged for various purposes and its contribution to the economy. The 'Innovate' pillar covers indicators related to the adoption and development of AI and other emerging technologies, as well as the start-up ecosystem. The fourth pillar, 'Protect,' measures a country's preparedness against and vulnerability to cybercrimes, and the risk of attacks and breaches. The 'Sustain' pillar measures efforts towards adopting environmentally sustainable digital technologies as well as the use of digital technologies to promote environmental sustainability.

Each pillar is sub-divided into sub-pillars and each sub-pillar is measured using two or more indicators.

This structure allows for the framework to be used modularly to compare pillars in isolation, as well as a comprehensive overview of overall digitalisation. The indicators included attempt to capture different aspects of digitalisation as experienced by a range of stakeholders including individuals, businesses, and governments, with the most updated data available.

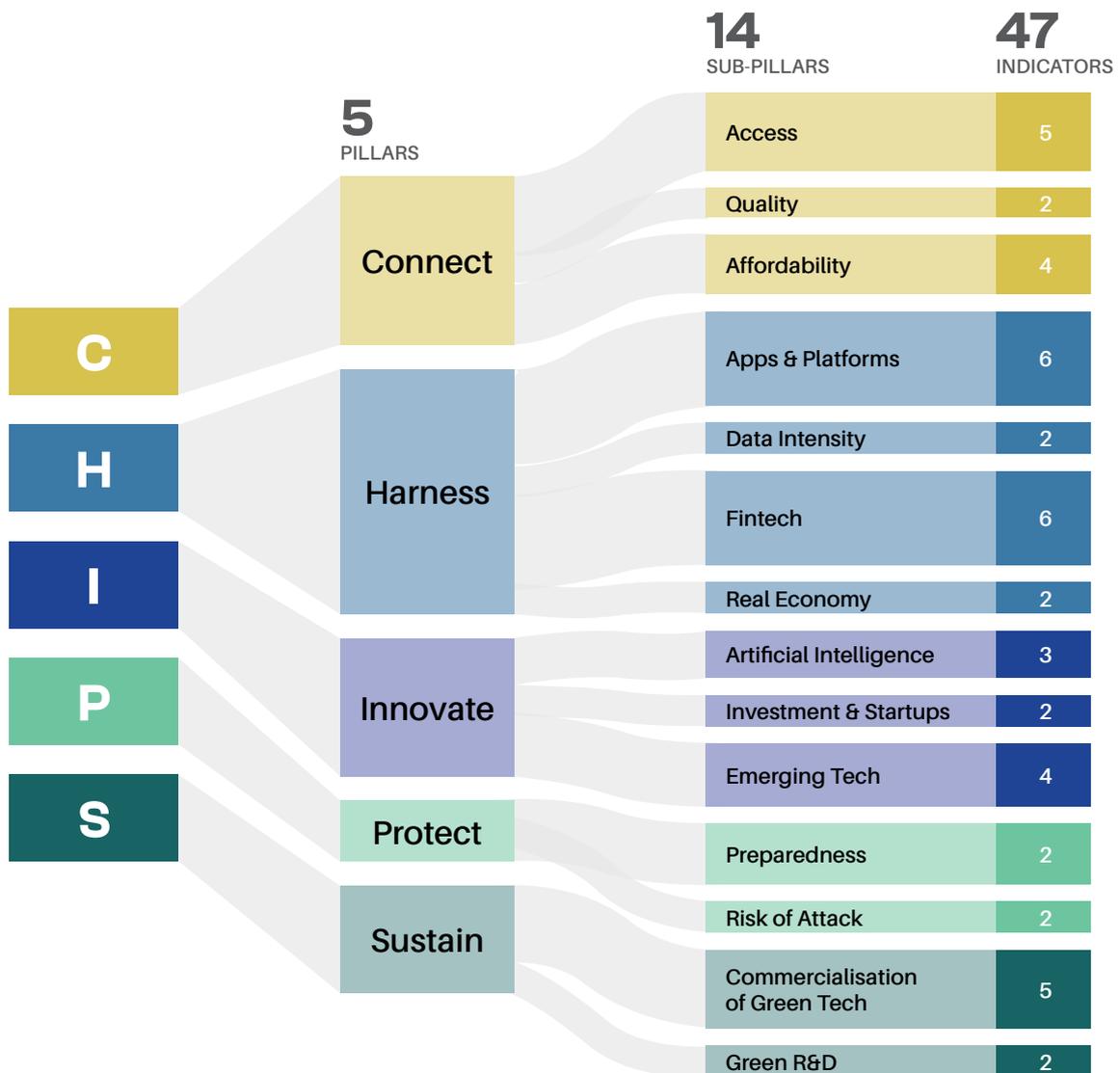
Similar to SIDE 2024, we have two versions of the index - CHIPS Economy and CHIPS User. CHIPS Economy measures digitalisation at an aggregate level and CHIPS User measures digitalisation at the level of a representative unit.<sup>9</sup> CHIPS Economy is akin to the idea of measuring a country's GDP and provides an estimate of the scale (breadth) of digitalisation. CHIPS User can be understood as equivalent to measuring the per capita income, assessing the intensity (depth) of digitalisation at the unit level. This year we also combine the two to produce CHIPS Combined, which provides a single measure of the state of digitalisation of the country. CHIPS Combined accounts in equal proportion for both, scale economies, as well as user-level outcomes.

<sup>7</sup> Draghi, M. (2024, September 09). *The future of European competitiveness: Report by Mario Draghi*. European Commission.

<sup>8</sup> International Telecommunication Union. (2022). *Global Connectivity Report 2022*.

<sup>9</sup> The unit varies depending on the indicator. In majority of cases, it is the average user and in other cases it is the average firm or enterprise or average investment or equity prices.

Fig. 1.1 CHIPS Framework 2025



Source: ICRIER-Prosus Centre (IPCIDE)

CHIPS Economy and CHIPS User are based on identical indicators. The difference is CHIPS Economy is an absolute measure while those in CHIPS User are normalised by relevant macro indicators including population, number of internet users, GDP, etc. To provide an example, for CHIPS Economy the indicator for internet users is the total number of internet users in a country, while for CHIPS User it is the share of internet users in population. For CHIPS Combined we use a combination of

absolute and relative indicators. Each indicator is standardised in order to enable comparison, and aggregation into the index. A total of 47 indicators are grouped into 14 sub-pillars, which aggregate to the 5 pillars of CHIPS. Detailed methodology is provided in Annexure 2.

SIDE 2025 makes two important improvements over SIDE 2024. First, it introduces the concept of CHIPS-Combined – a single summary measure of

digitalisation for each country -to enable easier cross-country comparison. Second, it includes 13 new countries in addition to 19 G20 countries that were assessed and ranked in SIDE 2024. These 13 countries were selected based on the size of their GDP as well as population and regional

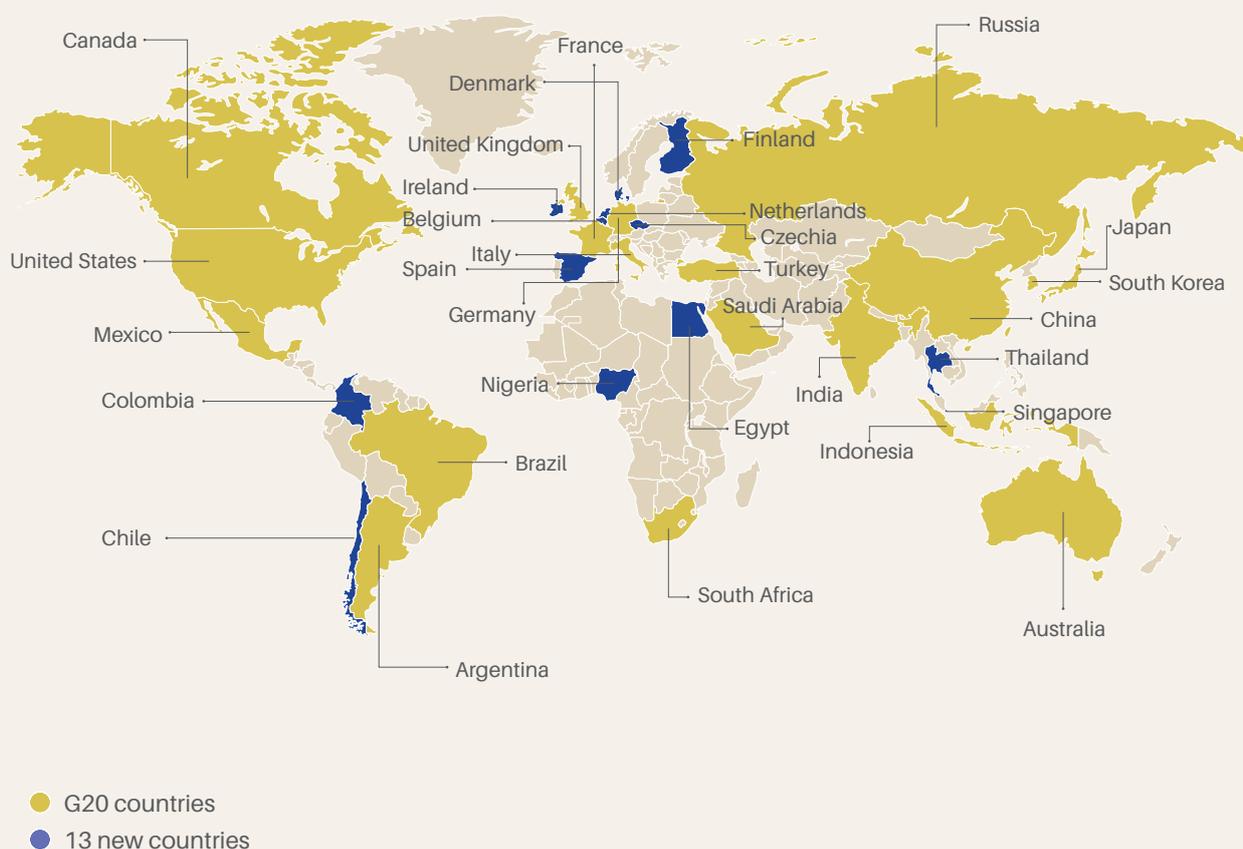
representation. The total of 32 countries under consideration comprise 66 percent of the global population, 72 percent share of global internet users and 84 percent of mobile subscribers. See Box 1.1 for more details on the selection process for new countries.

### Box 1.1: Selection of 32 countries (G32) for SIDE 2025

To expand the list of countries for assessment, we added to the existing list of 19 countries from the G20 to include 13 more. The selection was based on the following criteria:

- Belongs to the top 60 countries in the world by GDP PPP (2023)
- Minimum population of 15 million (2023)
- Regional representation
- Data available for at least 85 percent of indicators included in the CHIPS framework

The following 13 countries met the above criteria, and along with the 19 countries, form the Group of 32 countries: Africa (Nigeria, Egypt), Asia (Singapore, Thailand), Europe (Belgium, Czechia, Denmark, Finland, Ireland, Netherlands, Spain), Latin America (Chile, Colombia)



To ensure contemporary relevance of the CHIPS framework, we had to make three changes: changing sub-pillars; replacing indicators with more relevant ones, and changing the weights to ensure internal consistency (see Box 1.2). We replaced indicators under the AI sub-pillar to better capture the quality of infrastructure and research outputs, which were missing in SIDE 2024. We also used newer data, where available, replacing 2024 or 2023 data with more up-to-date numbers. Additionally, sub-pillars

have also been reorganised, reducing the number of sub-pillars from 16 to 14 and indicators from 50 to 47 for both CHIPS Economy and CHIPS User. The changes in SIDE 2025 are summarised in Box 1.2. However, for continuity of comparison the 2024 series for G20 countries has been recreated with old indicators. While G32 and CHIPS 2025 are the main focus of this report, we do provide comparisons for the G20 countries between 2024 and 2025 using the old data set.

## Box 1.2: Changes in CHIPS 2025

### Change in Sub-pillars

- We dropped the Trust sub-pillar from Protect as data for the expanded list of countries was not available from the original survey source used in SIDE 2024
- Fintech Public and Fintech Private sub-pillars, were combined into a single Fintech sub-pillar. Since the new Findex data (as sourced from the Global Findex Database, World Bank) is still to become available, we reduced the weights and combined data from the existing Findex into a single sub-pillar

### Change in Indicators

- Indicators in the AI sub-pillar for Innovate were changed. AI publications and contributions to GitHub AI projects were both dropped given their narrow scope and replaced with the sub-index score for Research in AI from Tortoise Media's latest Global AI Index
- The score for Infrastructure for AI was also added from Tortoise Media's Global AI Index as another indicator under the AI sub-pillar. While Infrastructure is usually thought of as an input, given the evolving nature of AI, the capacity to compute and run AI models and applications are being used as outputs, at least intermittently
- ICT value added was changed to IT market capitalisation, given the lack of credible data on ICT value added for most countries. Since there is no clear definition of ICT value added, countries exercise discretion in measurement, making the estimates incomparable. ICT market capitalisation has been estimated from the MSCI ICT sectoral weights for individual countries (as sourced from Morgan Stanley Capital International (MSCI) Index)
- Cybersecurity spending was changed to cybersecurity revenue. Source previously used for cybersecurity spending did not have data for several countries in the expanded G32. Cyber security revenue data is from Statista
- Number of startups as a percent of ICT value added has now been normalised as number of startups per number of listed companies. This was due to the lack of authenticity and comparability in ICT value added data
- Indicator on cyber security patents has been dropped due to unavailability of data for several countries in G32

### Change in Weights

- The weight assigned to an indicator is reduced to half, if the previous year value is used. This is applicable to five indicators in G32 and six indicators and one sub-pillar in G20. Details available in Annexure 2

02

# Global Ranking



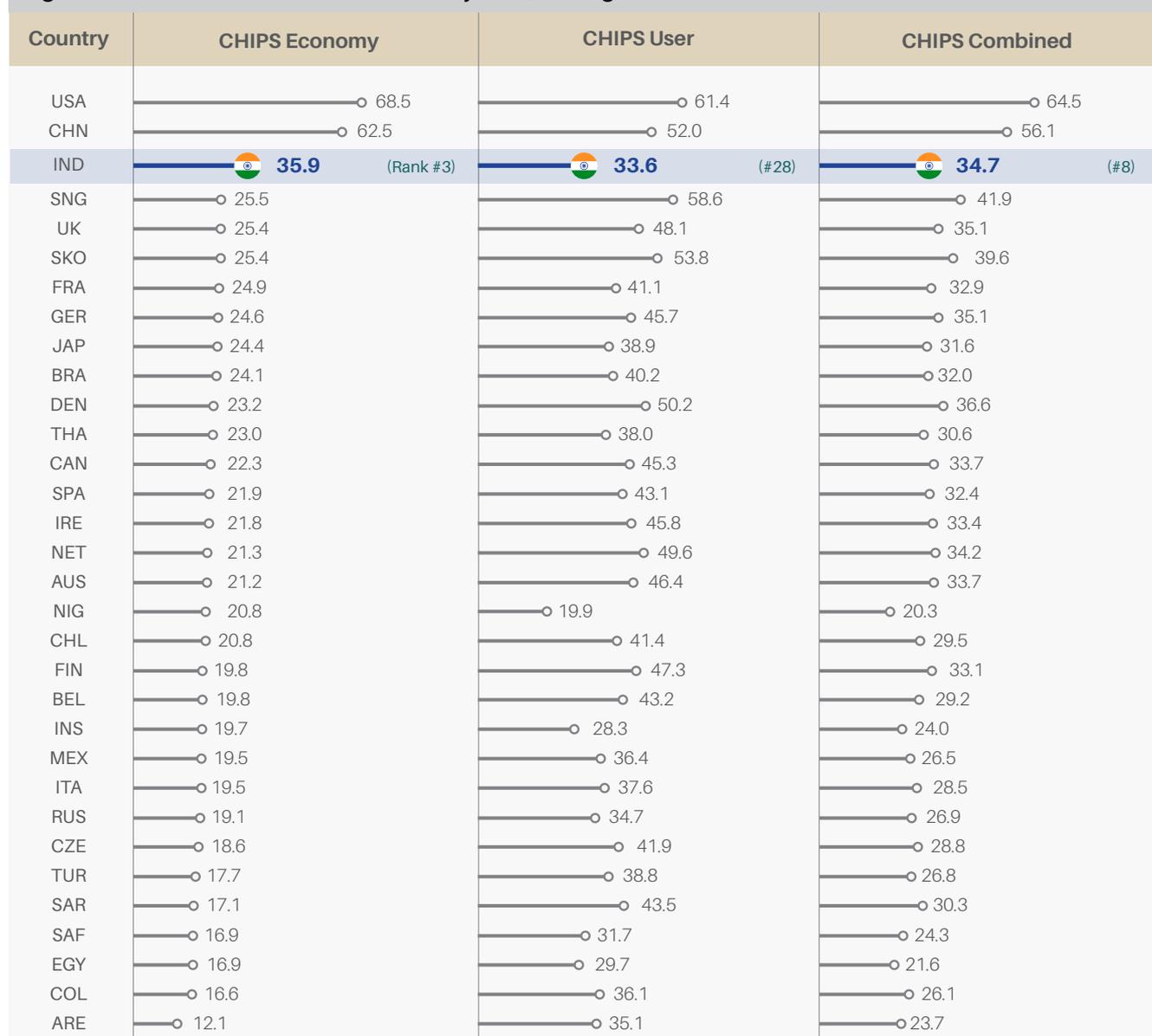
# A New Digital World Atlas

## 2.1. India continues to be the third largest digitalised economy in the world

Based on aggregate levels of digitalisation, as measured by CHIPS Economy, India ranks as the third largest digitalised country in the world, behind China and the US, and ahead of South Korea, UK, and Singapore. The fact that India has maintained its third position from SIDE 2024, despite two notable changes in the framework – expansion of the sample from 19 to 32 countries and replacing

indicators where India performed well (e.g., contribution to AI GitHub) with ones where it is lagging behind (e.g., AI research) – is reassuring of India’s digital potential (see left column, Figure 2.1). Moreover, India’s third position is unlikely to be challenged anytime soon given the large difference in its score vis-à-vis countries that are ranked below her.

**Fig 2.1 India ranks third at the economy level, but eighth overall**



India's high rank should not come as a surprise to the close observer of its digital economy. It has the world's second largest mobile and internet network by number of users. Few countries see data traffic per smartphone as high as it is in India. The country has rolled out 5G faster than in other countries, albeit from a low base. It is also the global leader in terms of the volume of digital transactions and export of ICT services. India has become the largest contributor to global GitHub AI project, and ranks third in the number of homegrown unicorns. During its G20 Presidency, India was recognised as the champion of digital public infrastructures (DPIs) and is also seen as a well-established digital powerhouse. Many of these aspects are further unpacked in the ensuing chapters.

Importantly, the rise of India in the ranking table is part of a larger story of the rise of the Global South in the world's digitalisation map. China, a close second to the United States, is the second most digitalised country in the world, when measured by CHIPS Economy. Brazil and Thailand are ranked 10th and 12th respectively, and Nigeria is the 18th largest digitalised nation in the world, overtaking many G7 countries.<sup>10</sup> Many of these countries enjoy the same advantage as India in terms of having a relatively higher GDP and larger population, though none to

the extent that of India. An exception to the scale explanation is Singapore, which despite its modest population, emerges as sixth largest digitalised nation in the world, largely on back of an affordable, high quality, innovative and secure digital ecosystem. Singapore's performance is discussed in more detail in the subsequent chapters.

India's rank however precipitously falls to 28th position on the relative scale, i.e., CHIPS User. This means while India as a country has achieved high level digitalisation at the aggregate level, the level of digitalisation for the average Indian remains fairly modest. The only four countries that perform worse than India are Egypt, Indonesia, Nigeria and South Africa (see centre column, Figure 2.1). While the addition of new countries and new indicators didn't affect India's ranking for CHIPS Economy, it significantly altered its position in CHIPS User.<sup>11</sup> This is because the user-level scores are clustered around a small range, and a small change in score can have a large change in rank. This also implies that India has the potential to sharply increase its user-level ranking given its large under-connected population and a rapidly growing digital economy. In fact, India's digital economy is growing at twice the rate of its overall economy, and is expected to become one-fifth of the economy by 2029.<sup>12</sup>

## 2.2. India is placed eighth in the combined CHIPS ranking

While CHIPS Economy and CHIPS User provide different lenses to view the digital economy, for a complete overview and assessment, a combined perspective is necessary. This is the first time we are reporting the CHIPS Combined score. India emerges as the eighth most digitalised nation

among the G32 for CHIPS Combined. The top seven countries that are ahead of India are United States, China, Singapore, South Korea, Denmark, United Kingdom and Germany (see right column, Figure 2.1). The ranking of countries using CHIPS framework varies considerably from what one

<sup>10</sup> Our sample consists of some of the largest (by GDP and population) and richest countries in the world. It is unlikely that any of the countries that are not included in our sample would be more digitalised than these 32 countries. Therefore, we often loosely describe a country's ranking as Xth in the world, even if it is Xth among the G32 countries.

<sup>11</sup> In 2024, India was placed 12th in the CHIPS User table among the G20 countries.

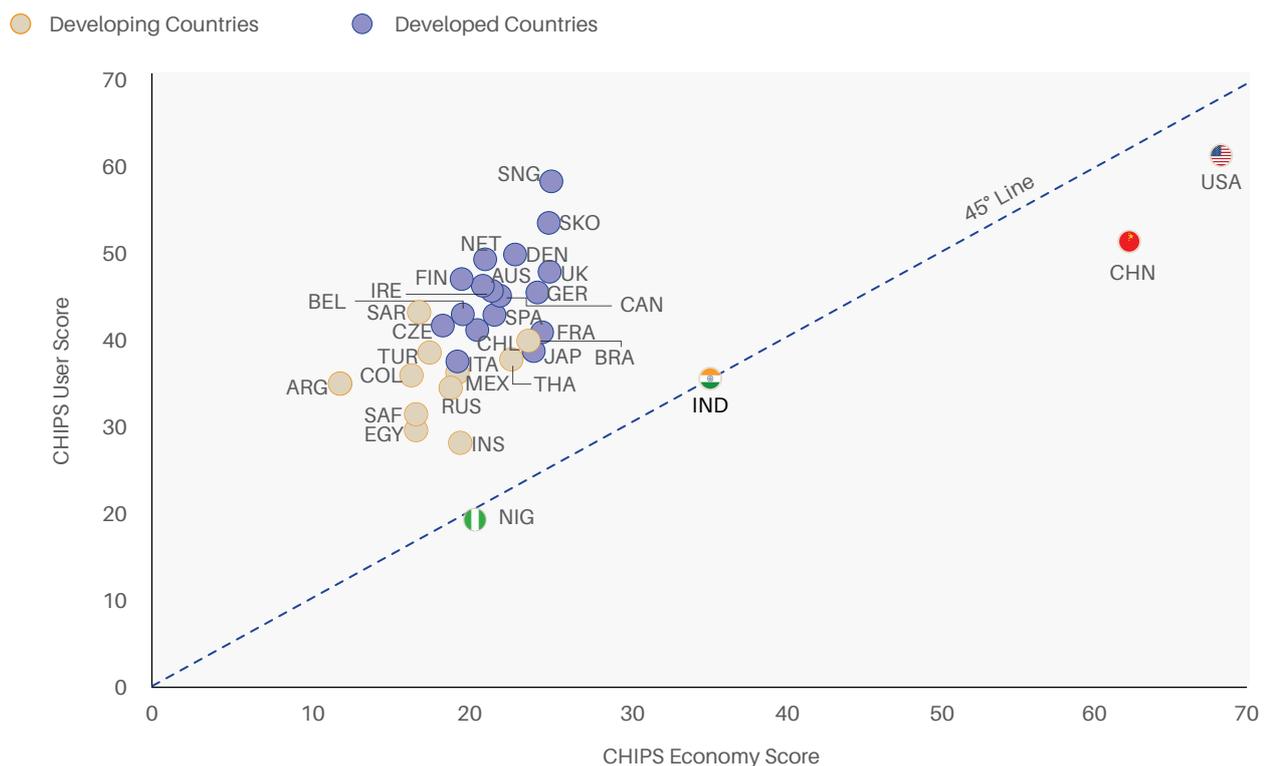
<sup>12</sup> ICRIER. (2025, January 22). *Estimation and Measurement of India's Digital Economy*. Ministry of Electronics and Information Technology

would see in the traditional indices, as it includes a combination of countries that enjoy significant scale (breadth) effect, such as China, US, and India, with those that have strong intensity (depth) effect, namely, Singapore, Korea, and Denmark.

The CHIPS Combined ranking holds many interesting insights. First, the US, continues to lead the global digital economy with a high score in CHIPS Economy, but a much higher score in CHIPS User, compared to China. China falls behind Singapore and South Korea in CHIPS User, but emerges second in CHIPS Combined due to the gains in CHIPS Economy. Singapore, a non-G20 country,

stands overall third with its high performance on the relative scale. Out of the top countries, four are from Asia (China, India, Singapore and South Korea) and only three from continental Europe (Denmark, Germany and Netherlands). Several large emerging markets and developing economies (EMDEs) such as Brazil, Nigeria, and Indonesia, which performed well on CHIPS Economy, saw their ranking slide in CHIPS Combined, for the same reason as that of India's. As shown in Figure 2.2, large EMDEs that are at par, or slightly ahead of developed countries in CHIPS Economy, lose out due to their significantly lower score in CHIPS User.

**Fig. 2.2** Developed countries gain from their relatively higher score in CHIPS User



Source: ICRIER-Prosus Centre (IPCIDE)

## Box 2.1: What matters most for digitalisation: Aggregate income, per capita income or population?

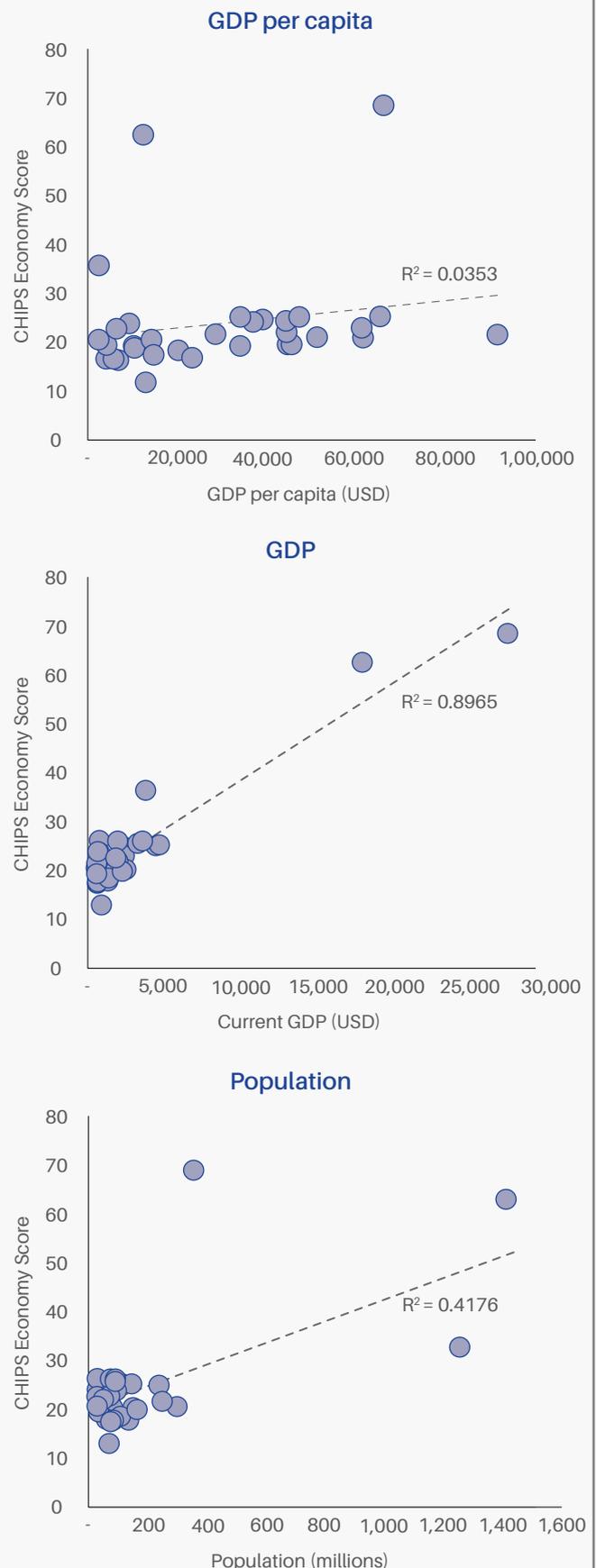
Unlike most other global indices on the digital economy which correlate with per capita income, we observe that scores in CHIPS Economy are driven much more by the population and overall size of economy (GDP) than per capita income (see Figure 2.3). US, China and India, and in that order, outshine all other countries in the absolute score. The elevated scores of India are likely to be driven by the size of the population, while that for US by the size of the economy. In case of China, it has an advantage in both.

On the other hand, scores for CHIPS User are rangebound, and correlates most with per capita income, following the trend of most global indices. However, once China and US are included in the set of countries, the correlation with GDP improves (see Figure 2.4).

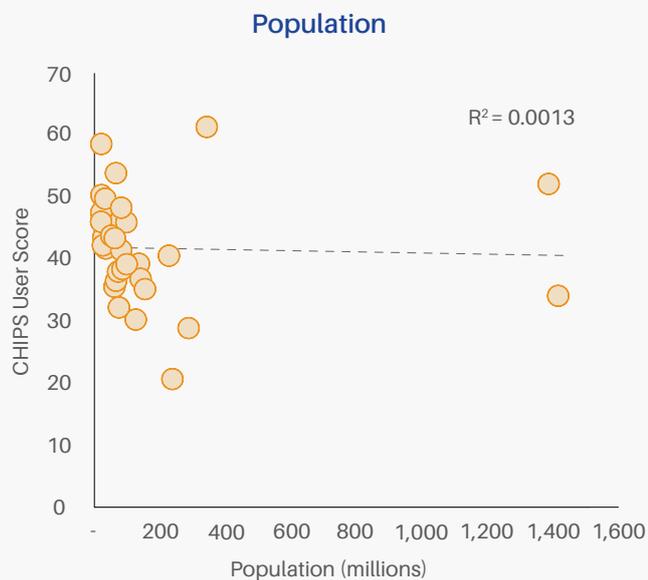
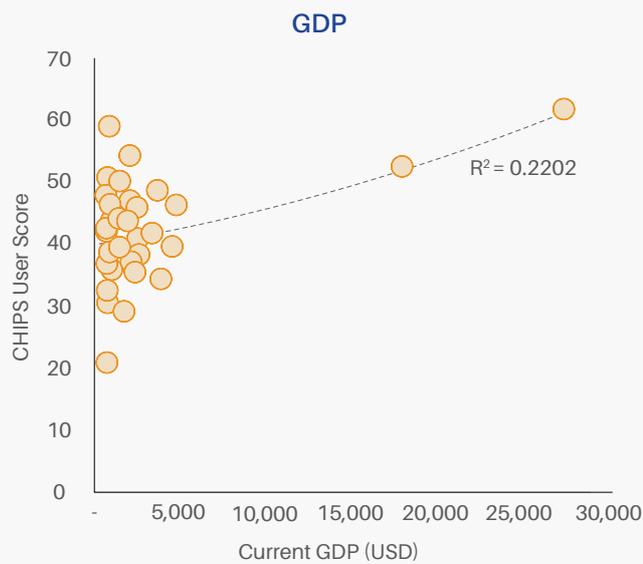
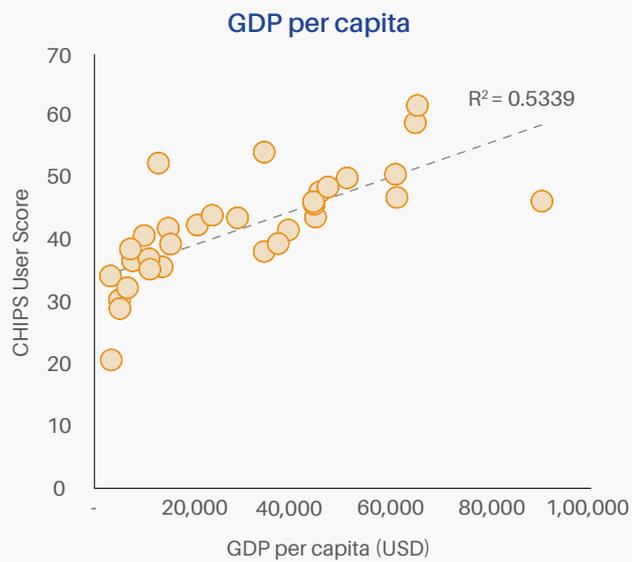
CHIPS Combined aggregates indicators from CHIPS Economy and CHIPS User, using appropriate weights and correlates well with GDP (see Figure 2.5). Using the CHIPS framework, therefore, helps overcome a shortcoming of other global indices, as the latter do not account for gains from the size of digital networks that are defined by the number of users or by the size of the industry. Since speed of digitalisation is driven both by the breadth and depth of adoption, i.e., the size of networks is as important as the level of use by an individual, CHIPS Combined does a better job in measuring the level of digitalisation. The below scatter plots reveal that India's eighth rank is not so much because of its population advantage but also because of the size of its economy (US\$ 3.9 trillion GDP in 2024).

Source: ICRIER-Prosus Centre (IPCIDE)

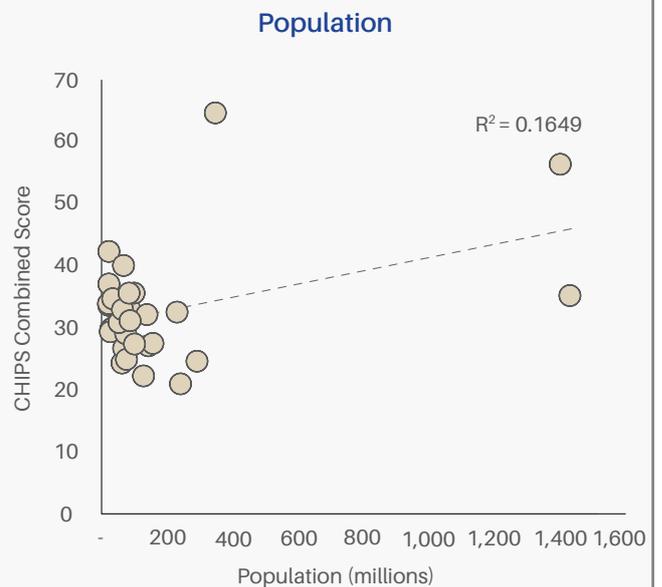
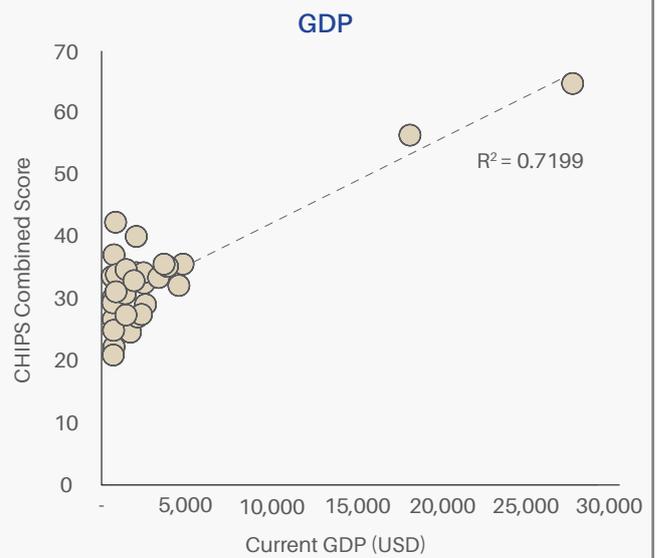
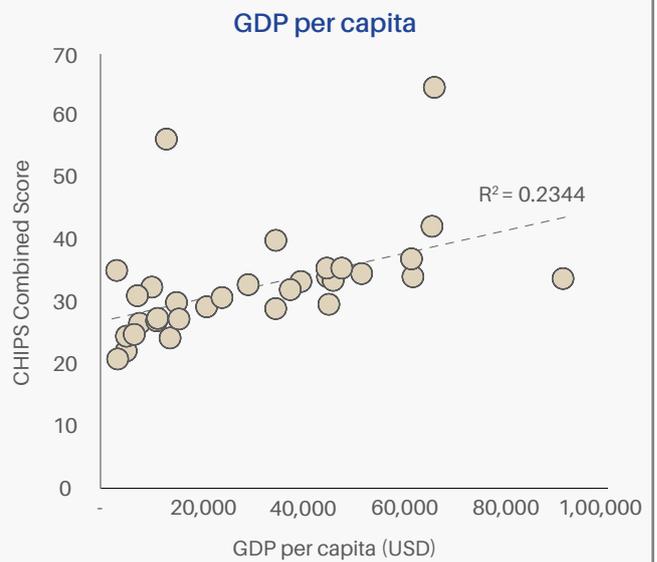
Fig. 2.3 Correlation of CHIPS Economy with macro variables



**Fig. 2.4 Correlation of CHIPS User with macro variables**



**Fig. 2.5 Correlation of CHIPS Combined with macro variables**



## 2.3. Unpacking pillars: India's strongest performance is in Harness and weakest in Protect and Sustain

Unpacking the pillar scores reveals many interesting patterns. First, there is a great deal of variation in the performance of countries across pillars, justifying our approach to take a more holistic approach to measuring digitalisation. While the US defines the frontier for Innovate (I) and Protect + Sustain (PS) pillars, it falls to second position in Harness (H) and further to 6th position in Connect (C) pillar.<sup>13</sup> China's ranking is more uniform across pillars, with top billing in C and H, and second position in I and PS pillars. The same applies to Singapore and South Korea, the two Asian countries that perform consistently well across all pillars. In contrast, France, a country that recently co-hosted the AI Action Summit with India, exhibits inconsistent performance across pillars, with rankings of 7th, 25th, 10th, and 22nd in C, H, I and PS pillars respectively. The same story holds for Germany, whose ranking of 4 (PS), 6 (I), 12 (H) and 18 (C) are quite erratic across pillars.

Besides the US and China that uniformly outperform in all pillars of the CHIPS, India's overall score is positively impacted by H. Its score in C as well as PS, drag the overall score (see Figure 2.6). For other countries too, the scores are not balanced across the pillars, especially where the frontiers are at a distance from the median countries. For example, the Innovate pillar, where the maximum score is 81 (US) and the minimum is 2.6 (Thailand). The lowest variation is in the PS pillar – emerging risks, areas where policy and performance are still evolving. In the following chapters we will decompose CHIPS to highlight key global trends as well as those for India across each pillar.

There is considerable variation in outcomes between the frontier country, the median country and the poorest performing country across most pillars, especially in I. The domination of the United States and China in emerging tech – such as AI, IoT, Metaverse, AR/VR – shows inadequate diffusion of technologies and practices to other countries. With the announcement of the Framework for Artificial Intelligence Diffusion, in January 2025, the US government is seemingly carving out a path to maintain control over how other countries access and deploy AI.<sup>14</sup> While the leadership of US and increasingly China, is somewhat undeniable in the short run, long term global dynamics is something to watch out for. The launch of Deepseek and the possibility of low-cost innovation has at least shifted the focus in India from startups building new AI apps to LLMops, that help other companies build with GenAI, i.e., startups that work with existing models to help enterprises build local solutions.<sup>15</sup> However, the more transformational opportunities to build models and enable widespread adoption is likely to come from stronger global partnerships among likeminded nations and public investment in building both AI infrastructure and talent.<sup>16</sup>

Finally, while PS pillar appears less dispersed than I, the risks of countries being left behind is real. This should also be an area of global cooperation, already becoming visible through the Coalition for Digital Environmental Sustainability (CODES) anchored by UN Environment Program on sustainable digitalisation and ITU's Global Cyber Security Agenda and International Multilateral Partnership Against Cyber Threats (IMPACT) on Protect.

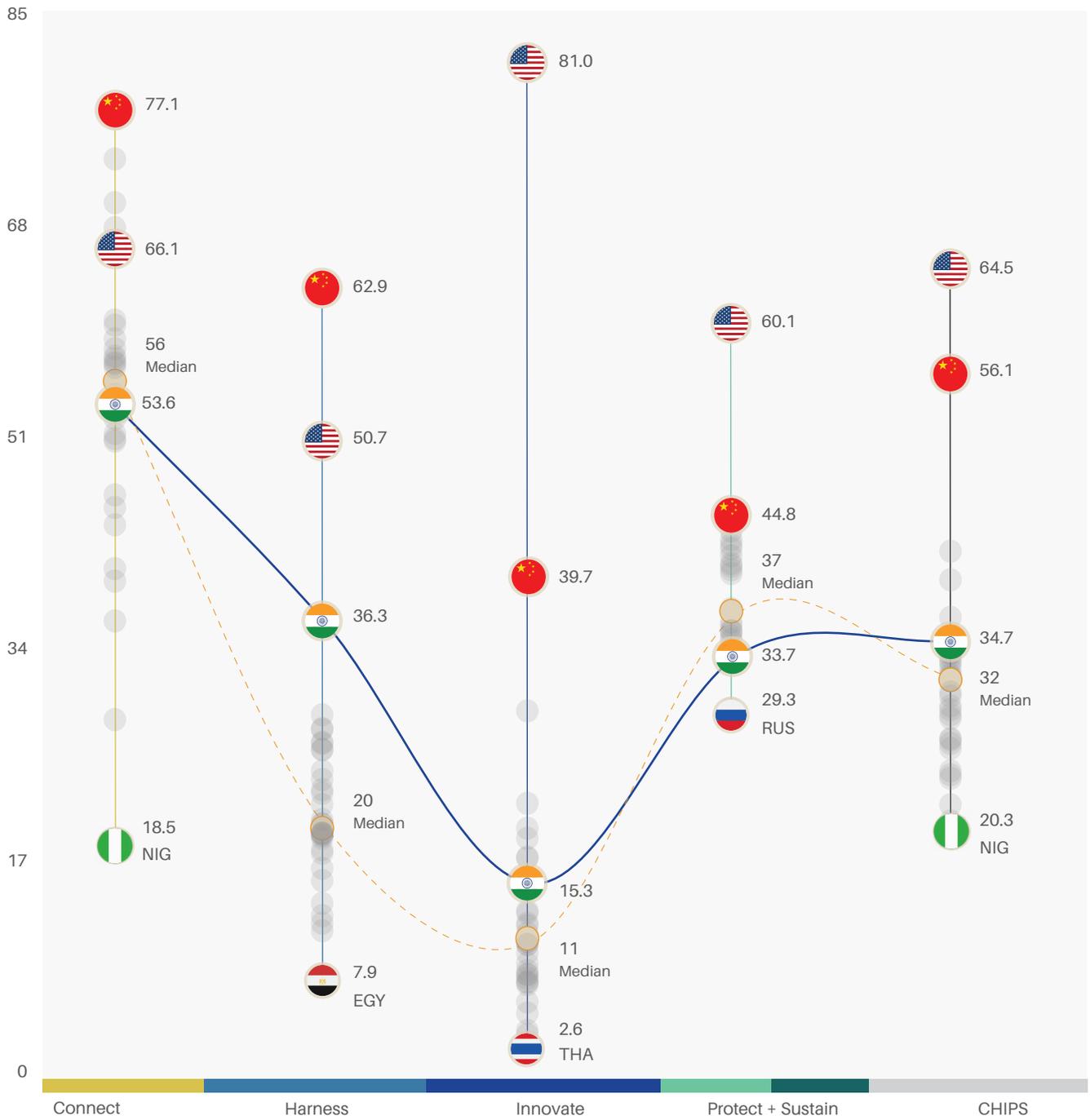
<sup>13</sup> The Protect (P) and Sustain (S) Pillars have been combined into a single group Protect + Sustain (PS) for two reasons. First, both pillars are conceptually similar as they deal with risks emanating from rapid digitalisation. Second, the quality of data available for these two pillars are not as good as for the other three pillars, and so the combined weights assigned to these two pillars is same as for each of the other individual pillar.

<sup>14</sup> Heim, L. (2025, January). *Understanding the Artificial Intelligence Diffusion Framework*. RAND

<sup>15</sup> G, A. (2025, February 17). *Deepseek cracked open AI. India's AI plumbers are loving it*. The Ken.

<sup>16</sup> Gazzane, S., & Li, C. (2025, January 21). *How can all nations realize the full potential of AI?* World Economic Forum.

Fig. 2.6 Unpacking CHIPS Score by Pillars



Source: ICRIER-Prosus Centre (IPCIDE)

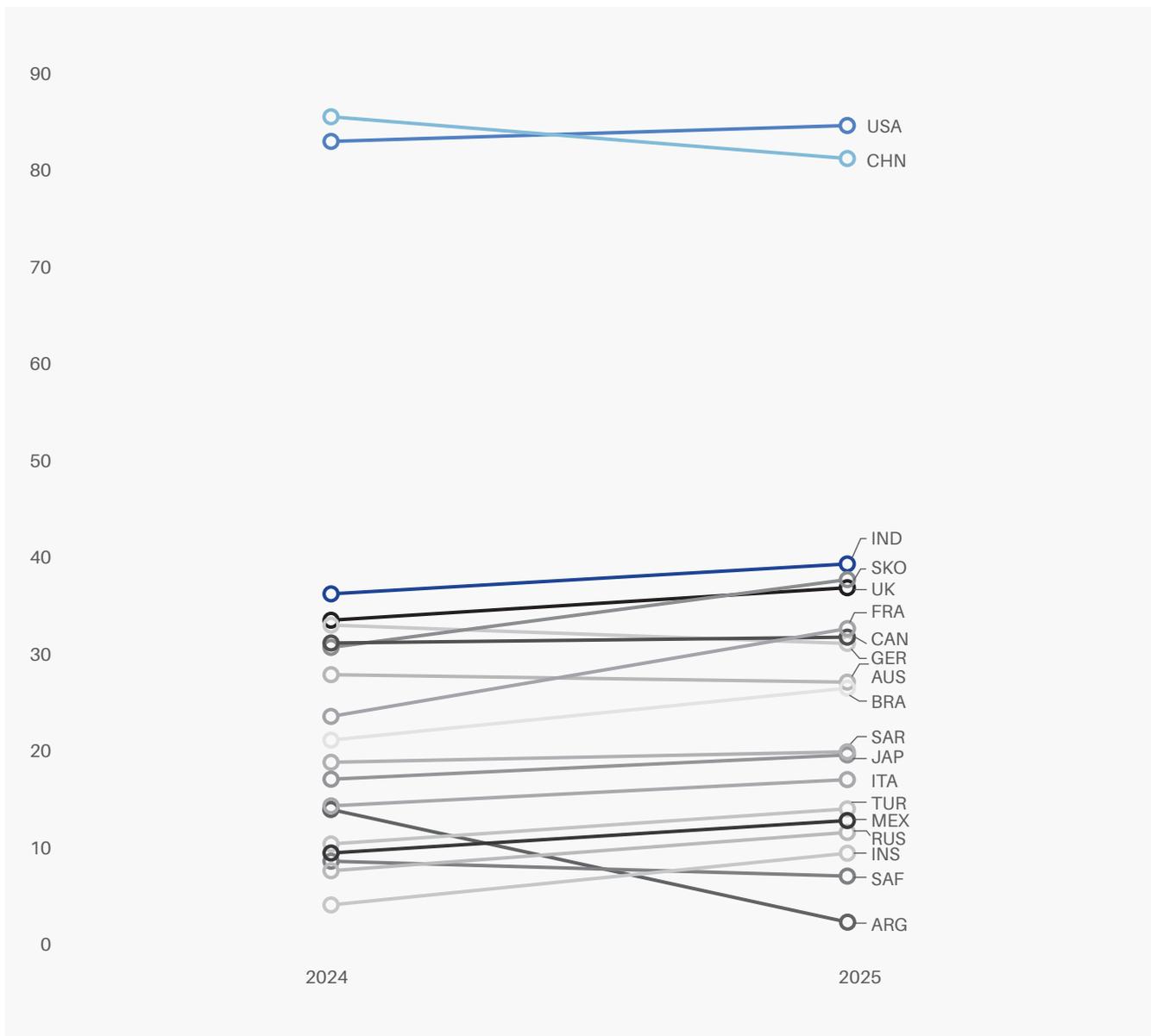
<sup>17</sup> Specifically, we replaced indicators on AI patents and GitHub contribution, with AI infrastructure and AI research output.

## 2.4. India's continued improvement among the G20 countries

It is worth reminding the readers why India ranks above South Korea in the CHIPS Combined in G20 but below South Korea in G32. As discussed in Chapter 1, in SIDE 2025, we replaced the two indicators under the AI sub-pillar that are broader in scope and considerably more representative of AI capabilities.<sup>17</sup> But it turns out that India's

performance is considerably weaker in both the new indicators compared to the replaced ones. Therefore, India's ranking falls below South Korea when we use the new indicators. But we use the old data set when comparing performance for the G20 countries between 2024 and 2025, where India continues to perform better than South Korea.

**Fig. 2.7 India's improving performance within the G20 in CHIPS Combined**



Source: ICRIER-Prosus Centre (IPCIDE)

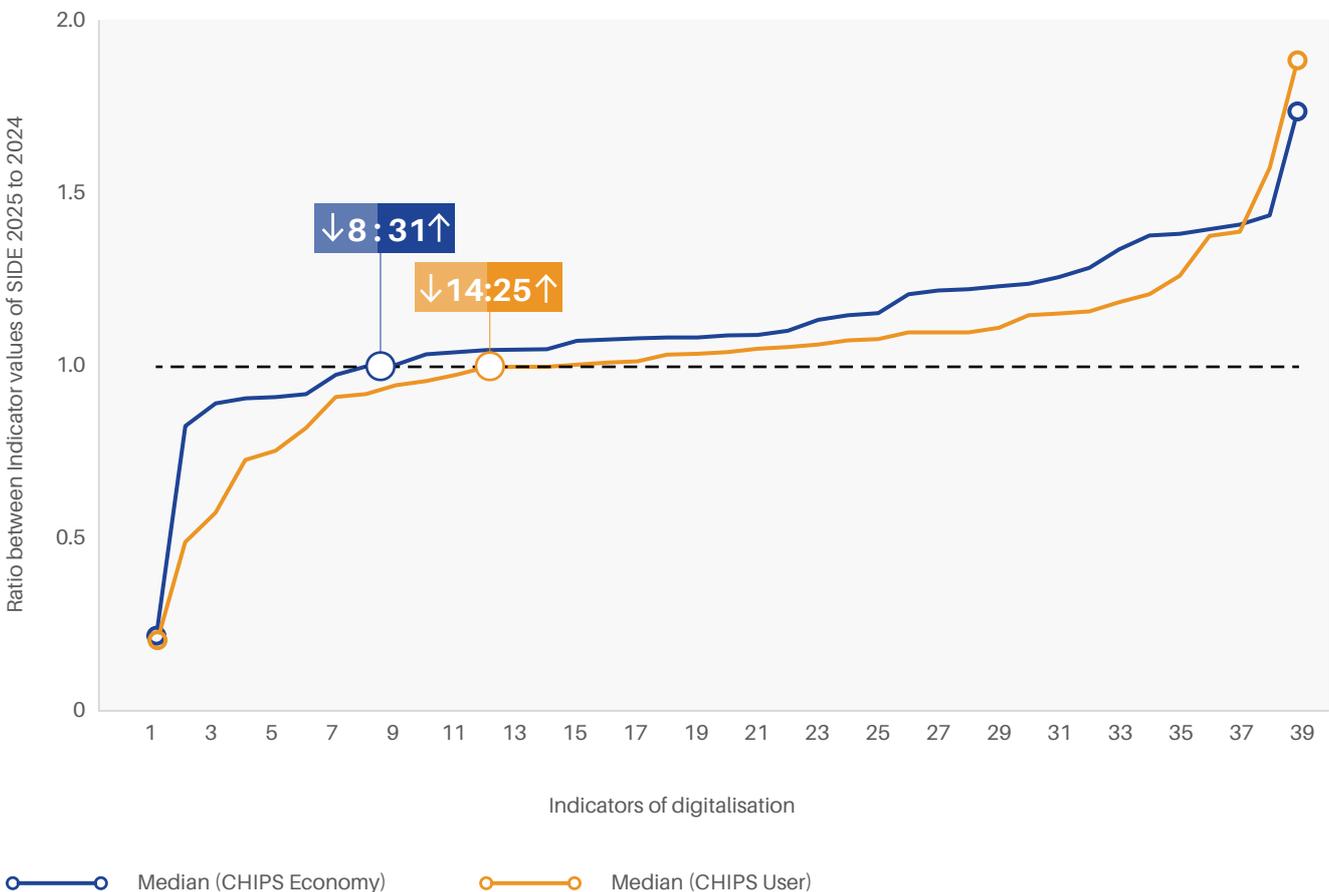
## 2.5. Not all forms of digitalisation improved between 2024 and 2025

Given the euphoria surrounding digital technologies, one would expect that all forms of digitalisation must be improving over time. If not every country, one would expect that the average for all countries and the frontier countries should show positive change. But surprisingly, that's not the case, with several indicators of digitalisation deteriorating in value in the past one year. Out

of the 39 indicators for which data are available for both 2023 and 2024, we find that almost one-fifth of indicators declined in average value for CHIPS Economy and about one-third for CHIPS user, between the two periods (see Figure 2.8). Additionally, for CHIPS economy the deterioration in number of indicators is higher for countries at the frontier than the median value for all countries.

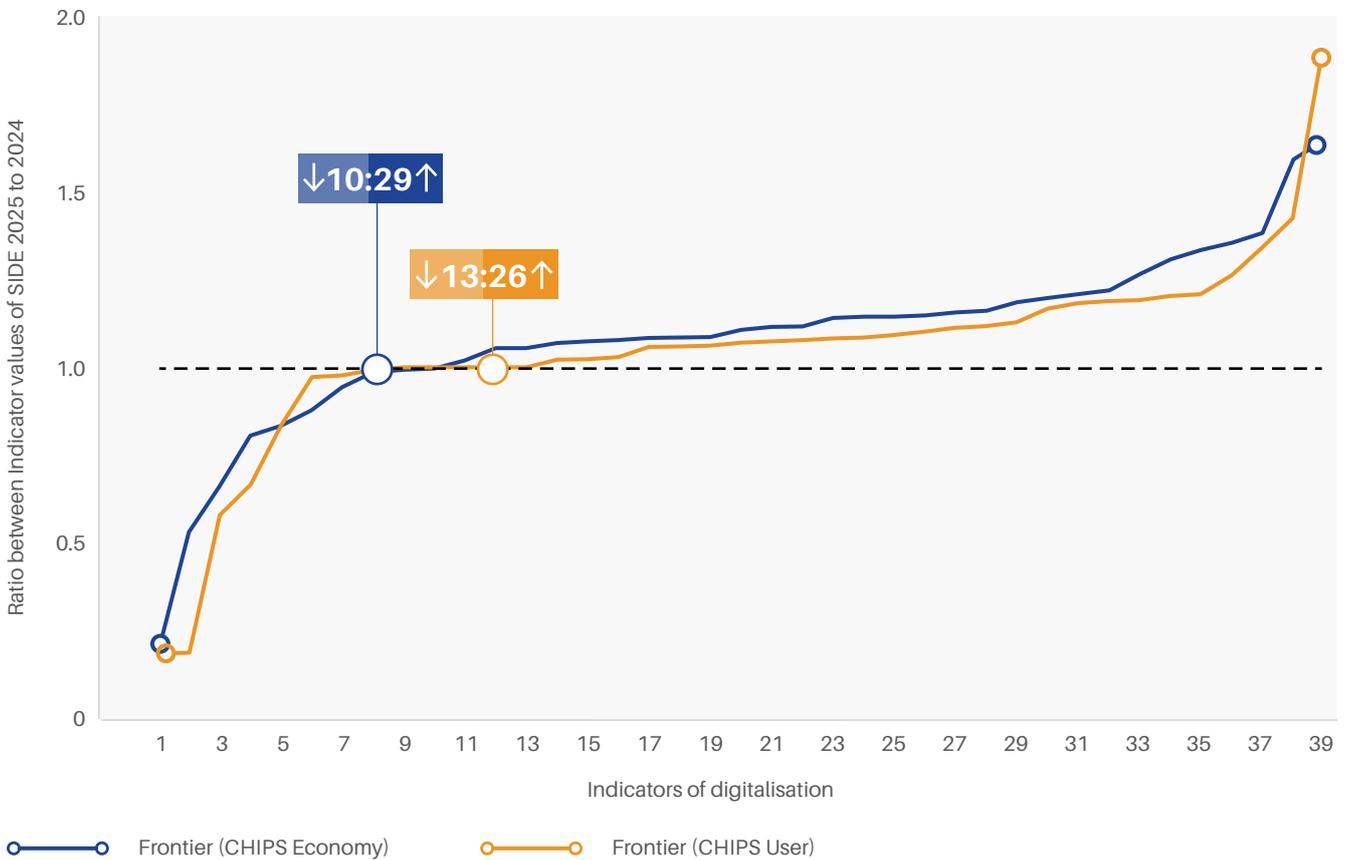
**Fig. 2.8 Comparing changes in digital diffusion**

For the median country



**Fig. 2.8 (Contd.) Comparing changes in digital diffusion**

**For the frontier country**

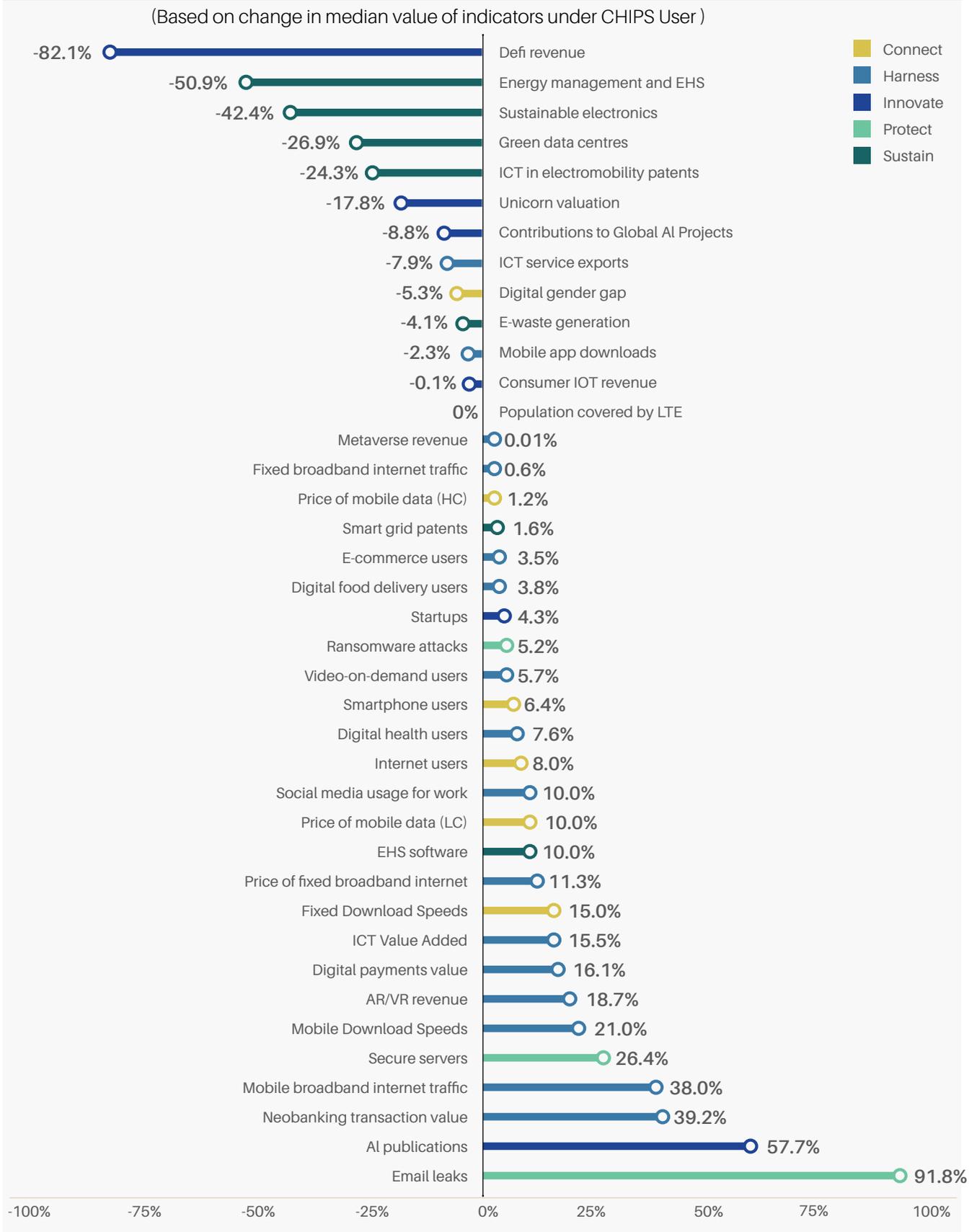


Source: ICRIER-Prosus Centre (IPCIDE)

Some of the largest improvements and deteriorations have come from the I and PS pillars. Between 2023 and 2024, DeFi revenues collapsed by 82 percent and unicorn valuations dropped by 18 percent. Similarly, revenues from energy management software and green data centres and patent for sustainable electronics fell by 51, 42 and 27 percent respectively. On the other hand,

the biggest improvement was the reduction in the number of email leaks per user, which fell by 92 percent.<sup>18</sup> Many of the indicators for C showed improvement; these include mobile broadband speeds and mobile traffic, number of secure servers, value of neobanking transactions, etc. (see Figure 2.9).

<sup>18</sup> Only five of 19 G20 countries saw an increase in emails leaks. These include Russia, China, United States, Germany and Japan

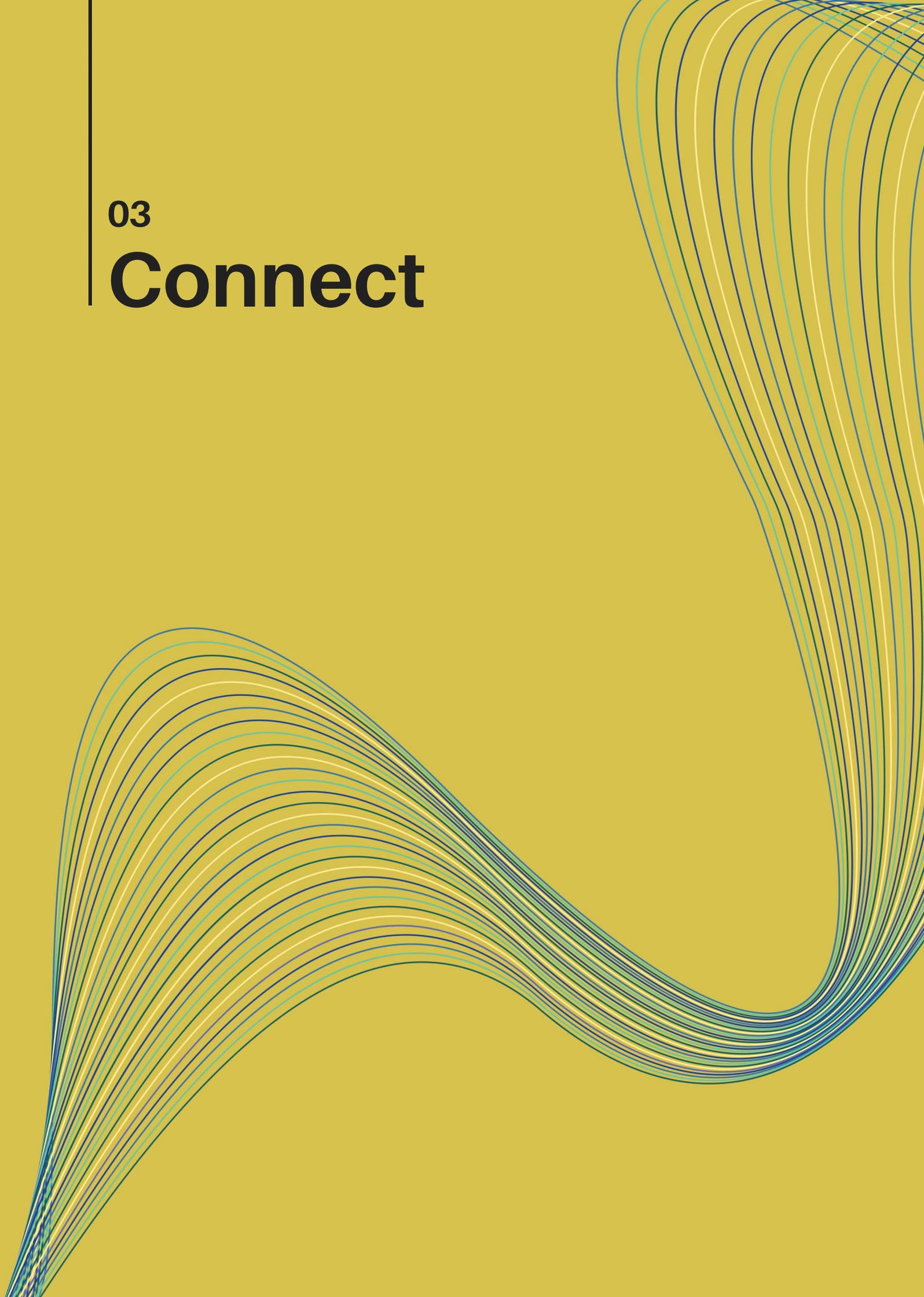
**Fig. 2.9 The largest reversals have been in innovation and sustainability pillars**

Source: ICRIER-Prosus Centre (IPCIDE)

Note: The indicators showing positive change reflect an improvement in performance and those showing negative change reflect decline in performance. For indicators like email leaks, ransomware attacks, price of mobile and broadband services, e-waste and gender gap, a positive change is an improvement or a decline in attacks, leaks, prices, etc.

03

# Connect



# Connect: Another Big Push

## 3.1. Countries playing to their strengths

China has emerged as the most connected country in the world, ahead of its developed country peers. China's strong performance across the sub-pillars of affordability, quality and access, has catapulted it to the top rank in the Connect pillar (see Figure 3.1). It stands out in access with the largest network of internet and smartphone users in the world. Singapore and Denmark, are a close second and third, respectively. They gain from their exceptional performance in quality. Singapore's average fixed broadband download speed at 312 Mbps is the highest among the group of 32 (G32) countries and twice as high as the group median. On the other hand, Denmark's average mobile download speed close to 150 Mbps is almost three times more than the median. Singapore is also the most affordable for mobile broadband when measured as a share of per capita income and China for fixed broadband services.

Despite considerable effort and investment, the Connect pillar remains India's Achilles' heel. A true picture of contrast, India's second largest network of internet and smartphone users globally, coexists with over 40 percent non-users of internet and over 50 percent without smartphones. Being the country with the largest population gives it unprecedented scale, but having the lowest per capita among G32 burdens it with a large share of unconnected population. Consequently, India is ranked 18 in the Connect pillar, slightly below the overall median score. This is also true for the three sub-pillars under Connect. However, things are looking up and are expected to improve significantly in the coming years. Data from the recent ICUBE survey on India, finds that the increase in rural internet users is twice

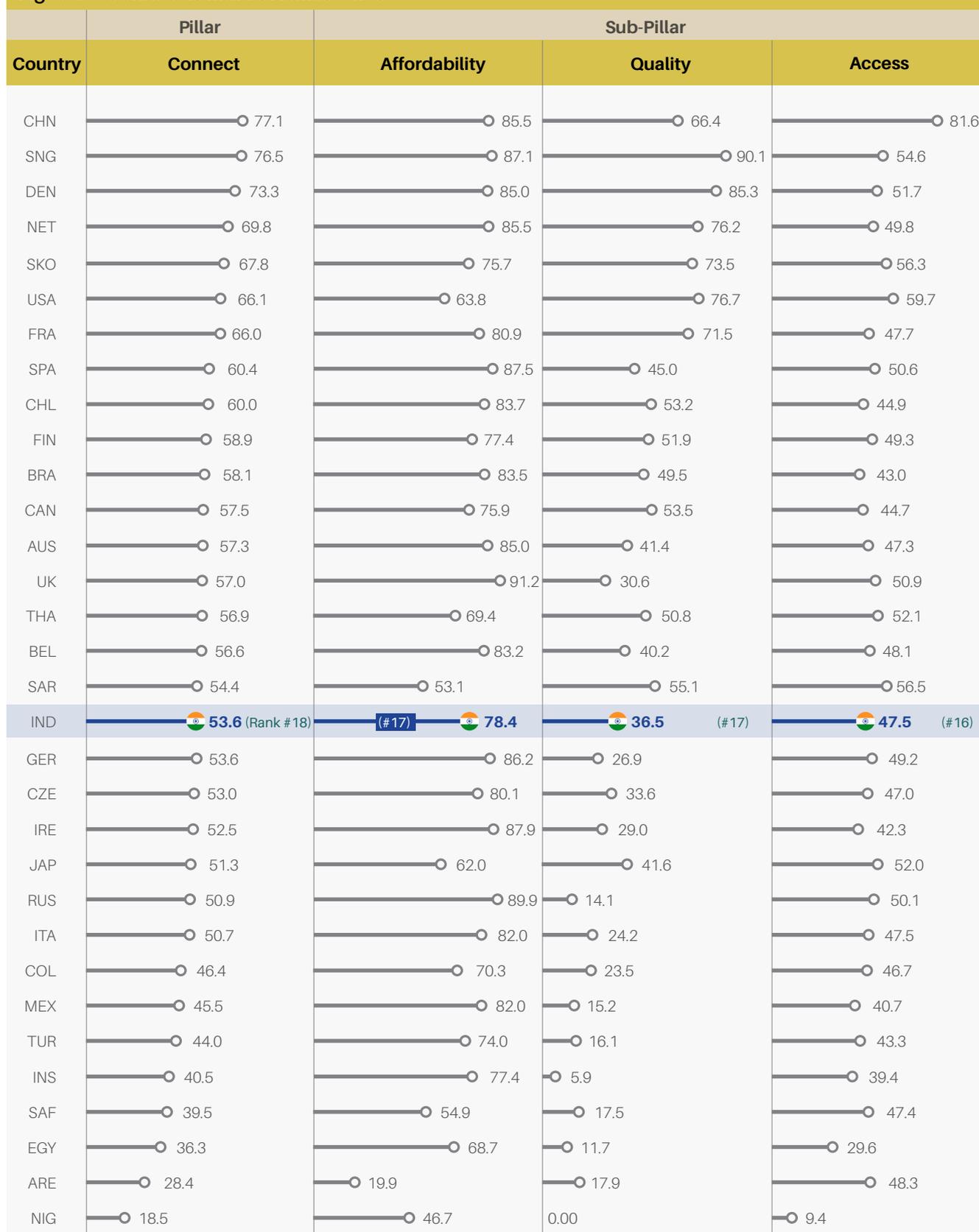
that of urban internet users, and that for smartphone users is about 1.5 times showing a narrowing of divides (discussed in Section 3.5). Much of the divide in internet adoption as highlighted by GSMA emerges from a usage gap – population that lives within reach of a mobile broadband network but do not or cannot afford to use the internet. This is likely to narrow with some policy support and India's rising income.<sup>19</sup>

Connectivity, which carries the highest weight among the traditional indices on digitalisation, is one where developing countries generally perform poorly.<sup>20</sup> This also resonates with results of our Connect pillar. For example, among the top ten countries in the Connect pillar, only two are developing countries, namely China and Chile, and both countries are categorised as upper-middle-income by the World Bank. Similarly, among the bottom 10 countries in the Connect pillar, nine are developing countries, with Italy being the exception. While developing countries have found ways to make internet accessible and affordable by liberalising their telecom sector, appointing independent telecom regulators, and the private sector responding through cheaper data and voice plans and less expensive smart phones, they still have a lot to catch up on. Besides closing the access gap, quality of connectivity and affordability will continue to remain challenging, as demand for data-intensive applications will grow in the future. Well-regulated burden sharing arrangements between private telecom players and the internet companies, along with some fiscal support will help fund the next upgrade of infrastructure in these countries.

<sup>19</sup> Okeleke, K., & Nayak, N. (2022, September). *India: On the road to a digital nation*. GSMA.

<sup>20</sup> For example, ITU's ICT Development Index is entirely based on indicators that measure connectivity

**Fig. 3.1 Connect is India's Achilles' heel**



Source: ICRIER-Prosus Centre (IPCIDE)

## 3.2. Affordability remains a challenge in the developing world

In the group of 32 countries (G32), out of the total population of roughly 5.3 billion (2023), about 1.4 billion don't use the internet, of which 1.2 billion (or 86 percent) are from developing countries.<sup>21</sup> The corresponding numbers for smartphones are 1.7 billion non-users and 1.6 billion from developing countries (94 percent). While for most countries in our sample (Argentina being an exception), the price of mobile data is below 2 percent of GNI, the threshold defined by the Broadband Commission for affordability, this may still be unaffordable for the lowest income percentile.<sup>22</sup> However, much of the affordability challenge comes from the price of smartphones. The price of the cheapest smartphone as a share of GNI, on average, is 10 times higher in

developing countries than developed countries compared to a factor of three times for data prices. (see Figure 3.2). 15 out of 17 developed countries in our sample have achieved more than 80% smartphone ownership and 90% internet access (left panel). In contrast, only three of 15 developing countries have reached the same level of adoption.<sup>23</sup> Despite extremely low prices, they comprise a significant percent of the per capita income in developing countries, making connectivity out of reach for millions of people. Unless a concerted effort is made by the governments, private sector and multilaterals to pursue universal access at affordable prices and decent quality, the world risks leaving millions behind in digital darkness.

**Fig. 3.2** Affordability a persistent challenge among developing countries

### Smartphone – price and use



Source: ICRIER-Prosus Centre (IPCIDE)

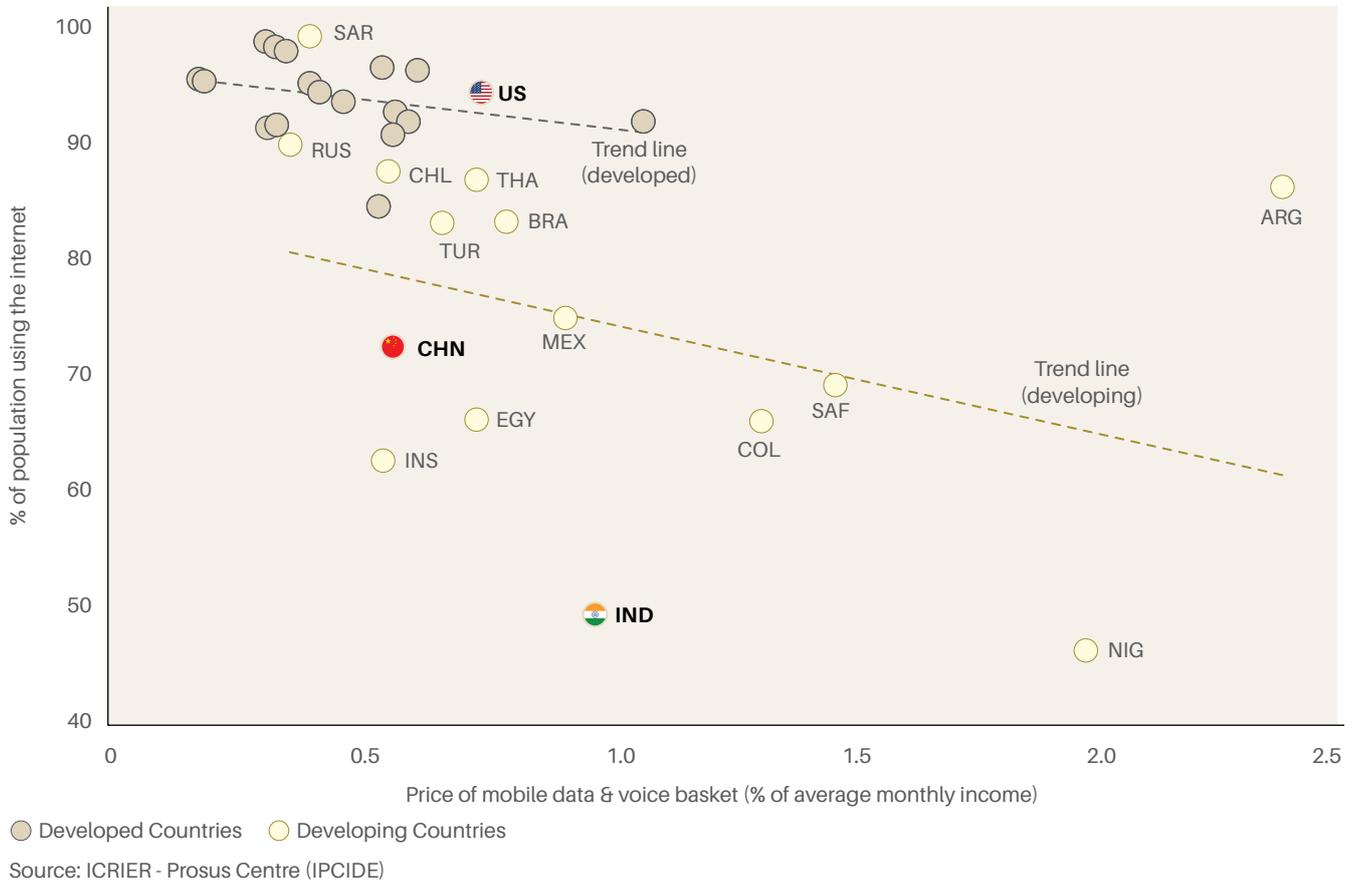
<sup>21</sup> International Monetary Fund. (2023, April). *Country Composition of WEO Groups*. World Economic Outlook Database: Groups and Aggregates Information.

<sup>22</sup> Broadband Commission for Sustainable Development. *2025 Broadband Advocacy Target 2: Make Broadband Affordable*.

<sup>23</sup> Despite official classification of Saudi Arabia as a developing country, it is *de facto* a high-income country.

**Fig. 3.2 (Contd.) Affordability a persistent challenge among developing countries**

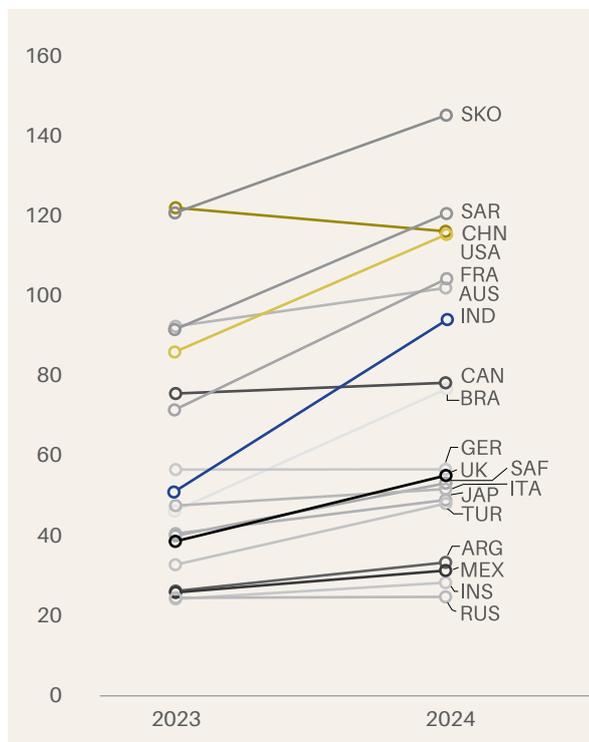
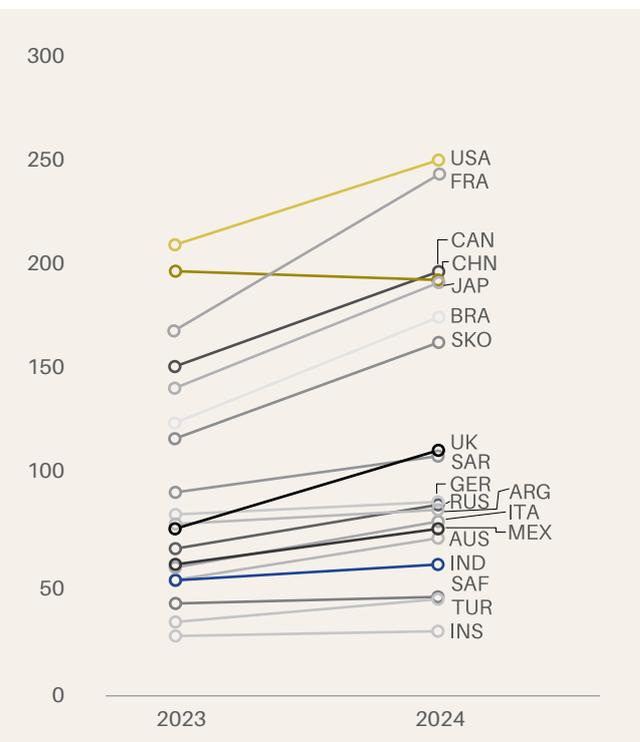
**Internet - price and use**



### 3.3. Quality of broadband has uniformly increased among G20 countries

The quality of broadband has been steadily improving. Both the median and maximum download speeds for fixed line and mobile broadband have improved in the last twelve months (see Figure 3.3). The median speed among G20 countries improved from 47.4 Mbps for mobile to 57.5 Mbps between 2023 and 2024. The corresponding estimates for fixed-line broadband are 80.5 Mbps and 92.3 Mbps respectively. The average download speed has increased for every country, except China. This could be on account of a rationalisation of infrastructure upgrade and

the existing quality, which despite the decline is higher than the average (see Figure 3.2). With the addition of countries like Singapore and Denmark in our set of comparator nations, the median speed for fixed broadband goes up to 120 Mbps. These improvements can be explained by widespread adoption of advanced fibre-optic technologies like 5G. In the future, accelerated improvements in quality of broadband may not be possible, as service providers globally face challenges in monetising 5G and realising return on investments (see Box 3.1).

**Fig. 3.3 Quality of mobile broadband has increased dramatically in India, but not for fixed broadband****Median Mobile Download Speeds (Mbps)****Median Fixed Broadband Download Speed (Mbps)**

Source: ICRIER-Prosus Centre (IPCIDE)

### Box 3.1: The Challenge of Monetising Investments in 5G

According to the latest data available over 100 countries have already rolled out 5G services. Over 261 service providers globally have invested billions of dollars in setting up 5G networks. However, the lack of use cases and the customer indifference between 4G and 5G network quality has led to very poor monetisation. New opportunities in enterprise connectivity and private 5G have scaled, but not at the expected rate. Besides capital costs, regulatory hurdles also hinder the adoption of enterprise 5G. The two-pronged policy response for 5G in India has been to lower the cost of 5G infrastructure including through availability of new spectrum and to build use cases through government set up 5G test-beds. However, India is still to unlock the true potential of 5G.

Sources: GSMA<sup>24</sup> and Tata Elxsi<sup>25</sup>

<sup>24</sup> Suardi, S., & Castells, P. (2022, February). *The Socio-Economic Benefits of Mid-Band 5G Services*. GSMA.

<sup>25</sup> Economic Times. (2024, August 27). *In-depth: 5G Monetisation in India Remains Elusive with Jio, Airtel Eyeing FWA as Potential Silver Lining*. Tata Elxsi.

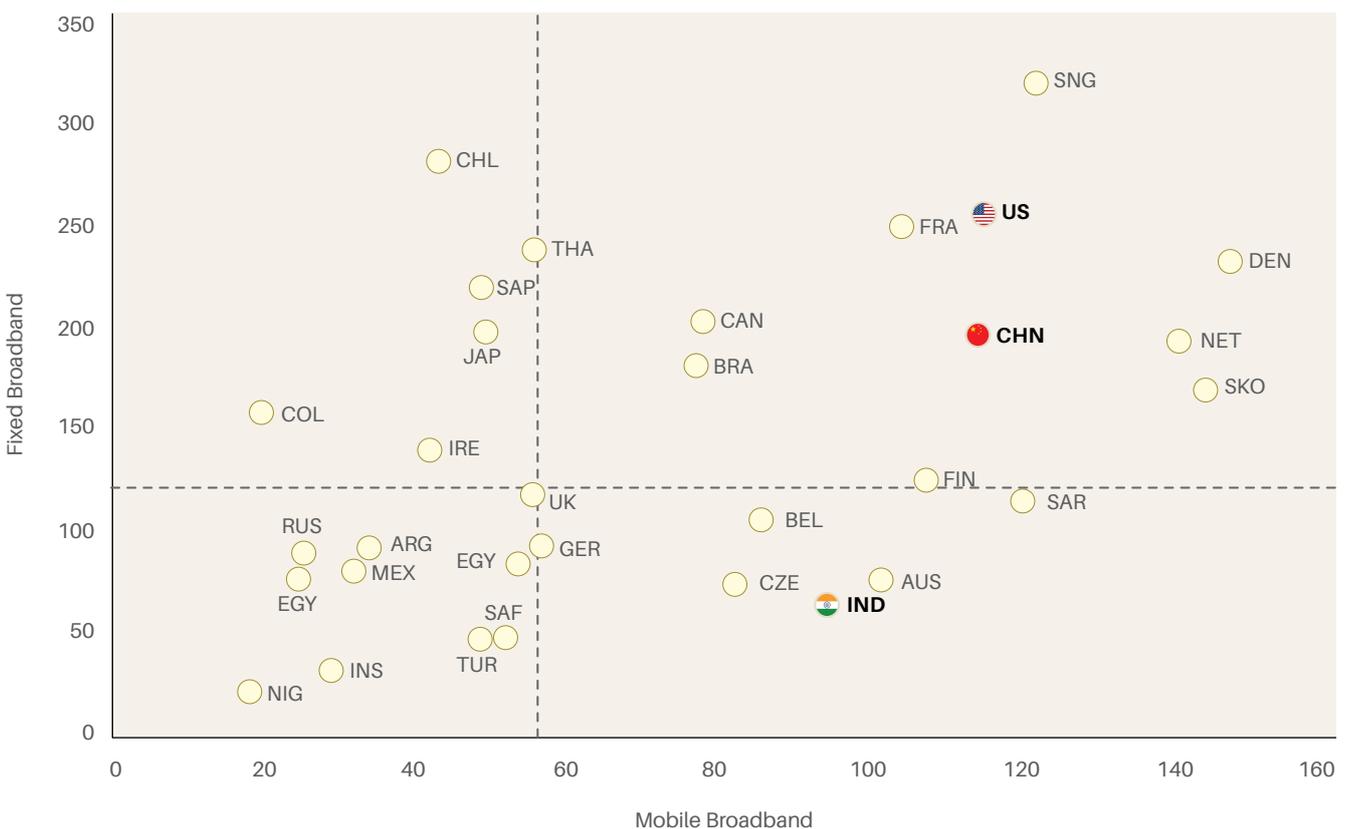
### 3.4. India's dependence on mobile networks: A blessing or a curse?

Empirical evidence finds that developing countries in general rely on mobile based internet networks as compared to the predominance of fixed line in developed countries. This in part is the leapfrogging by developing nations to help overcome the cost and technological complexities of building and maintaining fixed line broadband. However, in case of India, the imbalance between mobile and broadband networks seems unusually high (see Figure 3.4). India's mobile tariff are at the median;

however, the fixed broadband tariffs are much higher than the median. This disproportionate imbalance also exists in broadband speeds - mobile speed is much higher than the median, and fixed line speed is lower than the median. With lower costs and better quality, a significantly higher proportion of internet traffic flows through the mobile network. In fact, India is the only country, other than Nigeria (in our sample) where the traffic flow on mobile networks is higher than the fixed network.

**Fig. 3.4 India's disproportionate focus on mobile-based connectivity**

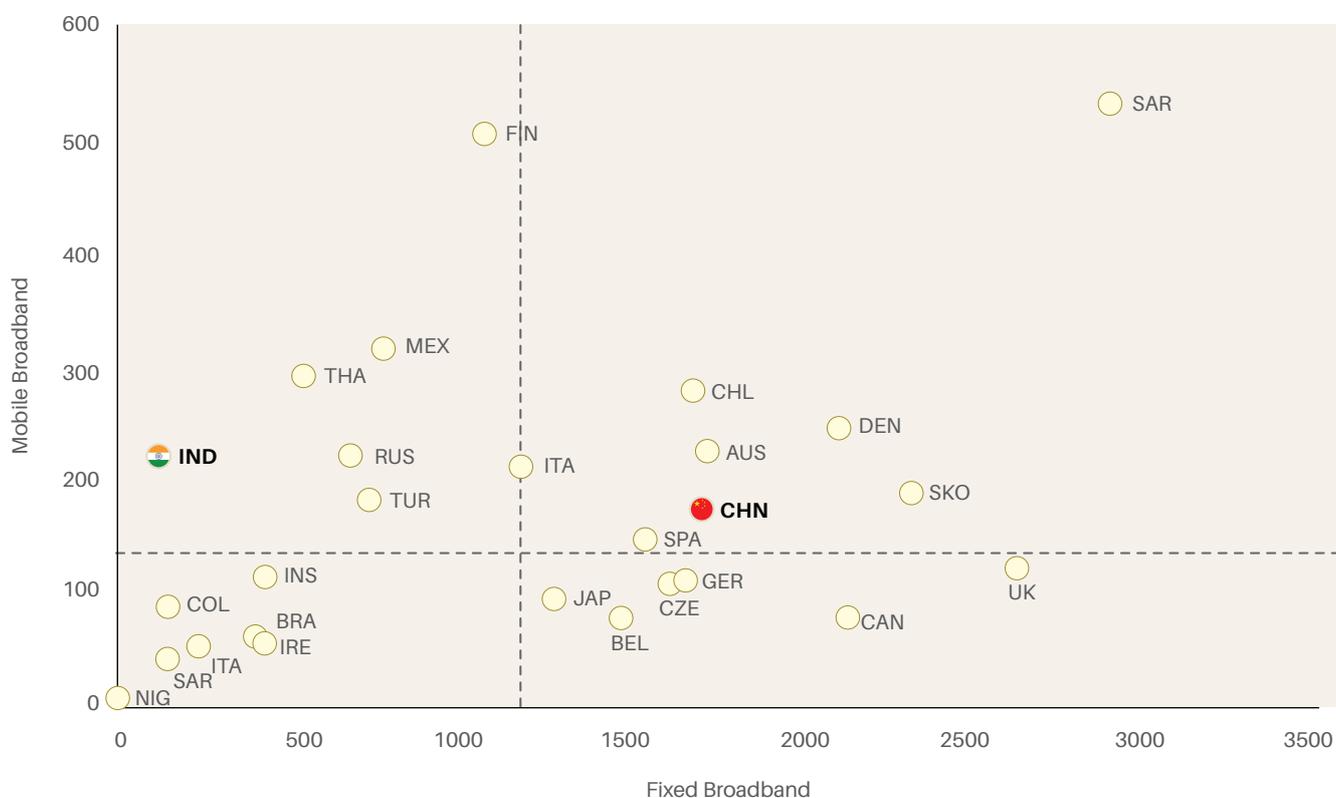
Download Speed (Mbps)



Source: ICRIER-Prosus Centre (IPCIDE)

**Fig. 3.4 (Contd.) India's disproportionate focus on mobile-based connectivity**

Traffic (GB)



Source: ICRIER - Prosus Centre (IPCIDE)

While a mobile-first network has helped accelerate adoption of internet in India (blessing), the lack of a complementary fibre backbone risks resiliency and can adversely affect the country's digital ambition (curse). In response to this challenge, the Union Budget 2025-26 has significantly increased the budget for India's rural broadband program, Bharat Net, proposing to connect all government

schools and primary health centres in rural India.<sup>26</sup> Other policy changes, including the alignment of Right of Way (RoW) Rules across states in India, is also directed toward enabling the private sector to lay more fibre.<sup>27</sup> With some of these efforts, the balance of India's communications network is likely to rebalance in favour of fixed line infrastructure.

### 3.5. Gender divide is declining, but remains high in many countries

A comparison of gender divides between the last two years, shows a nominal decline for most

countries (see figure 3.5) The median values in the G20 group hovers around 1 percent, as most

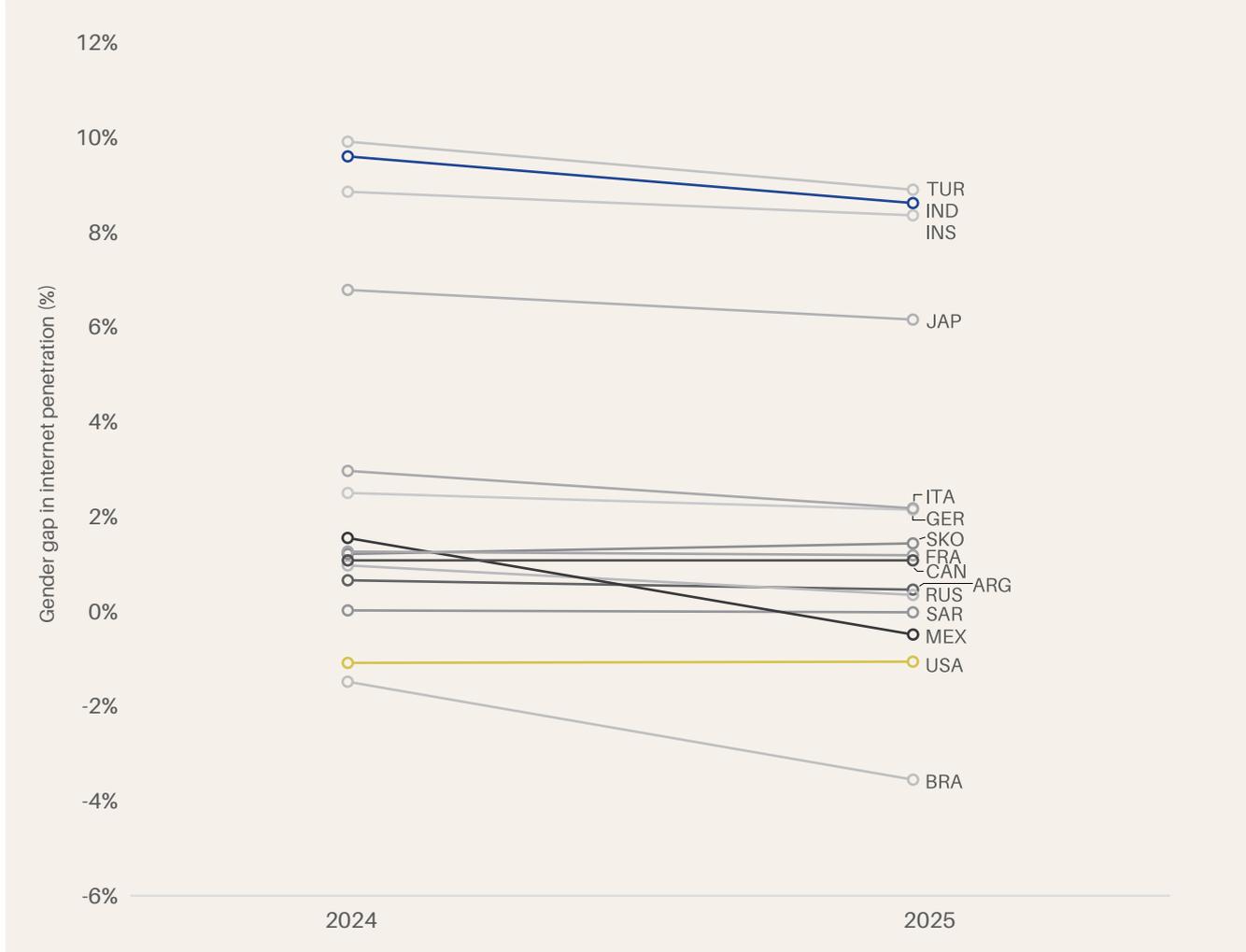
<sup>26</sup> Press Information Bureau. (2025, February 1). *Union education minister lauds historic budget 2025-26*. Ministry of Education.

<sup>27</sup> Rathee, K. (2024, November 21). *Telecom Right of Way rules must for states from January 1*. Economic Times.

countries have reached high levels of penetration. In countries like Brazil and United States, the gender divide is negative, indicating higher number of female users, as against male users. This trend must

not be misinterpreted as a time to abandon policies that focus on internet use among women since the gender divide is still high; and persists in countries like Indonesia, Japan, Turkey and India.

**Fig. 3.5 Digital gender divide is generally declining in G20 countries, especially in Latin America**



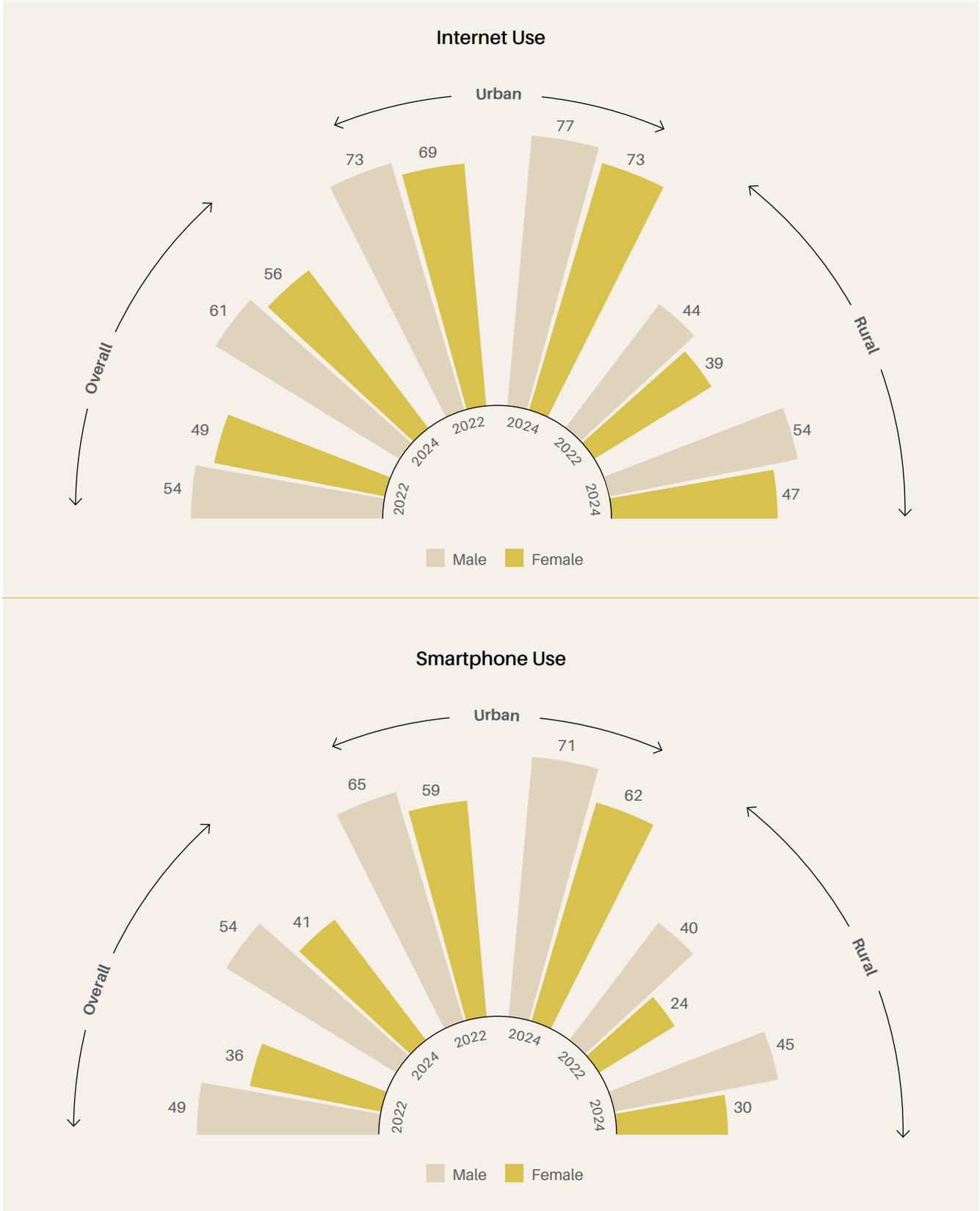
Source: ICRIER-Prosus Centre (IPCIDE)

Note: The gender gap is calculated as the percentage point difference in internet penetration divided by the percentage point population penetration. Countries for which we could not find updated values (Australia, China and South Africa) are not shown in this graph. In the 2025 index, the same values used in the 2024 index have been used.

In India the narrowing of gender divide has plateaued. This comes at the back of a rapid improvement reported in the previous iteration of the SIDE report (2024) as rural women had begun to use the internet through shared devices. While the percentage point difference between urban male and female internet users has remained the same, for rural users, percentage point difference

between male and female users has increased (see Figure 3.6). For smart phones, the gender divides are higher, but usage among rural women is growing. Policy efforts have to be kept alive to address the gender divides which arise due to a variety of socio-economic factors including levels of literacy and social agency among women.

**Fig. 3.6 Gender divide persists in urban areas and worsens in rural areas**

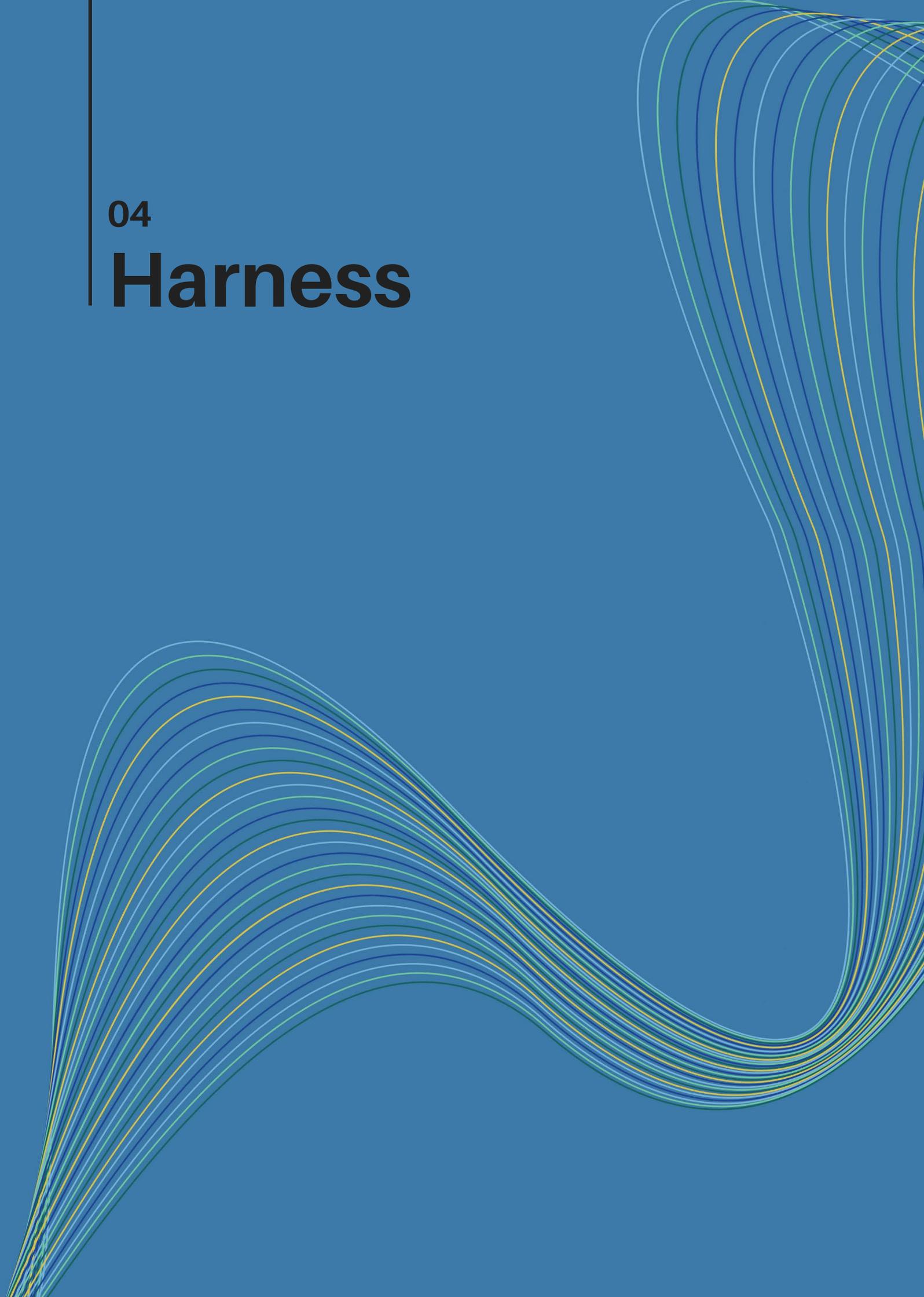


Source: ICRIER-Prosus Centre (IPCIDE)



04

# Harness



# Harness: A New Story Emerging from the Global South

## 4.1. India's success in digitalisation is largely one of better harness

The world is moving beyond the goal of universal connectivity to widespread harnessing of digital technologies. With 68 percent of global population online, the growth of the digital economy is beginning to be driven by the level and quality of technology use.<sup>28</sup> In the CHIPS framework, the variation in digital activity is likely to be much more in Harness, than the Connect pillar. This by no means deflects from the challenge of persistent disparities in connectivity, but to recentre the focus from only bridging access divides to greater leveraging of the platform and app economy, digital disruption of traditional industries (e.g., fintech), and building the value generating end of the digital ecosystem.

Harness is India's strongest pillar. India's eighth rank among G32 countries (as reported in Chapter 2) is largely driven by its outperformance in the Harness Pillar. India is placed third in harnessing digital technologies, after China and the US (see Figure 4.1). Within the Harness Pillar, India's highest score comes from the Real Economy sub-pillar, in which it ranks third in the world (detailed discussed in the following sub-sections). This is on account of the fact that India is the second-highest exporter of ICT services (19 percent of G32 share) after Ireland (27 percent), and the market capitalisation of its IT sector is also the third highest, following US and China. A recent study prepared by ICRIER for the Ministry of Electronics and Information Technology (MeitY), finds that India's digital economy accounted for nearly 12 percent of its GDP in 2023, and is expected to grow to become nearly USD one trillion by 2029.<sup>29</sup> India's strong performance is explained by its large and young population, that is eager to adopt new technologies; a globally-competitive ICT export sector, increasing penetration of mobile internet, and successful rollout of digital public infrastructures (DPIs) such as Aadhaar, Unified Payment Interface (UPI) and Digilocker.

Despite its delayed adoption of digital technology (compared to the US), China today, has the largest internet user base.<sup>30</sup> It tops the Harness Pillar with a score of 68, and also ranks number one in three of the four sub-pillars (apps & platform economy, data intensity and fintech). China has become the "app capital" of the world with one out of every two app downloads within G32 taking place in China. It also accounts for 42 percent of all e-commerce users, 40 percent of all food delivery platform users, 30 percent of digital health application users, and 29 percent of video-on-demand users within G32. High quality internet infrastructure, affordable prices, dynamic home-grown internet companies and high digital literacy explain China's ability to leverage and scale-up technologies for everyday use. While China's proclivity to control the internet through firewalls, extensive censorship and social credit scores have not impaired the spread of the internet as its critics feared, its inability to export the Chinese model to the rest of the world has taken some shine off its status as the most successful harnesser of digital technologies.

The successful harnessing of digital technologies by developing countries goes beyond China and India. As shown in Figure 4.1, Brazil is ranked fourth in the apps and platform sub-pillar, Saudi Arabia is placed second in data intensity, Nigeria ranks third in fintech and Chile is among the top ten countries both for apps and platform as well as data intensity. The large share of digital natives, absence of legacy systems that resist adoption of newer technologies, and spread of remote work and influencers, especially after the Covid-19 pandemic, are some of the factors that have helped developing countries leap frog and emerge as strong harnessers of digital technologies, especially for the app economy.<sup>31</sup>

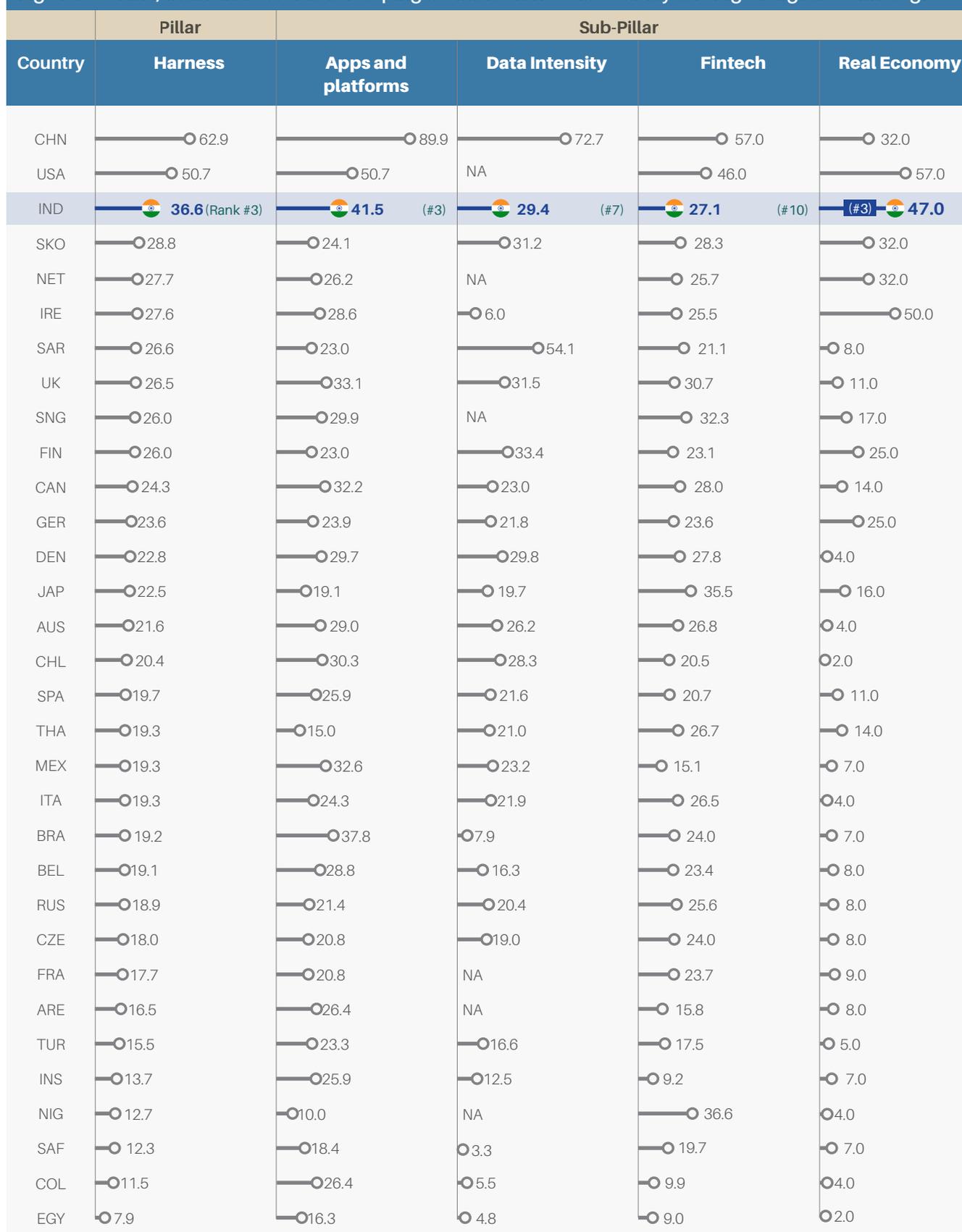
<sup>28</sup> Pham, M. (2024, November 27). *ITU: Global Internet users hit 5.5 billion, digital divide persists*. Developing Telecoms.

<sup>29</sup> ICRIER. (2025, January). *Estimation and Measurement of India's Digital Economy*. Ministry of Electronics and Information Technology.

<sup>30</sup> China has been on the Internet intermittently since May 1989 and on a permanent basis since 20 April 1994, although with heavily censored access. Source: China Internet Museum. (n.d.)

<sup>31</sup> We use the IMF's World Economic Outlook for classification of developing (including emerging) and developed countries. Source: International Monetary Fund. (2023, April). *Country Composition of WEO Groups*. World Economic Outlook Database: Groups and Aggregates Information.

Fig. 4.1 China, India and several developing countries have successfully leveraged digital technologies



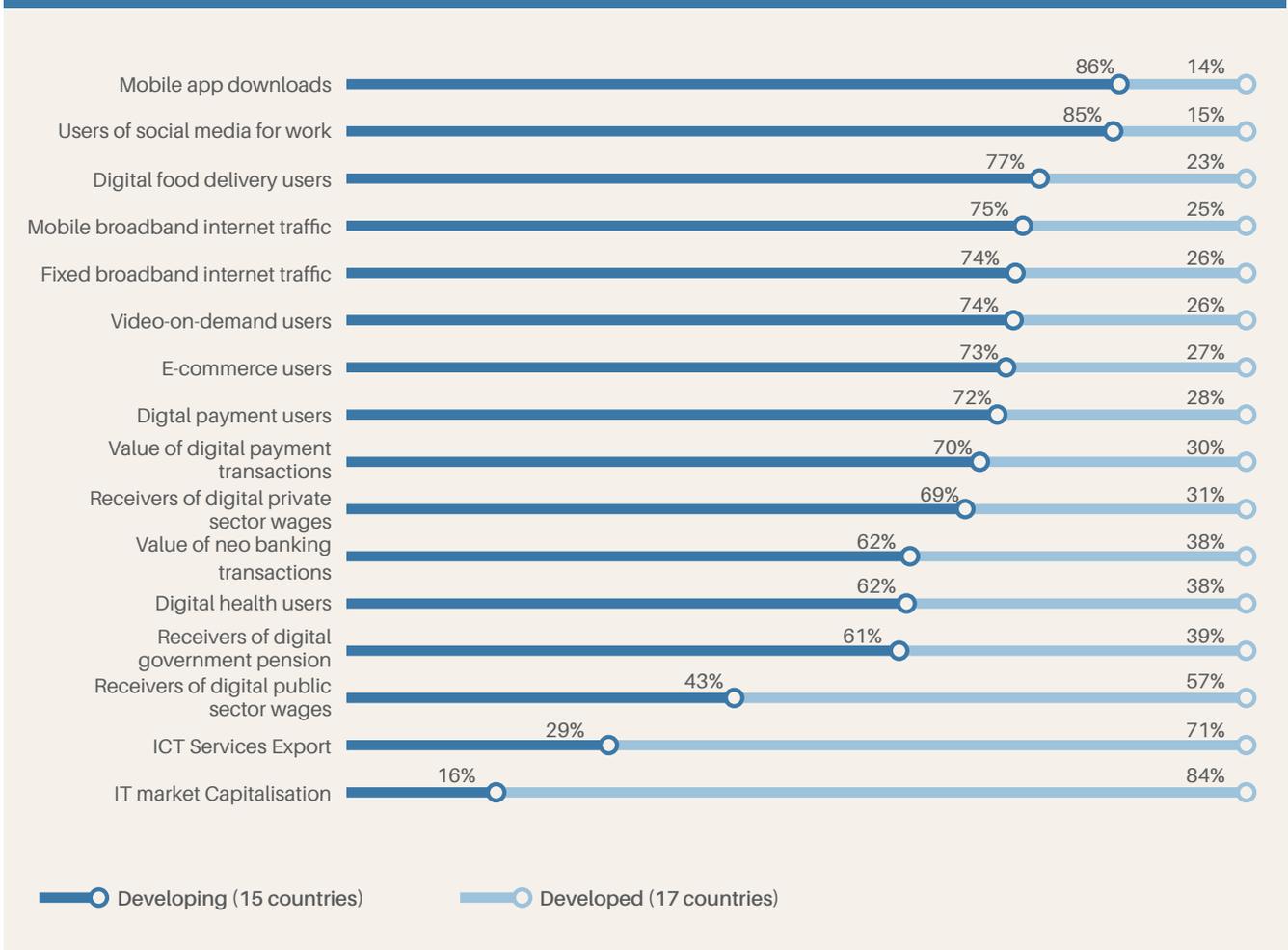
Source: ICRIER-Prosus Centre (IPCIDE)

## 4.2. Developing countries dominate as consumers and developed countries as suppliers of digital services

Users of digital technologies in developing countries far outnumber those in advanced economies. In our sample of 32 countries (G32), there are 17 developed or advanced countries and 15 from the group of emerging or developing countries, as per World Economic Outlook's latest information on country groups and aggregates. Even within this sample, users across developing countries form the majority in 14 out of 16 indicators under the Harness pillar (see Figure 4.2). In fact, for use social media for work-related activities, the share between developing and developed are 85 percent and 15 percent respectively. Even

when measured in relative terms, 41 percent of internet users in developing countries use social media for work related activities compared to 26 percent in developed countries. This is also true for number of app downloads per user – the average for a developing country user is 61 apps, while that for advanced countries is 39 apps. The share of developing country users for food delivery platforms, e-commerce, video-on-demand, digital payments, digital health applications are 77 percent, 73 percent, 74 percent, 72 percent and 62 percent, respectively.

Fig. 4.2 Developing countries dominate as consumers and developed countries as suppliers in the digital economy



Source: ICRIER-Prosus Centre (IPCIDE)

The gap between the number of users in developing and developed countries is likely to expand over time. In the last twelve months, for G20 countries, the number of users for e-commerce, video-on-demand, food delivery and digital health in developing countries grew by 10.7 percent compared to 7.1 percent in developed countries. However, for real economy indicators like ICT services export and IT market capitalisation, the developed countries have a significantly higher market share, indicating their continued dominance in supply of digital technologies and services. Such concentration of digital consumers in developing countries and those of digital service providers in developed countries will have far reaching consequences for global trade, investment and

distribution of gains from the digital economy. Global dialogue on taxation and governance of cross border data flows, has therefore taken centre stage.<sup>32,33</sup> As protectionist tendencies grow in the Global North, especially in the US, against imports and investments in goods from the rest of the world, they remain vulnerable to quid-pro-quo retaliation from developing countries on digital services. There is already evidence of increasing number of anti-competitive cases in developing countries against the big tech companies, including against large app stores.<sup>34</sup> With Global South users dominating the market and stepping up their participation in governance of global digital systems as well as standard setting practices, we are likely to see a new equilibrium evolve.

### 4.3. India's sweet spot as a large consumer and producer of digital services

India, however, has bucked the trend by emerging as an important consumer and producer of digital services. In 13 of the 16 harness indicators, India performs above average for our grouping of G32 countries, its share is as high or greater than that for all developed countries in indicators like social media use and app downloads. Also, India's mobile

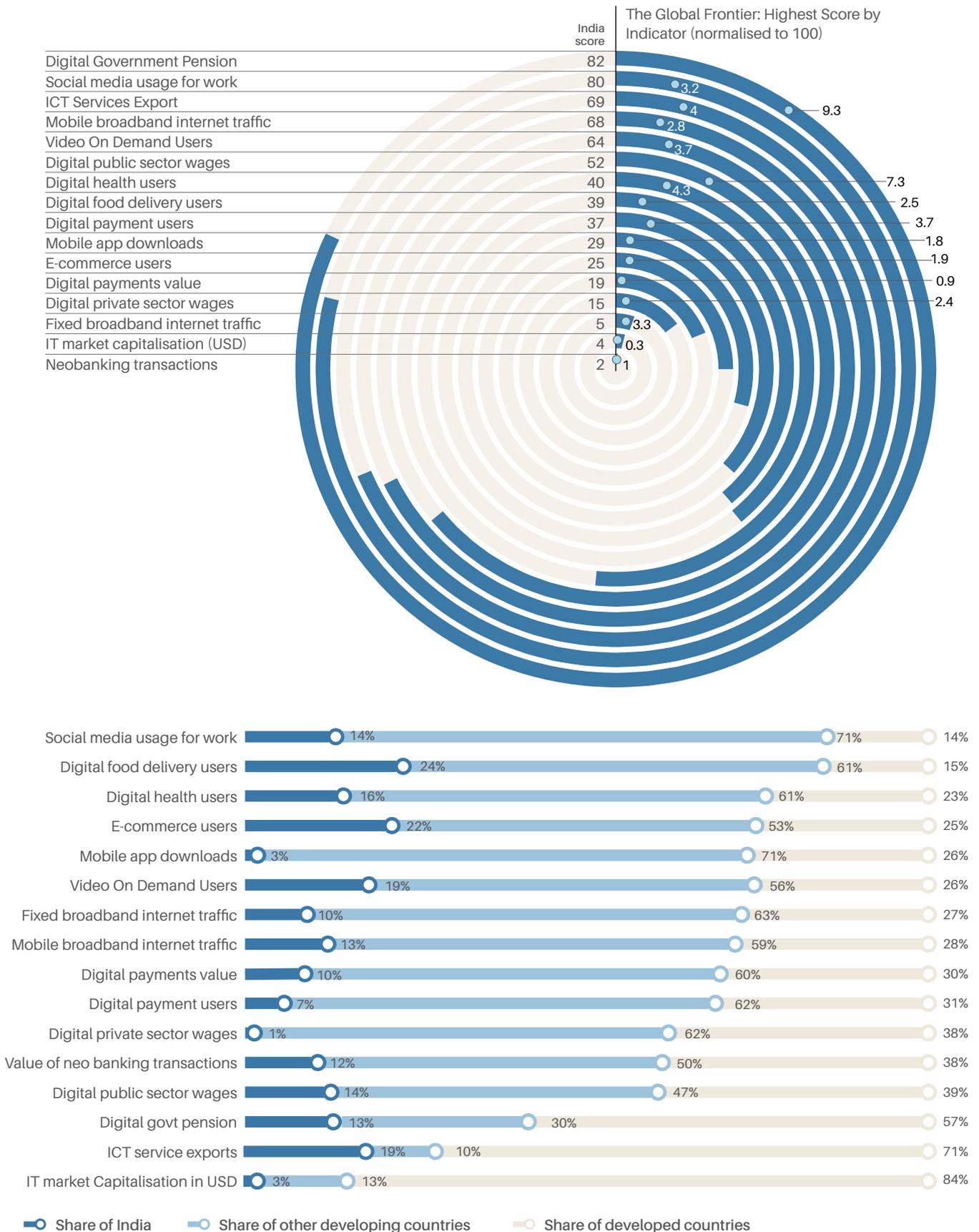
broadband traffic is 22 percent of the total for G32 countries, while that for all of developed countries in our samples is 25 percent (see Figure 4.3). It is also the largest exporter of IT services among developing countries, accounting for 65 percent share of all developing countries.

<sup>32</sup> OECD. (2021). *Tax Challenges Arising from the Digitalisation of the Economy – Global Anti-Base Erosion Model Rules (Pillar Two): Inclusive Framework on BEPS*. OECD Publishing.

<sup>33</sup> OECD. (n.d.). *Cross-border data flows*.

<sup>34</sup> APEC Competition Policy and Law Group. (2022, March). *Competition Law and Regulation in Digital Markets*. APEC.

**Fig. 4.3 India's sweet spot as a large consumer and producer of digital services**



Source: ICRIER-Prosus Centre (IPCIDE)

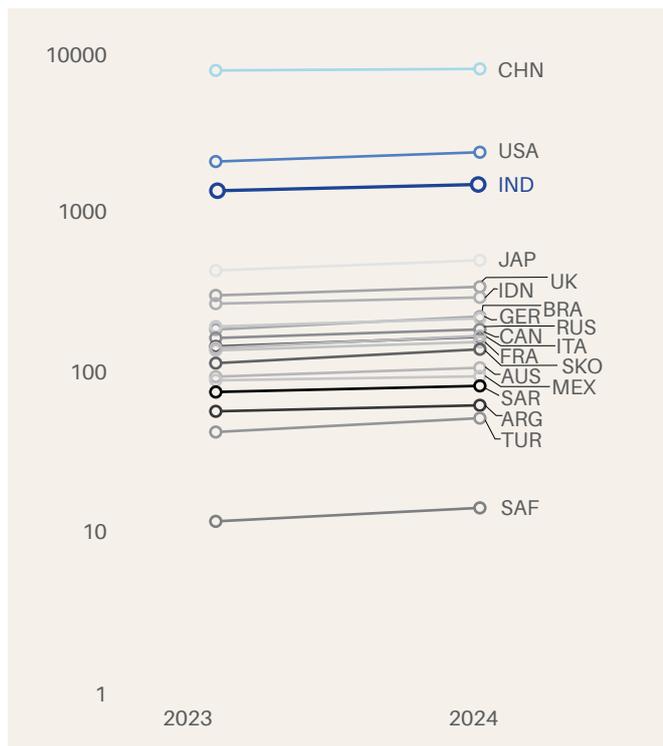
## 4.4. India gains spotlight in the fintech ecosystem

The success of India’s Unified Payments Interface (UPI) in scaling digital payments and driving financial inclusion is now well-documented. Over the last five years the volume and value of digital payments have increased at a staggering compound annual growth rate (CAGR) of 89.3 percent and 86.5 percent, respectively.<sup>35</sup> While no universally accepted estimate on the number of digital payment users is available, the latest media reports peg it at 424 million. This is lower than the 550 million registered users as of Q2 2024, reported by Phone Pe, India’s largest digital

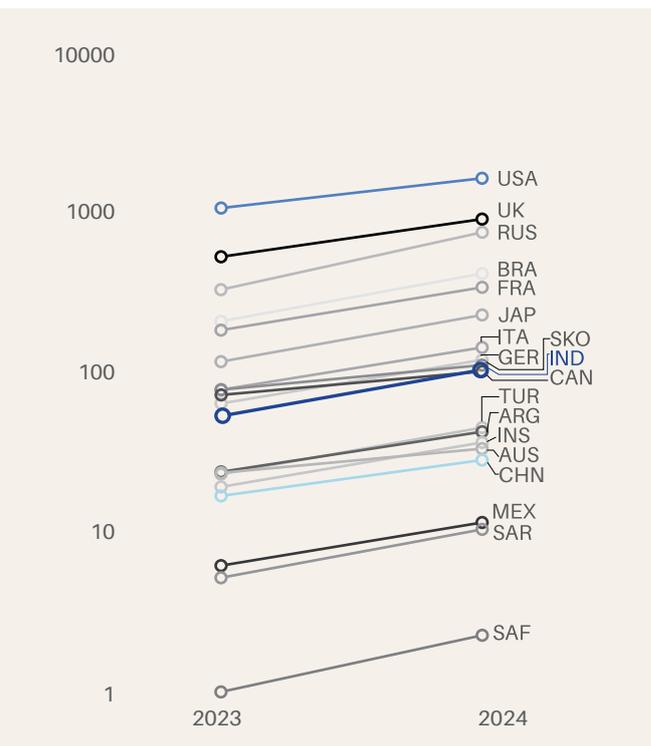
payment platforms.<sup>36</sup> Among our sample of G32 countries, India reports the third highest value in digital payments, following China and US (see Figure 4.4). A recent paper by the ICRIER-Prosus Centre on diffusion of digital payments suggests that improvements in socio-economic factors such as income, poverty, education, digital literacy, and financial access are necessary, but not sufficient for widespread adoption. A deeper assessment of costs and benefits of digital payments for different user categories, and a multi-pronged approach will be necessary.<sup>37</sup>

**Fig. 4.4 India’s emerging fintech landscape**

Value of digital payments (USD billion)



Value of neo banking transactions (USD billion)



Source: ICRIER-Prosus Centre (IPCIDE)  
 Note: Y Axis in log scale

<sup>35</sup> India Brand Equity Foundation. (2025, January 28). *United Payments Interface (UPI) dominates digital payments, sees explosive growth over five years.*  
<sup>36</sup> PhonePe Pulse. (2025). *Transactions.*  
<sup>37</sup> Kedia, M., Reddy, A., & Shukla, S. (2024, March). *Diffusion of Digital Payments in India - Insights Based on Data from Phonepe Pulse.* ICRIER.

The UPI network has also spurred innovation in the wider ecosystem, enabling firms to provide a range of financial services including lending and wealth management. India is home to the fourth largest number of fintech unicorns (26) with a combined market value of USD 90 billion, next to US, China and UK with 170, 38 and 37 unicorns, respectively.<sup>38</sup> The development of the fintech ecosystem has also supported the growth of neobanks in India (value of transactions doubled within 12 months), though the industry lags behind several developed and developing countries in its overall size (see Figure 4.4). Nigeria stands out as leader in neobanking, topping the continent in early-stage fintech investment in 2023. Nigeria also accounted for 42 percent of fintech deals, 32 percent of fintech startups and 49 percent of total fintech funding within Africa.<sup>39</sup>

The fintech sub-pillar is led by US, China and Nigeria that are playing to different strengths

(see Figure 4.1). Legacy systems, high levels of credit card penetration and digital banking are driving the growth of fintech in the US. China benefits from an extensive app-based payments system as well as digitally transformed commercial banks. Nigeria on the opposite end of the developed country spectrum, like several other African countries (Kenya, South Africa), is riding the start-up wave, with mobile-based, digital light platforms that were launched at least a decade before DPI-led systems of UPI and Pix were launched in India and Brazil, respectively.

In India, UPI helped accelerate financial inclusion as legacy systems were slow to transform. India can leverage the explosive growth in digital payments to strengthen its fintech ecosystem by encouraging a stream of new digital services – digital lending, wealthtech, insurtech, etc., but at the same time ensuring suitable guardrails to protect consumers.

## 4.5. India's full market potential is still to be harnessed

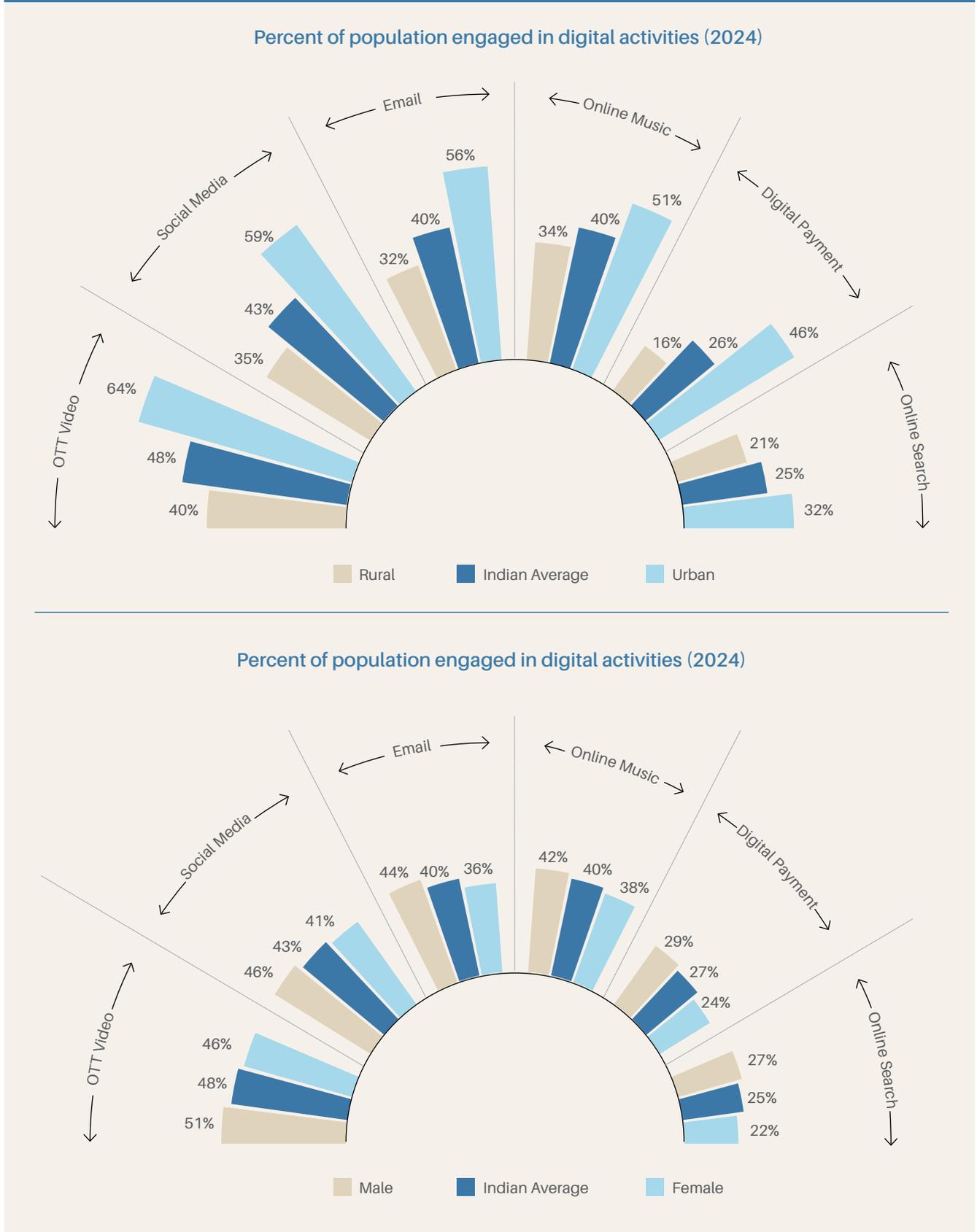
Given India's large population, even a small share of users implies a very large base. In 2024, only 48 percent of internet users watched video online, 43 percent accessed social media, 40 percent used email and listened to online music, 26 percent made any digital payments, and only 25 percent searched online (see figure 4.5). In absolute terms, these shares translate into roughly 400 million users for OTT video and food delivery and almost 350 million for social media. These numbers also imply that India will remain a massive business opportunity for tech companies for years to come. Use of digital activities is rapidly catching up in rural

areas, especially for OTT video, digital payments and search. The gender gaps are relatively lower for digital activities, ranging between 4 to 5 percentage points, but for email use it is wider at 8 percentage points. The gender divides in digital activities are smaller than that for smartphones access under the Connect pillar but converging at similar rates. Data suggests that on average geographical divides are higher than gender divides for adoption of digital activities, but are also narrowing faster. The only exceptions are OTT videos where gender gaps are narrowing faster and email use, where gender gaps are widening (see Figure 4.5 and 4.6)

<sup>38</sup> Chadha, S. (2024, September 03). *India home to 26 fintech unicorns with a combined market value of \$90 bn*. Business Standard.

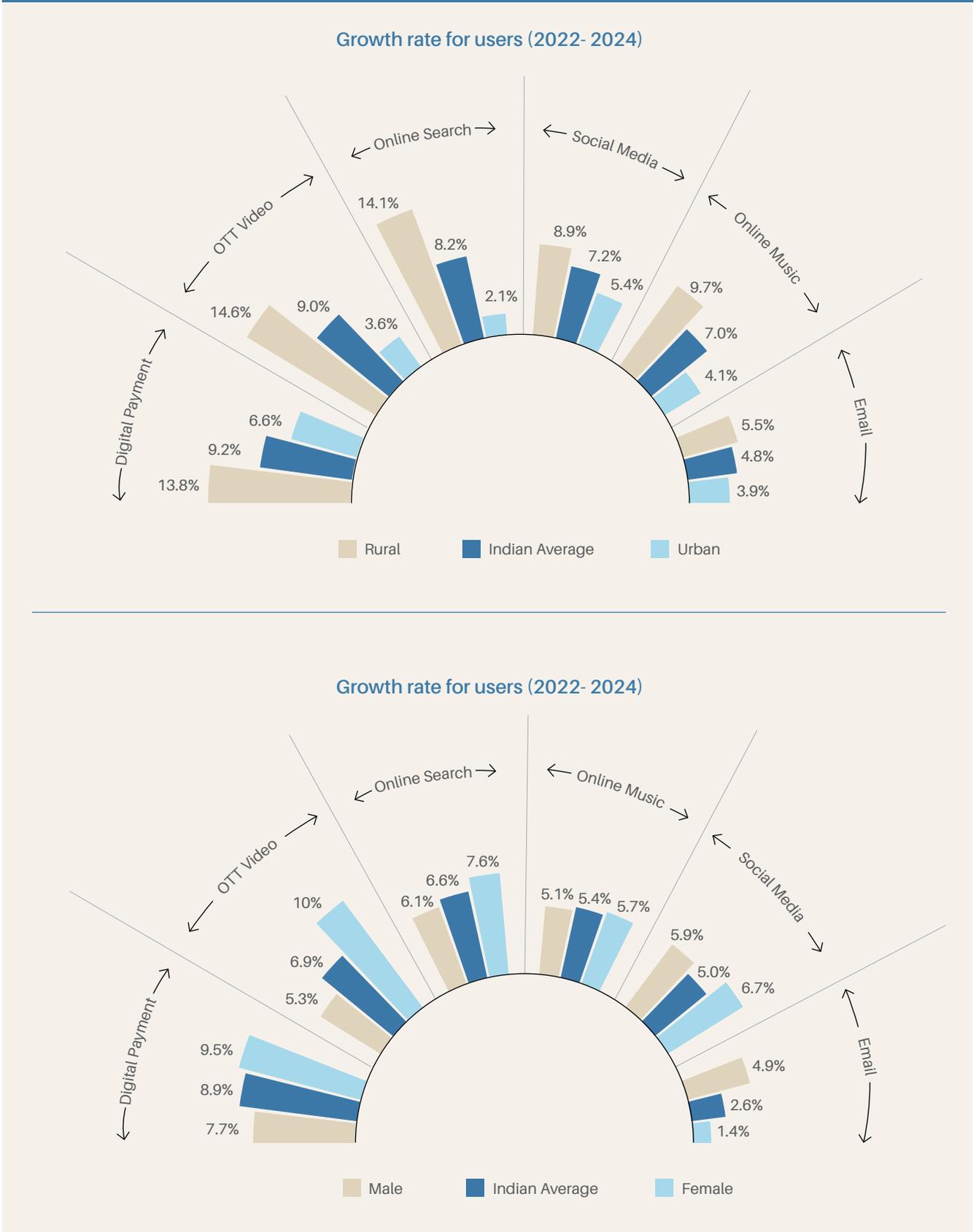
<sup>39</sup> Oriarewo, E. J. (2024, August 30). *Why The Nigerian Tech Industry is FinTech-Driven*. Veriv Africa.

Fig. 4.5 Geographical divides are higher than gender divides for digital activities



Source: ICRIER-Prosus Centre (IPCIDE), ICUBE 2024

Fig. 4.6 Geographical divides are closing faster than gender divides



Source: ICRIER-Prosus Centre (IPCIDE), ICUBE 2022 and 2024

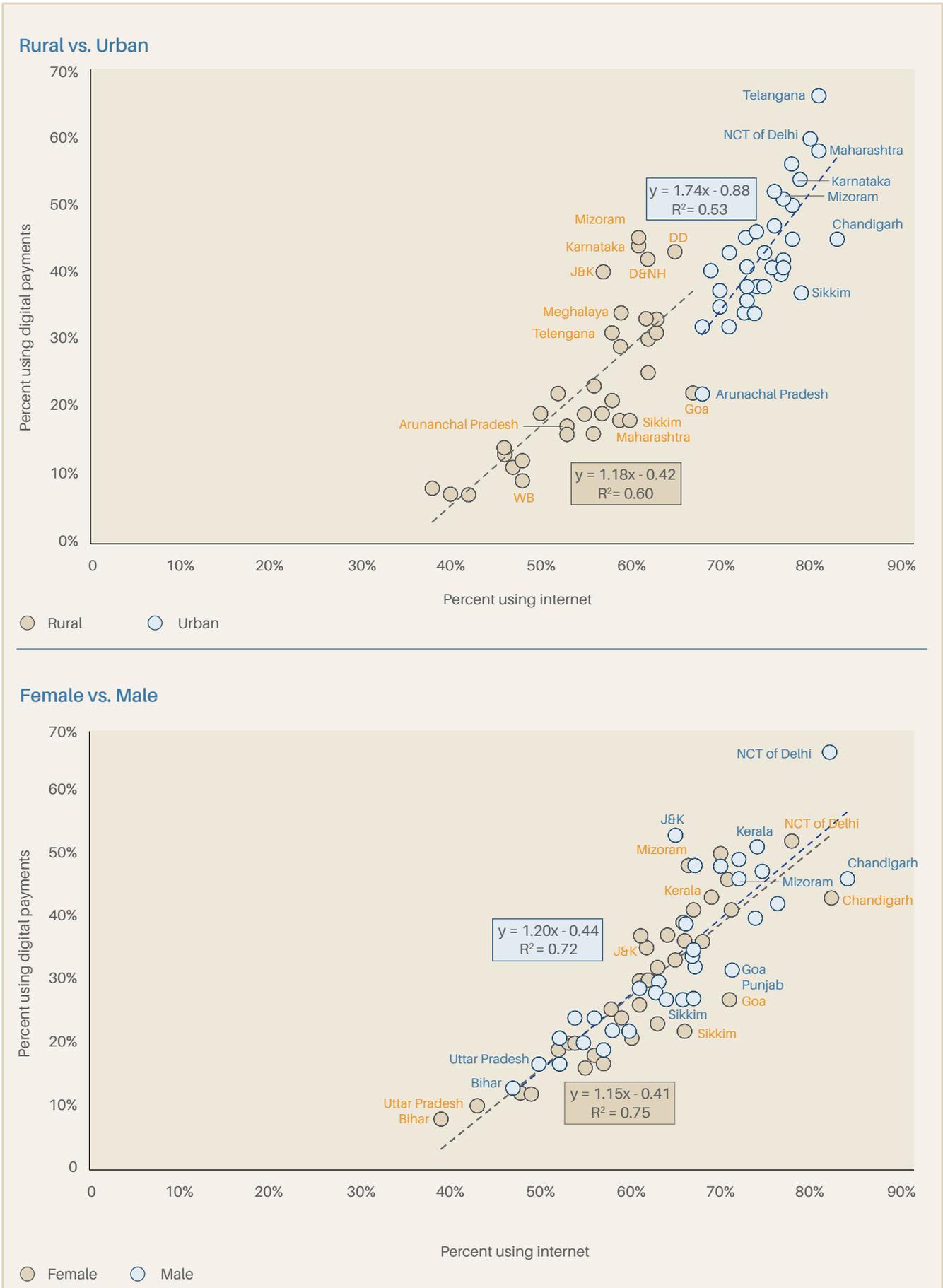
The case of digital payments is particularly interesting where government with the help of local communities- self-help groups (SHGs), banking correspondents, village common service centres and local administration or gram panchayats has made massive inroads into adoption of UPI in rural areas. SHGs particularly, have nudged

women towards adoption of UPI. Empirical analysis using state-level data finds that the likelihood of a male internet user to also use digital payments is higher than that for a female internet user, but the difference is surprisingly not very significant. The differences between rural and urban areas is far more significant (see Box 4.1 for more details).

### **Box 4.1: Geographical divides exist for digital payments but are not significant for gender**

The correlation between percent of population using the internet and percent of population using digital payments is steeper in urban areas than rural areas (i.e., for every additional individual using the internet, there is a greater likelihood of using digital payments in urban areas. The result is intuitive not only due to higher network effects in urban areas but also because of factors such as greater network reliability, greater digital literacy, etc. The graphs shows that there is greater variation between states in adoption of digital payments as rural areas gain higher levels of internet penetration, suggesting the importance of a critical user base. Some such states are Mizoram, Karnataka, Jammu & Kashmir which have particularly high adoption of digital payments in rural areas. On the flip side, Arunachal Pradesh has seen particularly low adoption of digital payments even in urban areas, due to relatively lower internet penetration.

The graph on male -female use of internet and digital payment shows that the slope is slightly higher for males than females, but the difference is not as significant. However, the correlation is stronger and has a greater slope for males compared to females in urban areas (a male internet user in urban areas is significantly more likely to also adopt digital payments than a female user in urban areas) - whereas in rural areas, the correlation is slighter stronger and steeper for females than males, but not too different. This may be because in rural areas, access to the internet is still a significant barrier for women to access digital payments - and a greater proportion who are gaining access to the internet are individuals like the youth who are likely to make more diverse and bolder use of the internet.



Source: ICRIER-Prosus Centre (IPCIDE), ICUBE 2022 and 2024

05

# Innovate



# Innovate: Towards a Global Duopoly?

## 5.1. US, undisputed leader in digital innovation, is waking up to China's rise as a lead innovator

Home to the world's tech giants, US remains the undisputed leader in digital innovation with a score of 81 that is twice as high as the next in line, China. It ranks first across all three sub-pillars – (i) artificial intelligence, (ii) investment and startups as well as (iii) adoption of emerging technologies (see Figure 5.1). The outcomes reflect the longstanding culture of entrepreneurship, a large tech talent pool, robust funding and enabling government policies. Eight out of the top ten AI models ranked in Forrester's "AI Foundation Models for Language" report, belong to American companies, including major players like Amazon, Google, IBM, and Microsoft. The remaining two – Cohere, a Canadian AI company operates with co-headquarters in both Toronto and San Francisco, and Mistral AI is based out of France.<sup>40</sup>

Not yet taking over the US, but China is rapidly evolving from being an imitator to becoming a lead innovator for frontier technologies (rank 2). While known for years to be the world's manufacturing workshop, China has now gained significant global share in emerging industries such as robotics, AI, quantum computing and biotech. According to the Critical Technology Tracker published by the Australian Strategic Policy Institute, while China led in just three of 64 technologies in 2003–2007, it is now the lead country in as many as 57 of

64 technologies in 2019–2023.<sup>41</sup> These include radio-frequency communications, nanoscale materials and manufacturing, synthetic biology and supercapacitors. The announcement of Deepseek in early 2025, is yet another testament to the country's growing technical prowess. In contrast to the American model of tech leadership, China's centralised approach and state-led support for industries of national interest, has led to this sharp rise.

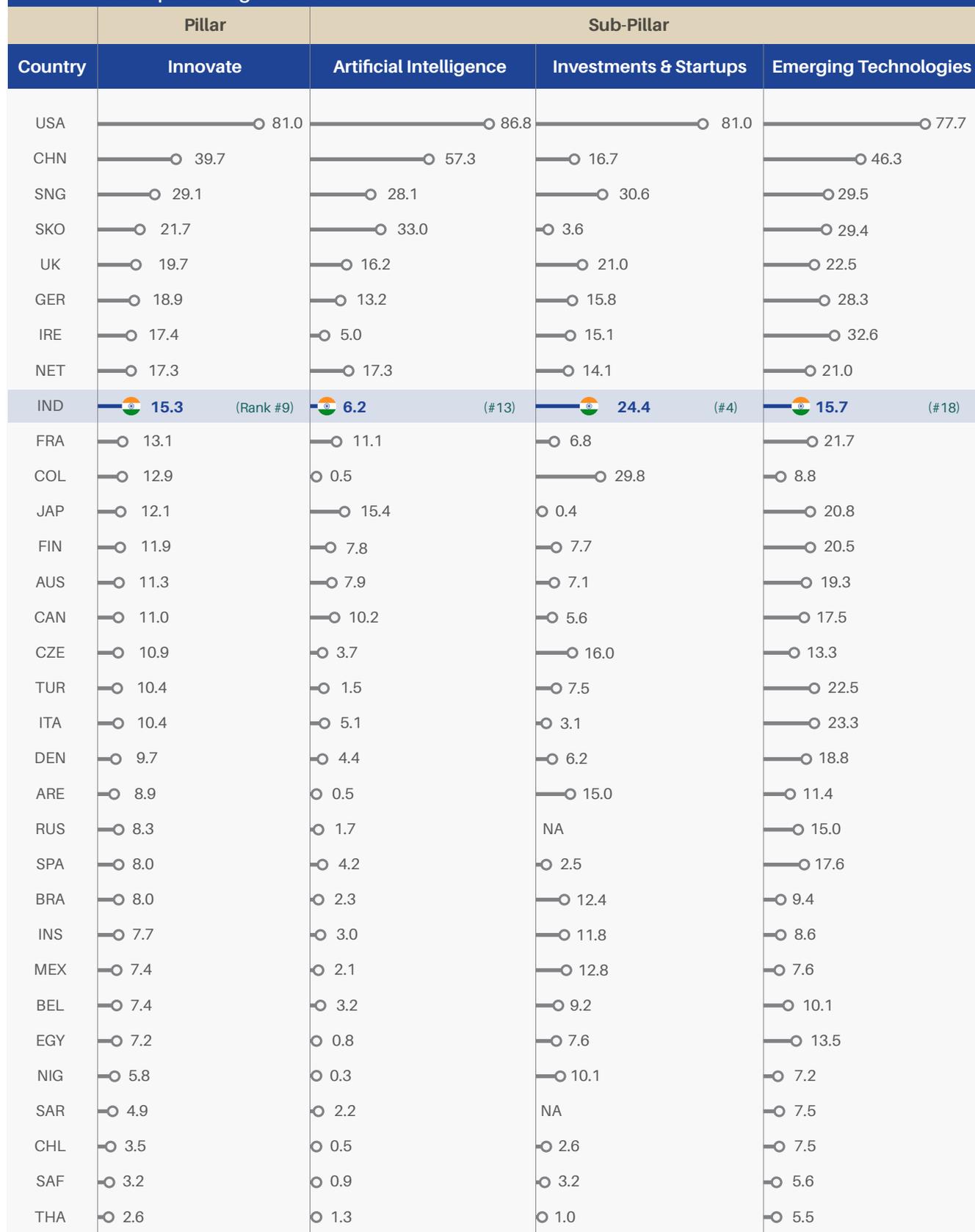
India's innovation capabilities are greater than its level of development, but nowhere near that of a leading nation. Overall, India ranks 9th among the 32 countries, which is impressive given that it has the lowest per capita income in the group. India performs particularly well (rank 4) on investments and startups, reflecting its status as home to the third largest number of unicorns in the world, and continues to receive fairly large sums of venture capital funds.<sup>42</sup> It however lags in the AI sub-pillar (rank 13) resulting from low infrastructure availability and lack of cutting-edge deep tech research. This situation could significantly change if the announced investments and policies in the Union Budget in 2024-25 and 2025-26 are effectively implemented (also see the last section of this chapter).

<sup>40</sup> Haranas, M. (2024, June 12). *Top 10 AI Foundation Models Ranked: Google, Nvidia, OpenAI Lead Forrester Report*. CRN.

<sup>41</sup> Leung, J W., Robin, S., Cave, D. (2024, August). *ASPI's two-decade Critical Technology Tracker: The rewards of long-term research investment*. Australian Strategic Policy Institute.

<sup>42</sup> Das, B. (2024, April 09). *Unicorns worldwide: India ranks third with 67 unicorns, US has 703, China has 340*. Business Today.

**Fig. 5.1 US is the top nation on digital innovation and China is catching-up, while India ranks high on startups and lags behind on AI**



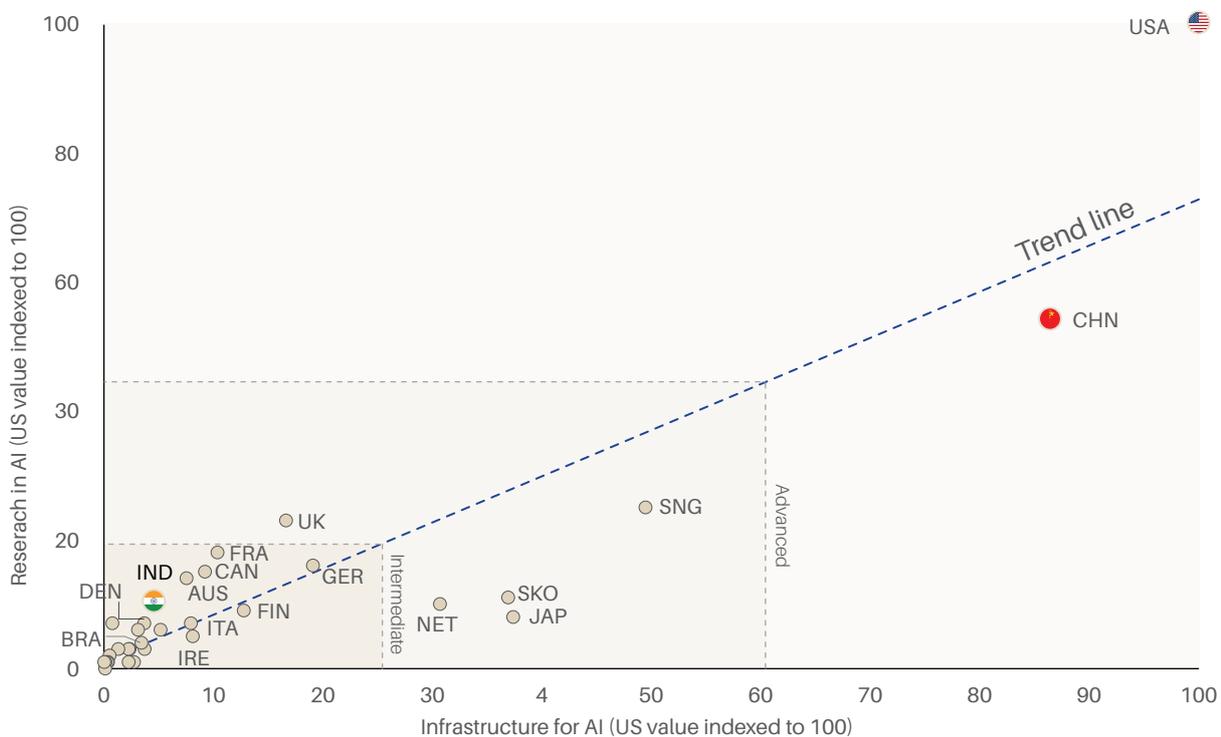
Source: ICRIER - Prosus Centre (IPCIDE)

## 5.2. Is the AI world at risk of being dominated by two countries?

US and China have gained decisive lead over the rest of the world in AI (see figure 2). As reported in SIDE 2024 and the Global AI Index 2024, US and China are ranked as first and second place. In the latter report, the dominance of US and China follows through for each of its three pillars – implementation, innovation and investment.<sup>43</sup> Here we look at infrastructure availability and research outcomes for our set of 32 countries, where both US and China dominate (see figure 5.2). Infrastructure and research outcomes in AI are also strongly correlated – a 1% improvement in the infrastructure score (indexed from 0-100) is associated with 0.76% improvement in AI research outcomes (also indexed from 0 -100).<sup>44</sup> The high association is reflective of overall AI capacity and the ecosystem

which reinforces outcomes for other pillars. Asian economies like Singapore, South Korea and Japan with high levels of government tech maturity are at the intermediate stage of AI development. They are investing in AI infrastructure, talent and research; as well as coordinating global cooperation on AI safety and security.<sup>45</sup> The AI ecosystem is also expanding in UK and France, though infrastructure availability has not expanded proportionately. India ranks 11th on AI research and 16th on AI infrastructure, which is significant, but not enough to make it an important player in the production of AI. With the world's largest AI-skilled workforce and the government's recent efforts, India has the potential to make rapid progress in the coming years.<sup>46</sup>

Fig. 5.2 US and China: Hegemons in AI



Source: ICRIER - Prosus Centre (IPCIDE)

<sup>43</sup> White, J., & Cesario, S. (2024, September 19). *The Global Artificial Intelligence Index 2024*. Tortoise Media.

<sup>44</sup> By including infrastructure in AI as well as research in AI as two independent indicators, we could be charged with mixing inputs and outputs as most other indices do. But given that AI is still in its infancy, there are few credible output indicators. We hope to replace *infrastructure in AI* with better outcome indicators in the future editions of SIDE.

<sup>45</sup> Mohanty, A., & Bharadwaj, T. (2024, June 28). *The Importance of AI Safety Institutes*. Carnegie India.

<sup>46</sup> Jeevanandam, N. (2024, April 16). *India tops global AI skill penetration and talent concentration rates*. INDIAai.

India remains a large consumer of emerging technologies, placed 6th in terms of the size of the market after US, China, Japan, Germany and UK. Despite a decline, India remains the second largest market for DeFi among G20 countries in 2024. Meanwhile, the overall market for virtual digital assets is steadily growing in India and is

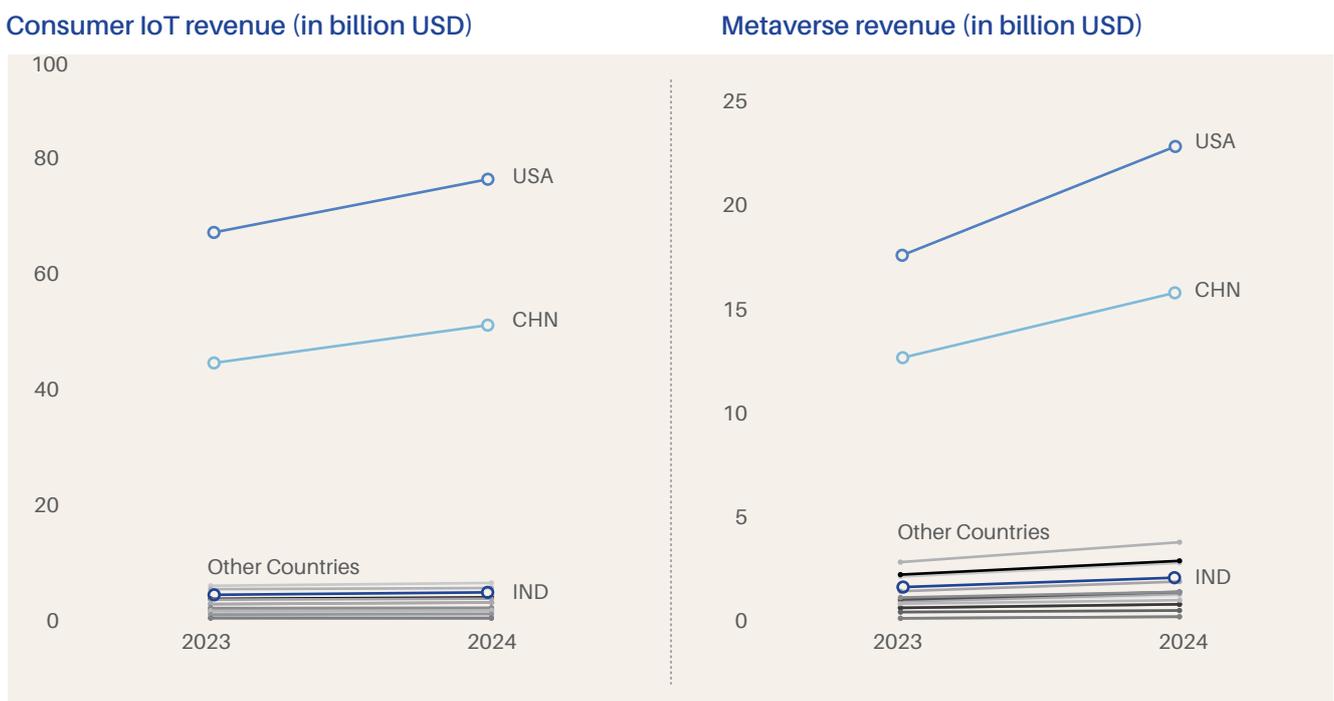
expected to reach USD 6.4 billion with over 100 million users by the end of 2025. This is higher than the market size for all other emerging technologies in India (consumer IoT estimated at USD 5 billion, metaverse at USD 2.1 billion and AR/VR estimated at 789 million in 2024).

### 5.3. US and China are also the leading adopters of emerging technologies

The global market for many emerging technologies - internet of things (IoT), metaverse, augmented and virtual reality (AR/VR) have grown over the past year, with the exception of decentralised finance (DeFi). The inherent risks in DeFi and the lack of regulatory certainty have now allowed its applications to scale to full potential. For other technologies the growth across countries has been very unequal. US remains the dominant player in adoption emerging technologies and its market share has gone up

further between 2023 and 2024. In 2023, US accounted for 42 percent, 31 percent, 35 percent, and 27 percent of total revenue in IoT, Metaverse, AR/VR, and DeFi, respectively.<sup>47</sup> By 2024, these numbers had gone up to 61 percent, 59 percent, 43 percent and 32 percent respectively (see figure 5.3). The increase in IoT, metaverse and AR/VR revenues in China, is also of similar proportions, as that in the US.

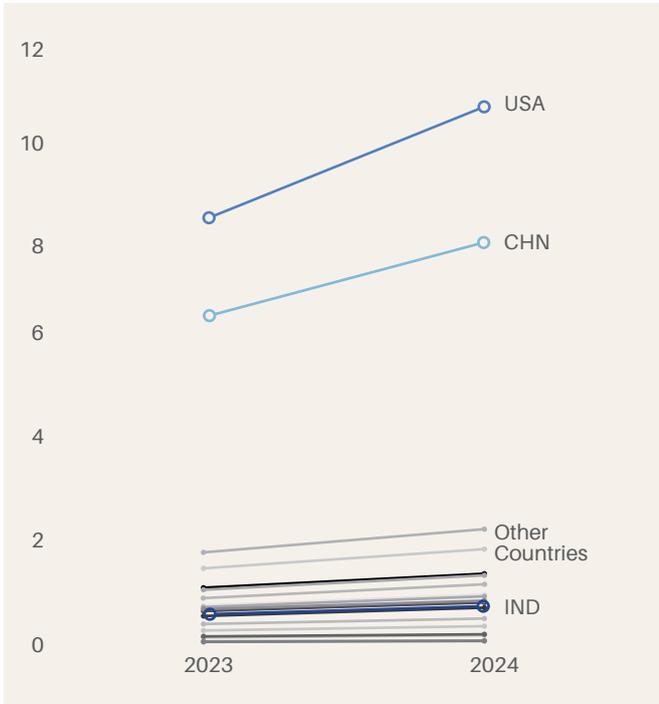
**Fig. 5.3** The gap between US and rest of the world has significantly widened in adoption of emerging technologies in the past twelve months



<sup>47</sup> Refers to total revenue in the G32 countries.

**Fig. 5.3 (Contd.) The gap between US and rest of the world has significantly widened in adoption of emerging technologies in the past twelve months**

**AR/VR revenue (in billion USD)**



**DeFi revenue (in billion USD)**



Source: ICRIER - Prosus Centre (IPCIDE)

Note: DeFi revenue data is not available for China.

India remains a large consumer of emerging technologies, placed 6th in terms of the size of the market after US, China, Japan, Germany and UK. Despite a decline, India remains the second largest market for DeFi among G20 countries in 2024. Meanwhile, the overall market for virtual digital assets is steadily growing in India and is expected

to reach USD 6.4 billion with over 100 million users by the end of 2025.<sup>48</sup> This is higher than the market size for all other emerging technologies in India (consumer IoT estimated at USD 5 billion, metaverse at USD 2.1 billion and AR/VR estimated at 789 million in 2024).

## 5.4. Big money betting on US and China

Two countries – US and China – account for 70 percent of the valuation of unicorns and 80 percent of venture capital (VC) investments in AI across the 32 countries in our sample (see figure 5.4). VC money chasing startups in these two countries not only pump up the valuation of startups, it also gives

AI companies the much-needed financial muscle to build capital intensive AI models. According to Pitchbook data, prompted by the success of Open AI, startups raised 30 percent higher capital for AI in 2024, compared to the previous year.<sup>49</sup> In China, central and local government VC funds invested

<sup>48</sup> Goswami, A., & Soundararajan, N. (2025, January 31). *Regulating Virtual Digital Assets In India: Balancing Innovation And Risks*. Business World.

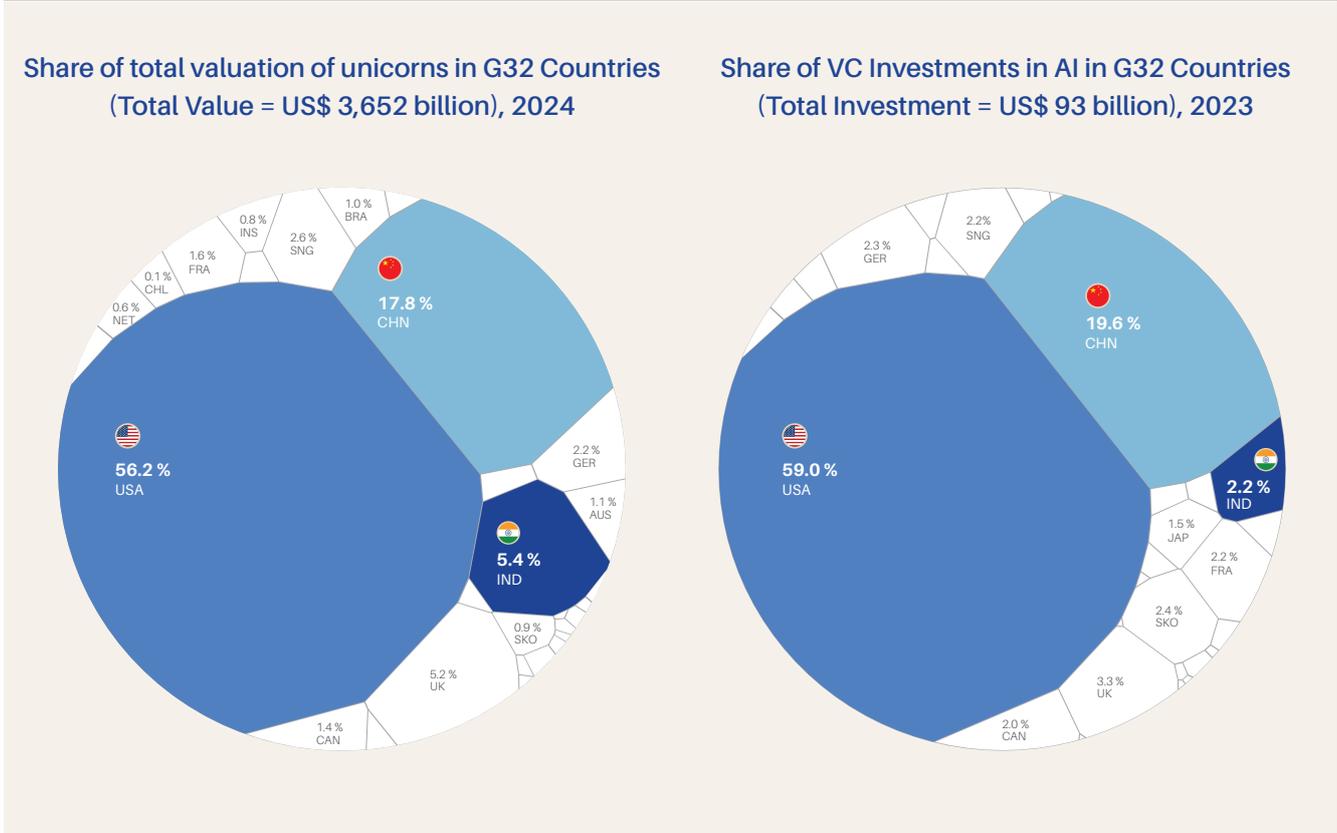
<sup>49</sup> Hu, K. (2025, January 07). *AI startups drive VC funding resurgence, capturing record US investment in 2024*. Reuters.

up to USD 912 billion in strategic industries like AI. Government investments worked as a signal for the private sector to also up their stake in AI companies.<sup>50</sup>

India is a distant third in valuation of unicorns and sixth in VC investments for AI. 2024 saw a resurgence in funding of tech startups after muted growth in 2023. Both the deal count and

total value of investments have increased. Sectors that received the highest amount of funding were technology and consumer discretionary (including household appliances, cars, leisure products, etc.) Reportedly, deep tech is likely to become an area of growth with drones, semiconductors, robotics, generative AI and space tech becoming focus areas for investment.<sup>51</sup>

**Fig. 5.4 US and China receive the lion share of VC funds pumping up valuation of unicorns**



Source: ICRIER - Prosus Centre (IPCIDE)

## 5.5. India off to a promising start but a long way to go

India's strength in the innovation pillar is reflected through three key indicators - enthusiastic adopters of decentralised finance (DeFi), a strong start-up culture and high valuations for unicorns (see Figure 5.5). However, the country lags in relative adoption of Consumer IoT and metaverse, with scores much

below the median score for G32 countries. It also scores poorly in AI infrastructure and slightly below the median in AI research. On AI specifically - government programs including the latest Union Budget's (2025-26) boost to the India AI mission should

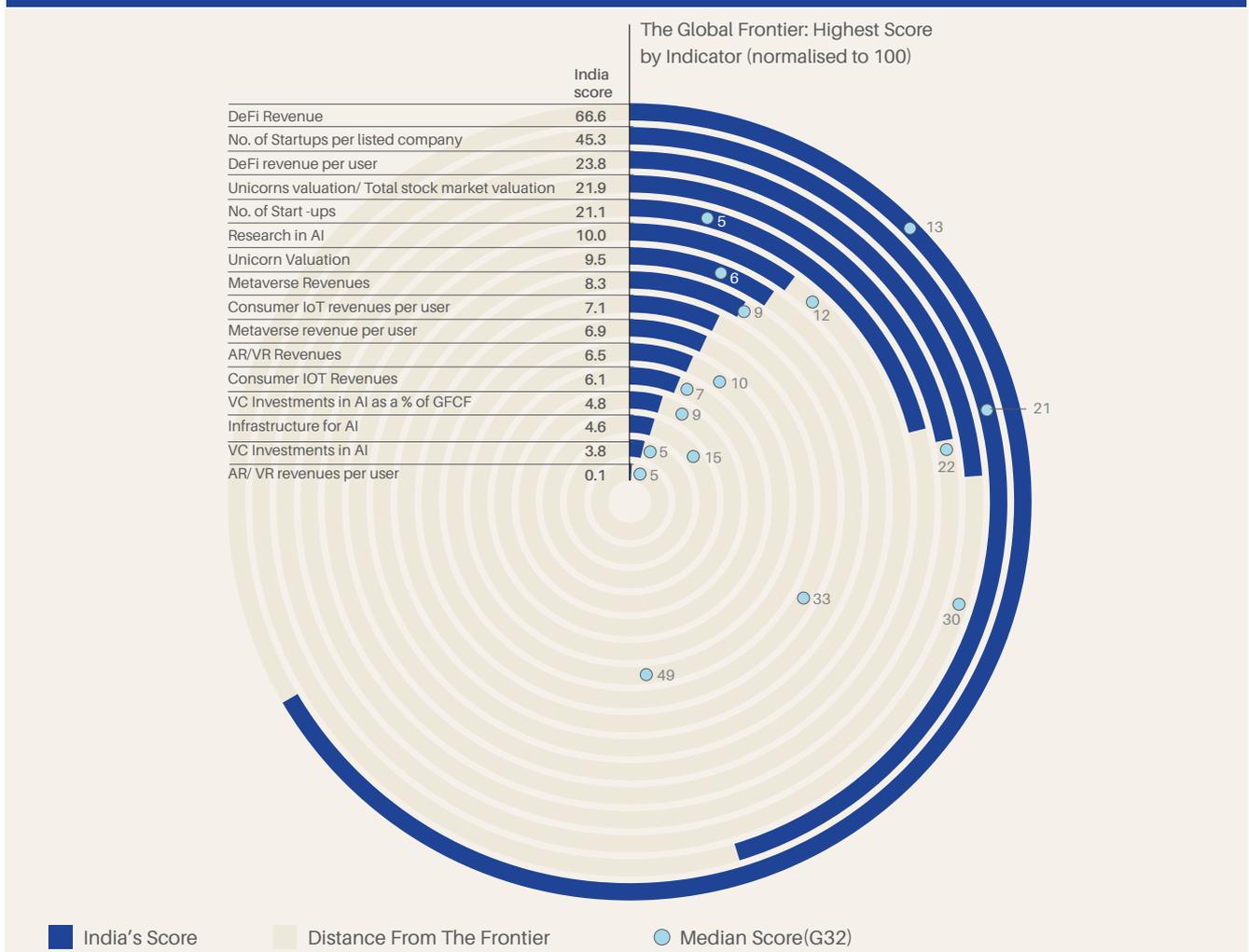
<sup>50</sup> Beraja, M., Peng, W., Yang, D., & Yuchtman, N. (2024, December 01). *Government Venture Capital and AI Development in China*. Stanford University.

<sup>51</sup> Paul, J M. (2024, December 22). *VC investments hit \$16.7 billion this year powered by tech sector*. Business Standard.

alter the landscape. The program is supporting the development of the overall ecosystem including compute capacity, an innovation centre, dataset platforms, application development, skills, start-up financing and governance.<sup>52</sup> 18,000 plus graphic

processing units (GPUs) are already being procured under the scheme. A new centre of excellence for education was also announced in the Budget, in addition to three on agriculture, health and sustainable cities.<sup>53</sup>

**Fig. 5.5 India's pockets of innovation**



Source: ICRIER - Prosus Centre (IPCIDE)

The other new area of AI innovation in India are domain-specific small language models (SLMs). These are specialised models with sectoral applications – healthcare, education, agriculture, and are not only cheaper but also easier to train and very relevant to localised applications. SLMs are poised to play a key role in democratising the adoption of AI models in India. Finally, some research is also being pursued in the area of LLMs

in Indic languages by pioneering startups such as Sarvam AI. Their model Sarvam-1 is optimised for Indian languages and supports English alongside ten major Indian languages, including Bengali, Gujarati, Hindi, Kannada, Malayalam, Marathi, Oriya, Punjabi, Tamil, and Telugu.<sup>54</sup> With several such initiatives, India has an opportunity to truly own and power indigenised AI models that can compete in global markets.

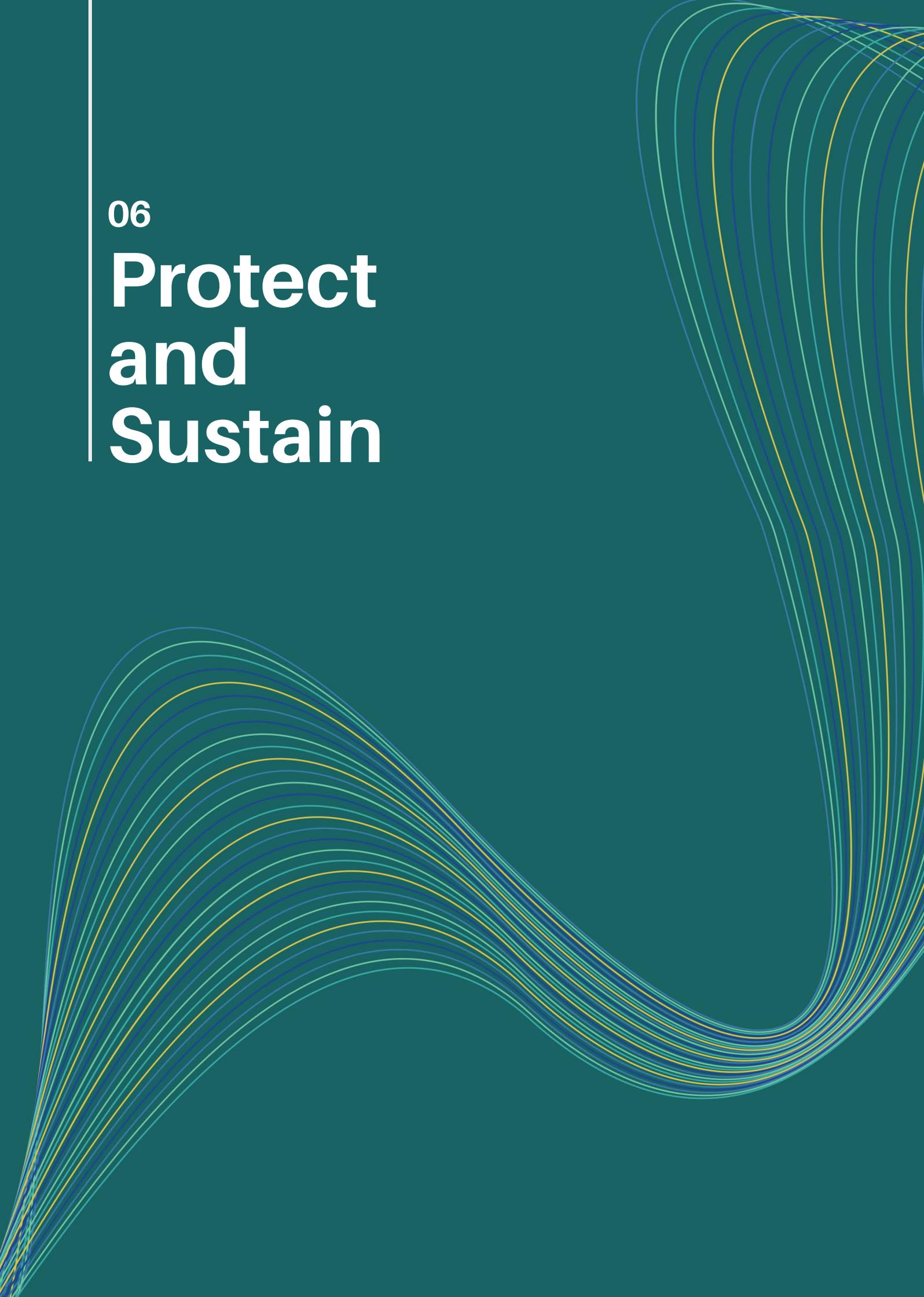
<sup>52</sup> INDIAai. (n.d.). INDIAai Mission Pillars.

<sup>53</sup> Tech Desk. (2025, February 9). India's AI strategy: A look at key govt announcements following DeepSeek disruption. The Indian Express.

<sup>54</sup> Elets News Network. (2025, January 16). Indian Government Teams Up with Sarvam AI to Build a Sovereign AI Model. eGov Magazine.

06

# Protect and Sustain



# Protect and Sustain: Lurking Threats to Gains from Digitalisation

The Protect (P) and Sustain (S) Pillars have been combined into a single group Protect + Sustain (PS) for two reasons:- (i) both pillars deal with risks emanating from rapid digitalisation; and (ii) the quality of data available for these two pillars are not as good as for the other three pillars. In other words, they don't capture the magnitude of some of the critical risks emanating from digitalisation,

for example, rising costs of data breaches (see Box 6.1) or estimated energy costs of Large Language Modelling (see Box 6.2). Nevertheless, leaving them out from an index measuring digitalisation was not desirable. As a compromise we include them in the framework, but assign them lower weights (half) compared to the other three pillars (see Annexure 2 for more details).

## Box 6.1 Rising cost of data breaches

The Cost of Data Breach report 2024 by IBM points to the steadily rising loss to business, cost of post-breach responses and higher regulatory fines (see Figure below). The 9 percent increase between 2023 and 2024 is the highest since the pandemic. The healthcare industry has consistently suffered the highest costs from data breaches (since 2011).

India falls in the list of top 15 countries/regions with the highest data breach costs in 2024. The report highlights that phishing and stolen or compromised credentials are the most common



Source: IBM<sup>55</sup>, Statista<sup>56</sup> and RBI<sup>57</sup>

<sup>55</sup> IBM. (2024). *Cost of a Data Breach Report 2024*.

<sup>56</sup> Statista. (2024, September 11). *Average cost of a data breach worldwide from 2014 to 2024*.

<sup>57</sup> Reserve Bank of India. (2024, July 29). *Report on Currency & Finance 2023-24: India's Digital Revolution*.

initial attack types in India, accounting for 18 percent of incidents each, followed by cloud misconfiguration (12 percent). According to RBI's Report on Currency and Finance for 2023-24, India's average cost of data breaches increased by 28 percent between 2020-2023.

## Box 6.2 Environmental impact of Large Language Models (LLMs)

According to Holistic AI, the technology industry contributes to 1.5-4 percent of worldwide emission; out of which Artificial Intelligence (AI), cryptocurrency and data centres contribute to 460 TWh, which is equivalent to 1.8 percent of global energy consumption. To put this into perspective, five billion YouTube hits of a song consumes the same amount of energy as 40,000 US homes. It is widely recognised that energy guzzling Large Language Models (LLMs) are having adverse impact on the environment. While it is difficult to directly compare the energy impact and therefore operational carbon impact of training different LLMs due to a lack of information available to the public, some estimations have been provided (see Table). To provide a reference, 25 tonnes of CO<sub>2</sub> eq is roughly equivalent to 30 flights between London and New York.

Model name	CO <sub>2</sub> eq emissions	Power Consumption	Number of Parameters
GPT-3	502 tonnes	1287 MWh	175 billion
Gopher	352 tonnes	1066 MWh	280 billion
Bloom	25 tonnes	433 MWh	176 trillion

Source: Holistic AI<sup>58</sup> and Nathan Bailey<sup>59</sup>

## 6.1. Countries on different trajectories

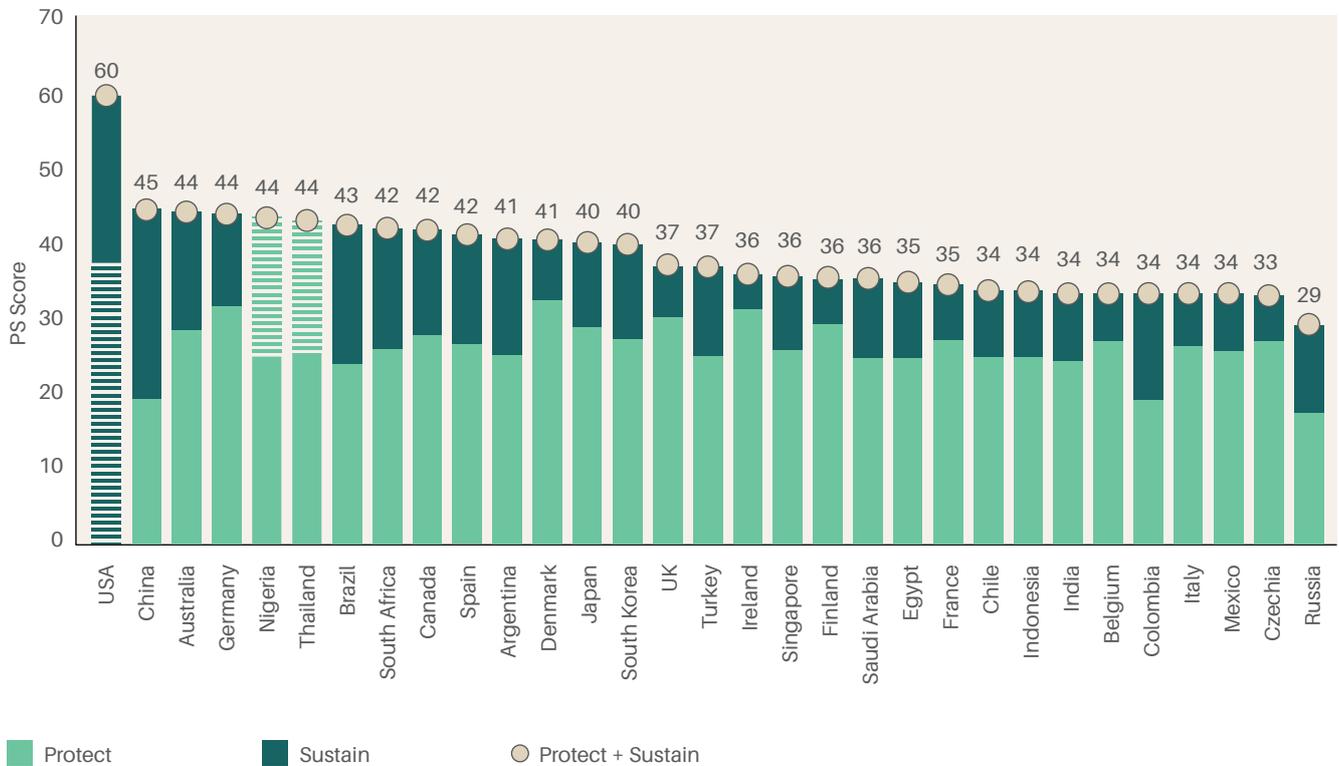
A quick look at the combined scores for PS Pillar suggest no significant difference in the performance among countries. Apart from the United States, which has a score of 60, the PS score for the remaining countries are crowded within a narrow range (see Figure 6.1). This is different from what we saw in the other three pillars, where the scores

were widely dispersed across countries, signalling divergence in digitalisation. Second, there is hardly any difference in score between the developed and developing countries, implying that when it comes to safeguard against risks, all countries have significant challenges to scale.

<sup>58</sup> Holistic AI Team. (March 29, 2024). *AI and ESG: Understanding the Environmental Impact of AI and LLMs*.

<sup>59</sup> Bailey, N. (2024, September 02). *The Carbon Footprint of LLMs – A Disaster in Waiting?* Medium.

Fig. 6.1 Performance of countries on PS Pillar is range bound



Source: ICRIER-Prosus Centre (IPCIDE)

Note: For the US, Nigeria and Thailand, we couldn't compute the score for one of the sub-pillars due to missing observations (also see Annexure 4). But rather than dropping the sub-pillar, we use proxy values for the missing sub-pillar by using similar results as for the rest of the group, and then use it to estimate the pillar score. These simulated scores are shown by bars with horizontal lines.

The uniformity in the PS scores turns out to be the result of two opposing drivers in developed and developing countries. This is seen from a strong negative correlation between P and S, with developed countries scoring high on Protect and developing countries performing better on Sustain (see Figure 6.2). The results are intuitive – developed countries with their longer history of digitalisation are not only more prone to cyberattacks, they have also invested relatively more in safeguarding their

networks. However, they carry the baggage of legacy infrastructure that was built long before the advent of new sustainable choices. Technological research has led to the advent of many new technologies that support greening of digitalisation, including the adoption of life cycle assessments that rationalise e-waste and energy consumption.<sup>60</sup> Developing countries that are in the process of building digital infrastructure have the opportunity to invest in new sustainable choices.

<sup>60</sup> United Nations Conference on Trade and Development. (2024, July 10). *Digital Economy Report 2024: Shaping an environmentally sustainable and inclusive digital future*. United Nations.

**Fig. 6.2** Developed and developing countries follow opposite trends in Protect and Sustain



Source: ICRIER-Prosus Centre (IPCIDE)

Note: US has been left out because the P score could not be computed due to missing data

The country ranking on PS reflects their commitment to address risks of digitalisation. United States comes out on top in addressing the overall risks of cyber security and environmental degradation from unsustainable digitalisation choices (see Figure 6.3). It leads by a huge margin on cyber security preparedness and also ranks second on adoption of green technologies, reflecting its focus on addressing both categories of risks.

China, the overall second, leads in Green R&D patents and ranks 13th in commercialisation of green tech. However, its outcomes on cyber security appear a lot weaker. As per data available on email leaks and ransomware attacks, China

is very vulnerable to cyber security threats and not commensurately prepared. Its ranks for Risk of Attack and Preparedness are 28 and 19, respectively. According to the Global Cybercrime Index, China ranks third behind Russia and Ukraine. The country faces severe cybercrime threat, with attacks targeting critical infrastructure and businesses.<sup>61</sup> It is also a country from where cybercrime originates. As understood, cybercrimes are usually transnational and require an international framework for cooperation. Many such global initiatives are now underway to collectively ward off threats of cybercrime, but these are yet to translate into meaningful impact.<sup>62</sup>

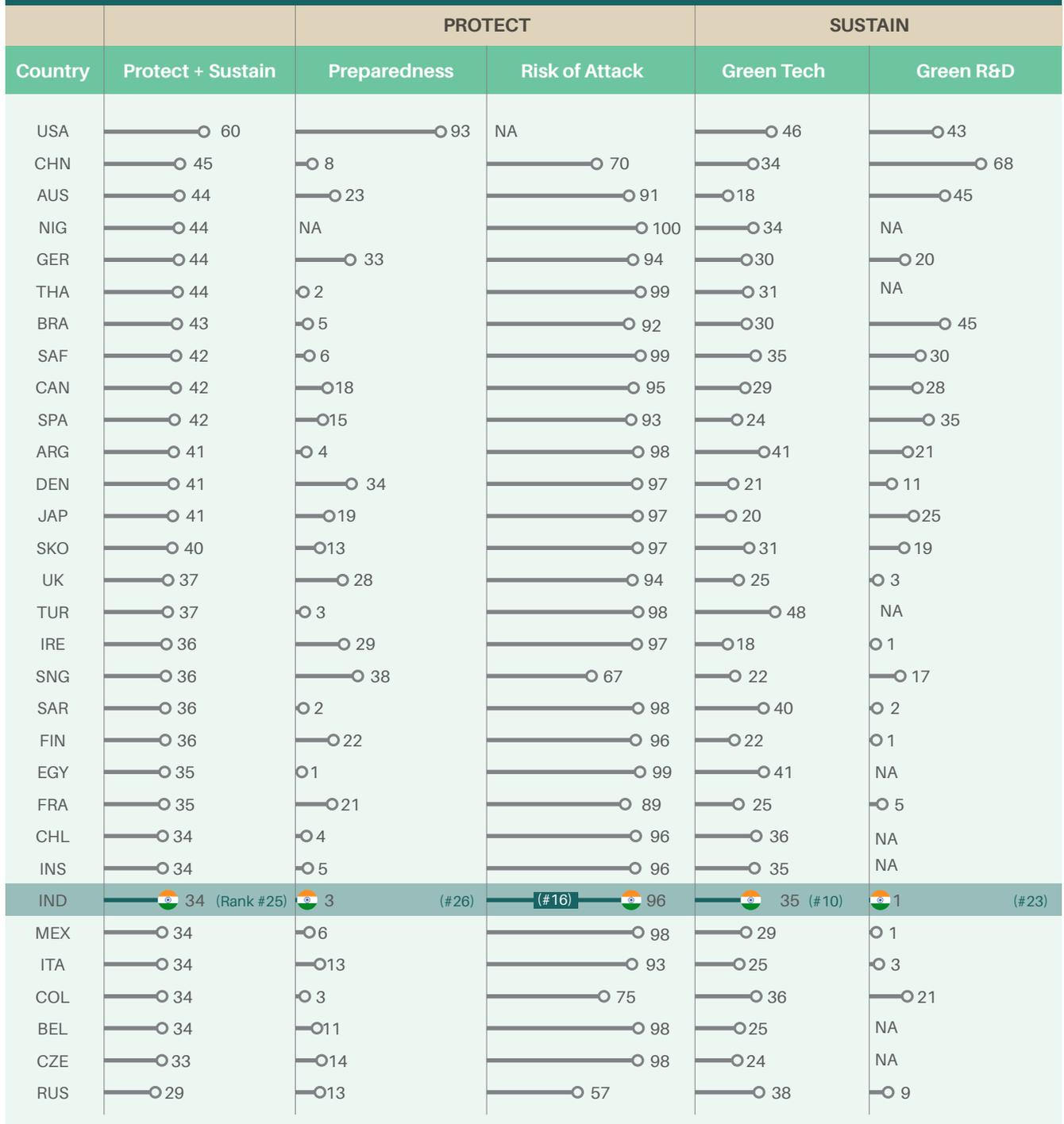
<sup>61</sup> University of Oxford. (2024, April 10). *World-first "Cybercrime Index" ranks countries by cybercrime threat level.*

<sup>62</sup> The Global Forum on Cyber Expertise (GFCE) is one example of a multi-stakeholder community of over 200 Members and Partners including governments, international organisations, companies, and academics from all regions of the world. The GFCE structures its work around five themes of cyber capacity identified in the Delhi Communiqué: (1) Cyber Security Policy and Strategy (2) Cyber Incident Management and Critical Infrastructure Protection (3) Cybercrime (4) Cyber Security Culture and Skills (5) Cyber Security Standards.

India’s poorest performing pillar in the CHIPS framework is PS. The overall rank for India in the PS pillar is 25, and the lowest ranking sub-pillar is

preparedness (26), followed by Green R&D (23). We discuss India’s performance in Section 6.4.<sup>63</sup>

**Fig. 6.3 Countries at varying outcome levels in addressing cyber security and sustainability risks**



Source: ICRIER-Prosus Centre (IPCIDE)

Note: N.A. – Data not available

<sup>63</sup> We have dropped Netherlands from the discussion for a purely technical reason. Mathematically, it ranks at the bottom of the pillar, giving an impression of poor preparation to looming risks. This however is the result of missing data for Netherlands on risk of attacks and algebraically results in a lower score following the rules laid out for aggregation in the framework. If we were to use a proxy for Netherlands – example, the average risk of attack similar to in northern Europe and UK (including countries like Denmark, Finland, Belgium, and Ireland and UK) – it would actually come out on top, ahead of the United States, collectively for Protect and Sustain. Such dramatic variation in the rank and score for Netherlands on account of one missing variable is unfortunate, and led to our decision to exclude it from the discussion here.

## 6.2. Preparedness for cybersecurity is growing

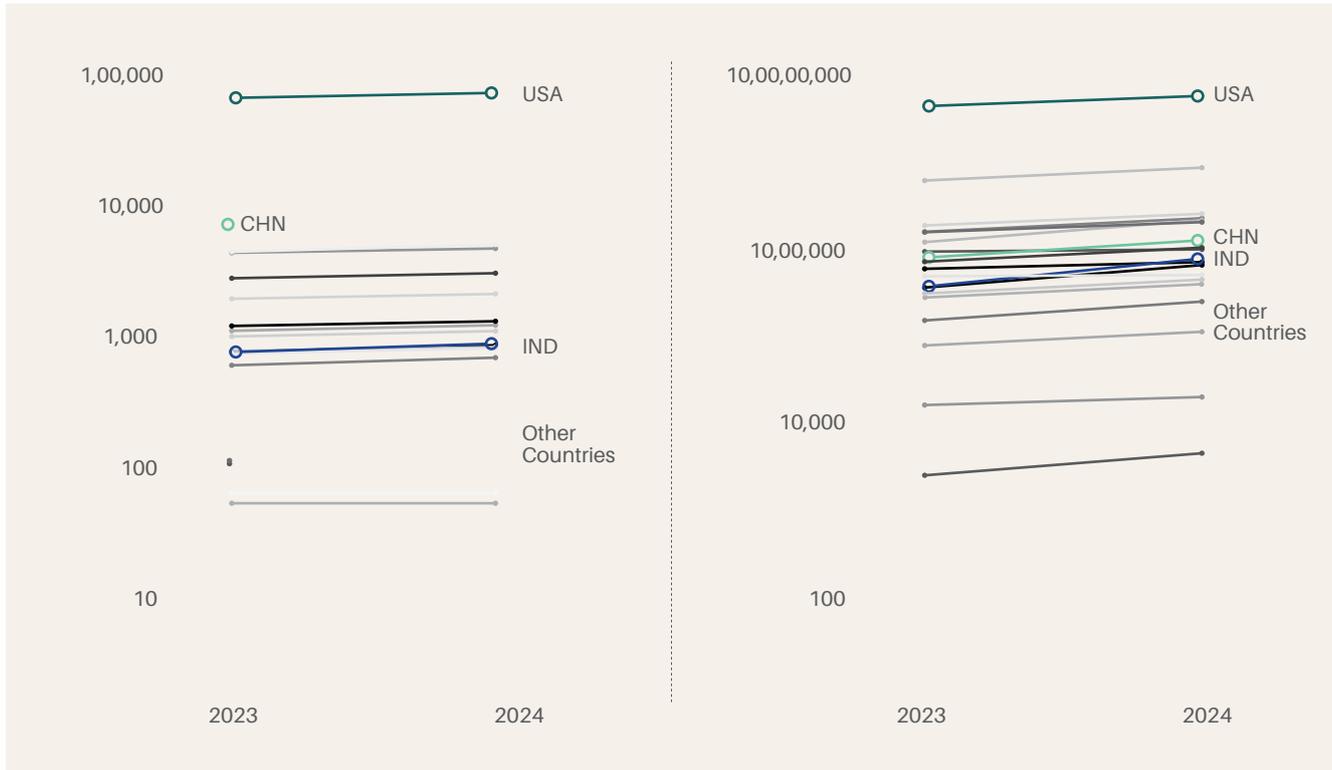
Comparing data for G20 countries finds that the preparedness for cybersecurity is growing, albeit slowly in overall spending (see Figure 6.4). The average increase in cyber security spending among G20 countries was 8.8 percent. India recorded the highest growth (14.5 percent), though from a low base. The reported spending for India in 2024 amounted to USD 2.9 billion, lower than the average for G20 countries, i.e., USD 3.5 billion for the same year.<sup>64</sup>

In comparison, growth in number of secure servers was significantly higher (see Figure 6.4). An average increase of 48 percent among G20 countries, with India yet again, recording the highest growth – doubled the number of secure servers between 2023 and 2024, matching the median values for the group in 2024. Despite these improvements, India’s ranking in the Preparedness sub-pillar is abysmally low (26), indicating huge efforts the country has to make to match up to the level of other countries (discussed further in Section 6.4).

**Fig. 6.4 India’s emerging fintech landscape**

### Cybersecurity spending in mn USD

### Number of Secure Servers



Source: ICRIER-Prosus Centre (IPCIDE)  
 Note: The Y Axis increases in a log scale.

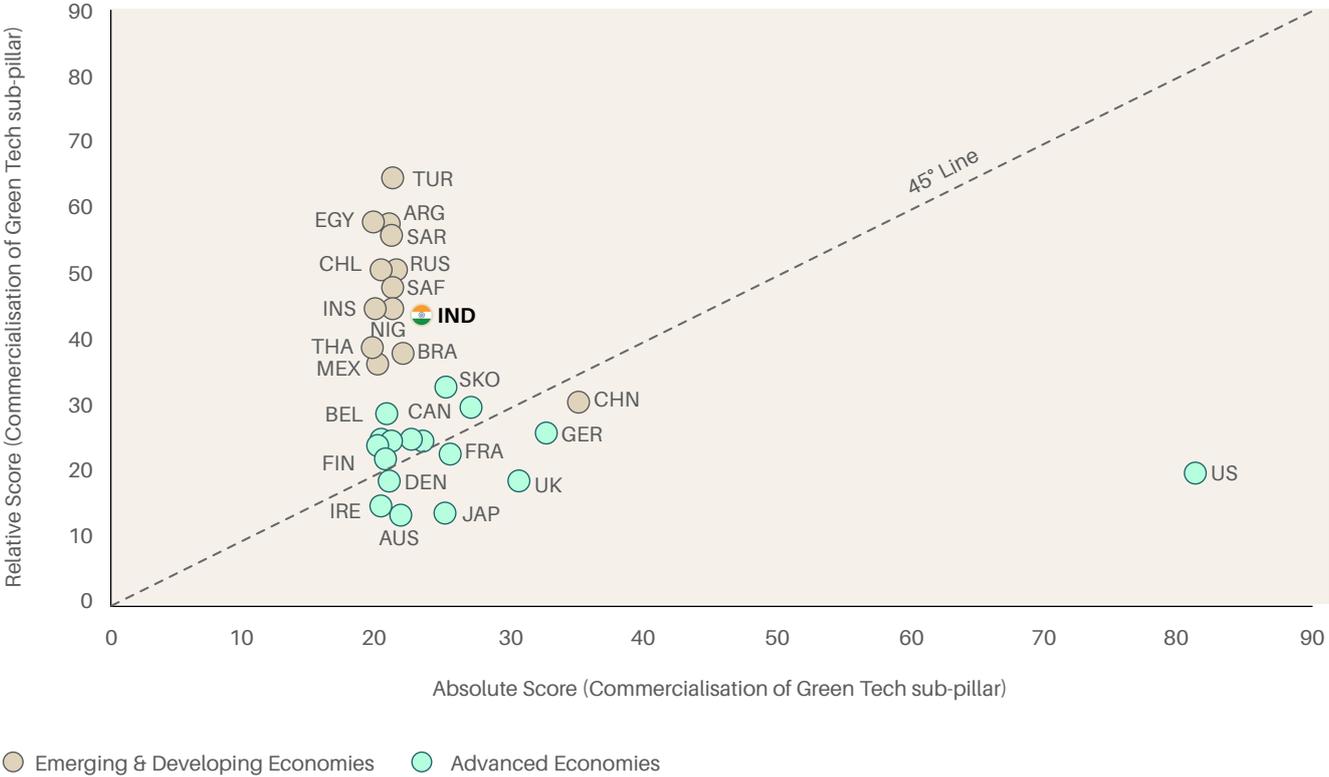
<sup>64</sup> Statista. (n.d.). *Cybersecurity-Worldwide*.

### 6.3. Developing countries are making sustainable digitalisation choices

The sub-pillar on commercialisation of green tech is interestingly led by developing countries. Besides US, all countries within the top 10 are developing countries. The outcomes are a result of combing absolute and relative metrics of sustainable digitalisation, where developed countries have larger markets - US clearly an outlier in terms of its overall spending on commercialisation of green tech. As discussed above, for developing countries, which are still building digital infrastructures like

data centres & investing in software, the share of green technologies is significantly higher; i.e., relative scores for developing countries are higher (see Figure 6.5). While developed countries benefit from legacy infrastructure, they incur extra cost and effort in transforming them to green technologies. Developing countries, on the other hand, have a unique opportunity for greenfield investments in sustainable digital technologies.

**Fig. 6.5** Developing countries are spending relatively more on sustainable digital technology



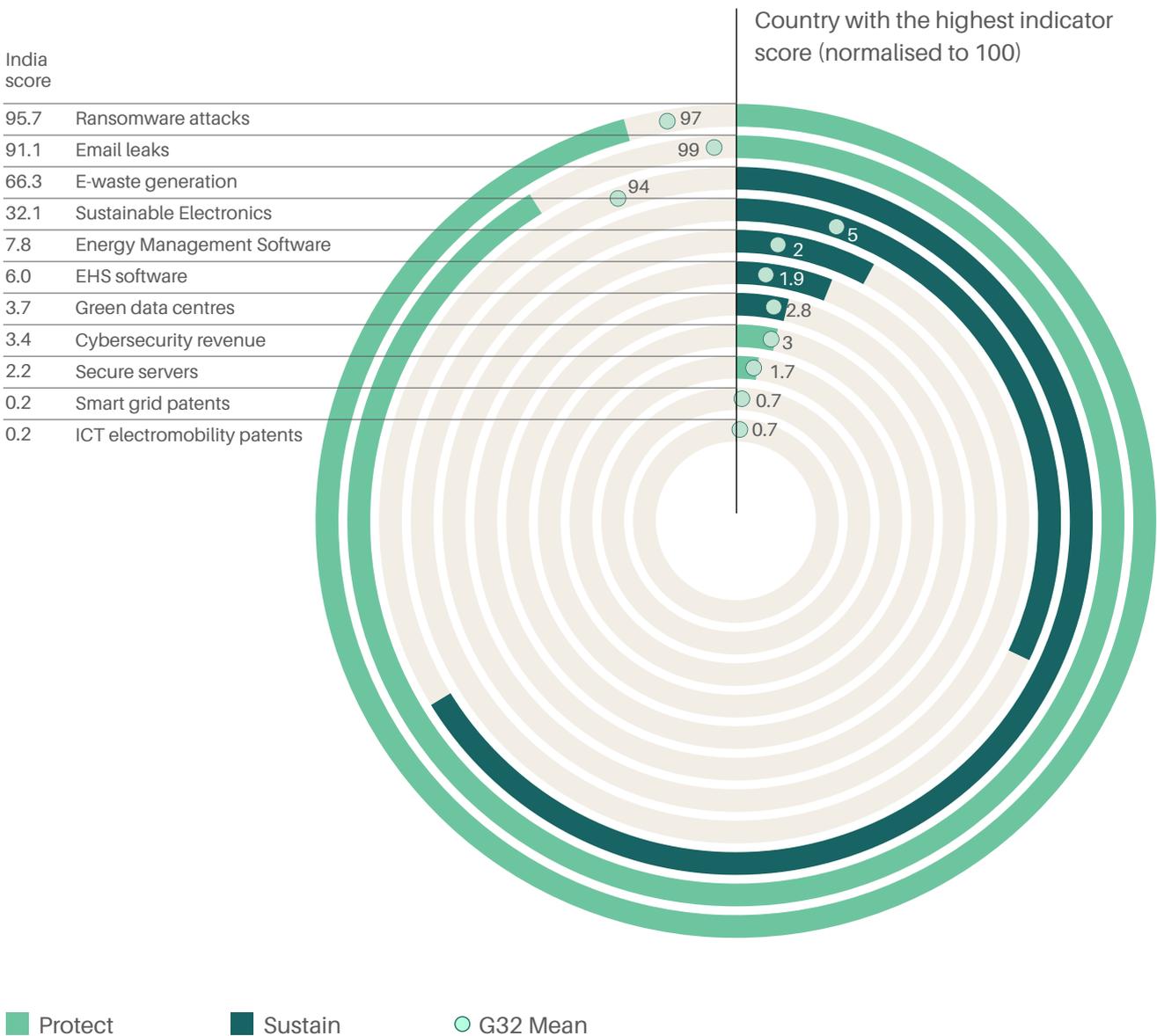
Source: ICRIER-Prosus Centre (IPCIDE)

## 6.4. India needs to step up its effort in cybersecurity and sustainable digitalisation

India’s large population gives it the advantage of scale but also creates risk of cyber threats and environmental degradation due to rapid digitalisation. The high scores illustrated in Chapter 4 on Harness can easily be dampened by poor performance in cyber security and sustainable

digitalisation if commensurate efforts are not made. In three out of four indicators for Protect and seven out of nine indicators in Sustain, India is below the median. While previous subsections illustrate the efforts made by India, more needs to be done.

**Fig. 6.6 India’s below average performance in Protect and Sustain**



Source: ICRIER-Prosus Centre (IPCIDE)

India however, stands to gain from adoption of digitalisation for sustainable development, with successful deployment of its digital public infrastructure (DPI). A recent case study from the US shows that nearly 99 percent of environmental costs of cash (paper currency) comes from distribution and operation, which is reduced with a digital payment platform like Unified Payment Interface (UPI) (see Figure 6.7). Other applications such as

Aadhaar based electronic KYC (eKYC) has helped minimize paper waste; Digilocker, the government's initiative on paperless governance, is also expected to reduce the need to store, print and carry paper certificates, collectively lowering environmental costs through digitalization. Similar use cases for ID and credentials could improve efficiency of citizen services, while reducing environmental costs.

**Fig. 6.7** Lifecycle estimate of the total environmental cost of a 1 USD cash note in the United States



Source: Digital Planet, Tufts University

However, balance needs to be maintained between sustainable digitalization and digitalization for sustainability. In pursuit of the latter, technology that promotes sustainability must not be overlooked. In

other words, new technology should be powered through clean energy, improved engineering and minimum waste.



07

# Afterword



## CHIPS as a Policy Tool

CHIPS is not just a framework for measuring digitalisation and ranking countries (or states, in the sub-national context) on their performance, it can be a useful diagnostic tool for policymakers to identify gaps and design interventions. In a macro sense, the framework helps benchmark a country to world frontiers and world averages. Comparison is also possible within different country groupings – G20, BRICS, European Union and notable countries from ASEAN, Latin America and Africa.<sup>65</sup>

Additionally, the modular design of the CHIPS framework allows for isolation of pain points, across

the spectrum of digitalisation – Connect, Harness, Innovate, Protect and Sustain. Micro-level inputs for each indicator, enable decision making on the directionality of policy and the necessary resource allocation. In other words, CHIPS enables evidence-based policymaking, by anchoring the diagnosis and policy choices through data and comparisons.

In the following sections, we provide illustrative examples of how CHIPS can be used as a diagnostic tool for day-to-day policymaking.

### 7.1. Creating Digital Heatmaps

The CHIPS framework can be used to generate the digital heatmap of a country – a commonly used two-dimensional data visualisation technique that shows distribution of values using a set of colours. It provides a visual summary of the information available, highlighting the relevant data points. The digital heatmap similarly provides a snapshot of the country's performance on digitalisation, highlighting areas of strengths and weaknesses, by mapping 47 indicators, across sub-pillar and pillars.

The heatmap can be generated at the economy level (CHIPS Economy), at the user level (CHIPS User), or a combination of both (CHIPS Combined). While the illustration below uses the group average to create the map, different benchmarks could be used, i.e., a peer country, average of peer group countries or the country at the frontier.

We illustrate this by showing the heatmap for India (see Figure 7.1). The visual summary provides

many useful insights. At first glance, the number of green and dark green cells, highlight that India performs above the G32 average in 33 out of 47 indicators in CHIPS Economy. The colour spread changes drastically for CHIPS User, with fewer green cells - only 14 out of 47 indicators. Second, India's best performing pillar is the Harness pillar, both for the Economy and for the User, while its worst performing pillar is Protect and Sustain. Third, the biggest contrast between the economy and the user is in the Connect pillar, where it exceeds G32 average in 8 of the 11 indicators for CHIPS Economy, while falling short of G32 average in 9 of the 11 in CHIPS User.

The ability to quickly identify these key trends and also over time, can be an important input for policymaking.

<sup>65</sup> We hope to continue expanding the set of countries included in CHIPS

Fig. 7.1 Comparing India's performance on digitalisation with respect to G32 average

CHIPS Economy	Indicator Score = India Score - Average Score															
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16
Connect	30	28	-13	15	17	-27	65	54	89	53	-84					
Harness	69	31	29	18	23	54	-1	58	13	28	8	-4	39	64	57	0
Innovate	-2	-10	-2	16	4	-1	-4	0	54							
Protect +Sustain	-3	-3	5	-3	-5	0	-1	21	-22	-8	-8					

CHIPS User	Indicator Score = India Score - Average Score															
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16
Connect	0	-12	-56	-5	17	-27	-67	-47	5	-55	-14					
Harness	25	-11	-31	-33	-1	-15	-36	10	21	-31	-47	-7	-35	-46	61	8
Innovate	-2	-10	-4	25	0	-26	-5	-42	-6							
Protect +Sustain	-27	-22	7	12	-24	10	-5	13	58	-24	-30					

Note: The names of the indicators associated with each pillar, represented alphanumerically here (column head) can be found in Annexure 1; A negative number implies India's score is lower than the median score and vice-versa.

Source: ICRIER-Prosus Centre (IPCIDE)

## 7.2. Digital Diffusion Pyramid (DDP)

The diffusion of digital services is a complex journey for countries, with governments navigating challenges of infrastructure, literacy, and other economic and social constraints. In the CHIPS framework, countries that have an edge in Connect and Harness, i.e., adoption of internet, smartphones and digital services, are able to push up their overall score. To view a country's progress on digital

diffusion using the CHIPS dataset is to create Digital Diffusion Pyramids (DDP).

The idea is similar to the population pyramid or the demographic pyramid which provides the structural composition of population by age, gender, etc.<sup>66</sup> We start with the percentage of population covered by LTE (this is close to universal for most countries), and

<sup>66</sup> PopulationPyramid.net. (n.d.). *Population Pyramids of the World from 1950 to 2100*.

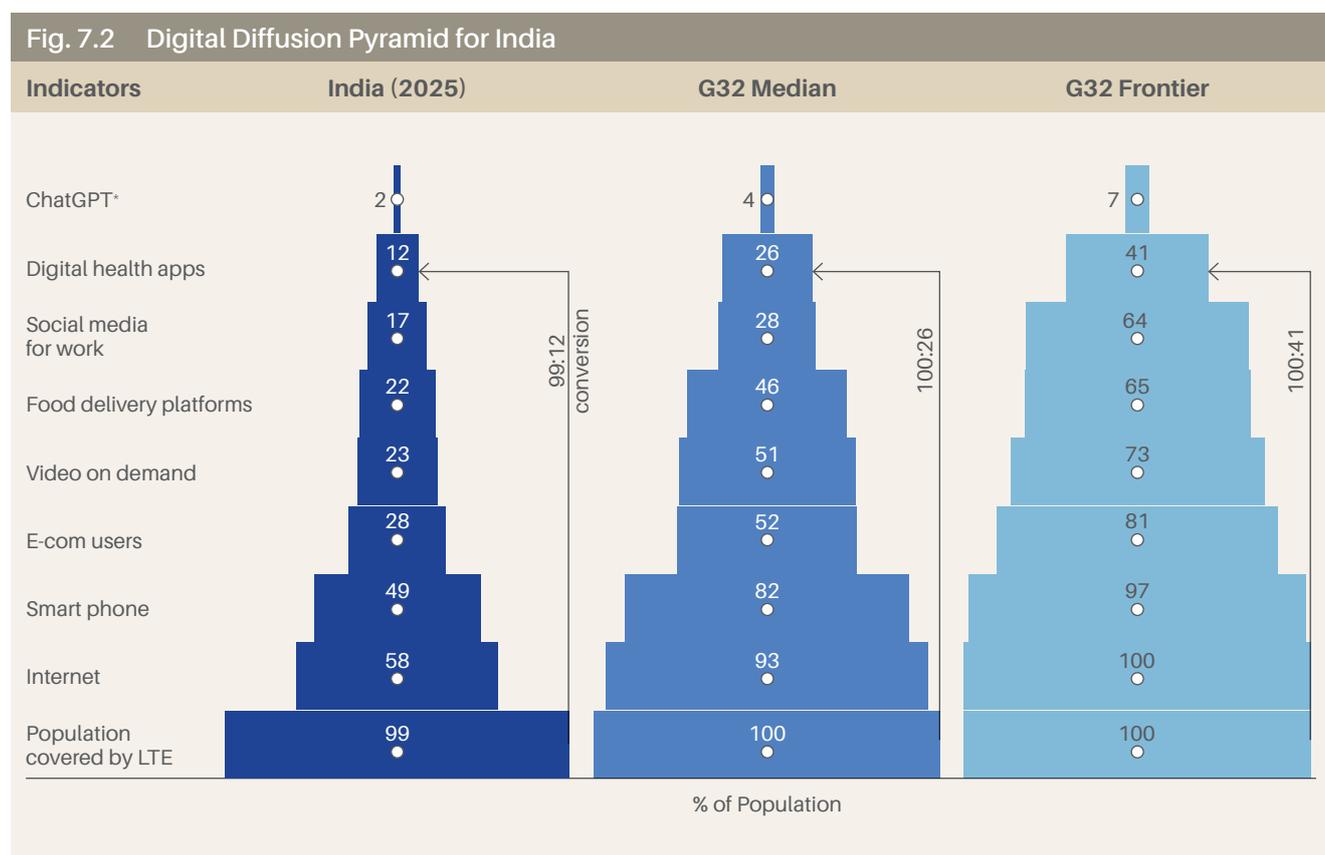
gradually move up with percentage of population using internet, smartphones and then a series of digital services.

We illustrate by creating the DDP for India and comparing it with median and frontier values of G32 (see Figure 7.2). India's skinny pyramid implies slower diffusion of digital technologies, compared to both the median as well as the frontier. In other words, stouter pyramid implies higher diffusion and vice versa.

India's DDP shows 99 percent of Indians are covered by LTE, though only 58 percent access the

internet – a gap of 41 percent. The gap increased by another 10 percentage points, with only 48 percent owning a smart phone. At each stage of the pyramid, some Indians are left behind and by the time we reach the use of digital health apps, India has nearly 88 percent of its population left behind. The corresponding number for the G32 median is 74 percent and for frontier country is 59 percent.

A skinny pyramid is also a huge opportunity for countries like India, to expand the adoption of services, thereby generating more growth, jobs and improved service delivery.



Source: ICRIER-Prosus Centre (IPCIDE)

Note: \* The number for median ChatGPT was approximated by using the 2025 number of user's in Brazil, the median country as per the AI sub-pillar.

### 7.3. Digital Drill Down

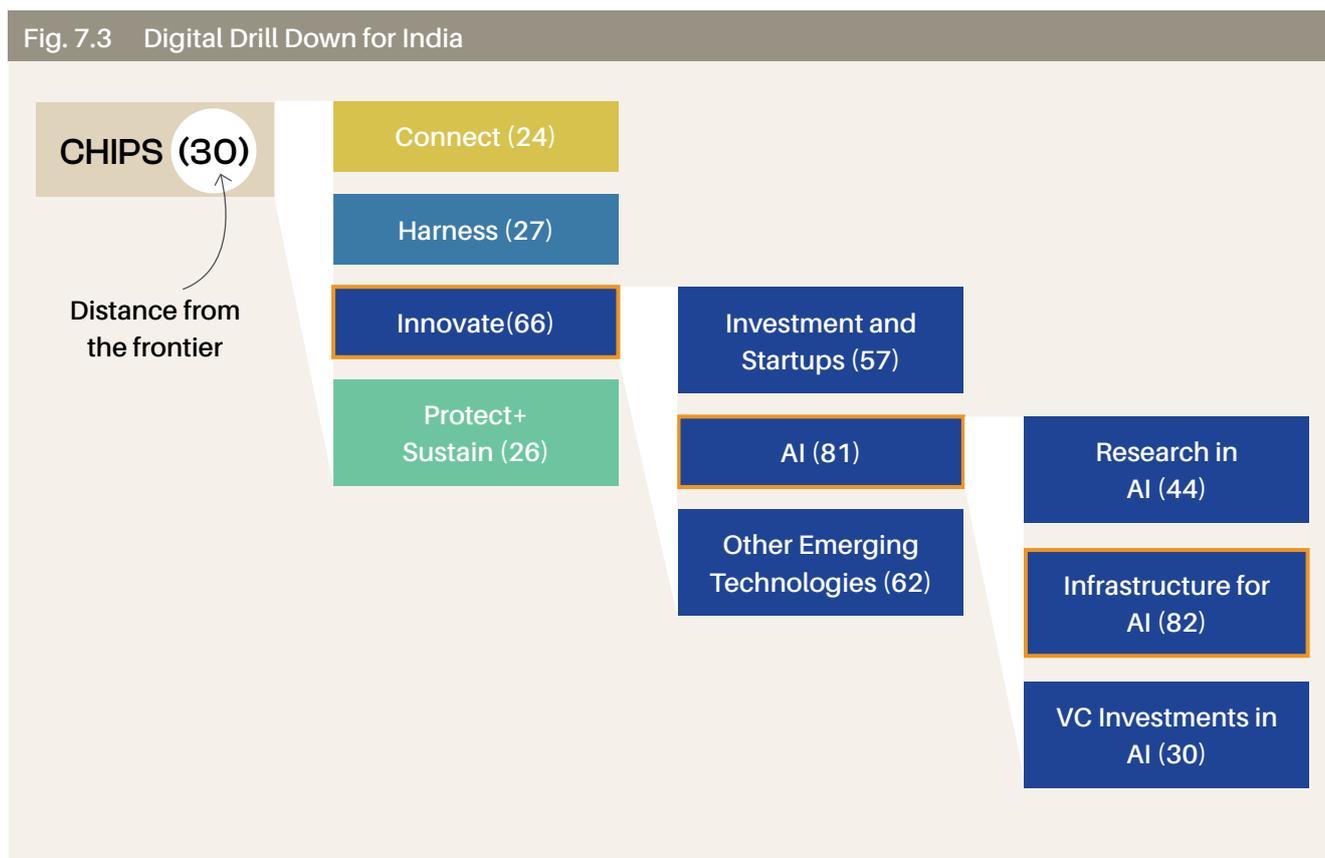
One of the interesting features of the CHIPS framework is that there is a clear line of sight from the indicator to the final score. This not only makes the framework fairly transparent, but it also creates an opportunity to unpack and disaggregate the score, from aggregate to pillar level, then to sub-pillar level and finally to the indicator level. This is similar to the commonly deployed drill down technique for problem solving - breaking down complex problems into its elements and finding a solution to each factor, with the overall aim of solving the key problem.<sup>67</sup>

For example, let's say an Indian policymaker is interested in finding out the weakest link in our digital ecosystem or the indicators that are furthest

from the global frontier. The CHIPS framework makes this complex task fairly straightforward. The policymaker could also use a peer country or the group average as the benchmark. In the example illustrated below, we use the global frontier for the Digital Drill Down (DDD)

In DDD, one starts by looking at the pillar that is furthest from the frontier, which in our case is Innovation. The next step is to look for the sub-pillar that is furthest from its corresponding frontier, which turns out to be AI in case of India. The last step is to find the indicator that is furthest from the frontier and that turns out to be infrastructure for AI (see Figure 7.3).

Fig. 7.3 Digital Drill Down for India



Source: ICRIER-Prosus Centre (IPCIDE)

<sup>67</sup> Accipio. (n.d.). *Drill Down Technique*

Based on the DDD, Infrastructure in AI, is among the 47 indicators for digitalisation, that needs most attention in India. Infrastructure in AI has been an area of policy debate in India, given its significant policy trade-offs. The high capital costs and energy requirements did raise concerns about whether India should focus on building foundational layers of the AI value chain or focus more on incremental innovation and use cases. As a result, they may have lost some precious time in, lagging behind lead

nations. With the advent of Deepseek there is reason to believe that foundational models may not be as capital intensive as was initially believed and that they do not require the most sophisticated GPUs. Its reassuring that the government has recognised the infrastructures gap and announced enhancement to the IndiaAI mission in 2024-25 budget, which aims to address this failure and guide the building of compute capacity in India.

## 7.4. Unpacking digitalisation at the sub-national level

The SIDE 2024 report provided the CHIP score for major Indian States.<sup>68</sup> It showed that Southern and Western States are far advanced in digitalisation that the Eastern and Northern States. The 2025 iteration will be released later this year. This report will help identify the national frontier and allow states to

compare their performance sub-nationally as well as with other countries, if relevant. Policymakers can use these tools - digital heatmaps, digital diffusion pyramid and the digital drill downs at the state-level for better scrutiny and policy interventions.




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<sup>68</sup> It was CHIP and not CHIPS, since we could not find reliable data for sustainability at the sub-national level.

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# Annexures

## Annexure 1: List of Countries and List of Indicators

**Table A1 List of Countries**

Argentina	ARG	Ireland	IRE
Australia	AUS	Italy	ITA
Belgium	BEL	Japan	JAP
Brazil	BRA	Mexico	MEX
Canada	CAN	Netherlands	NET
Chile	CHL	Nigeria	NIG
China	CHN	Russia	RUS
Colombia	COL	Saudi Arabia	SAR
Czechia	CZE	Singapore	SNG
Denmark	DEN	South Africa	SAF
Egypt	EGY	South Korea	SKO
Finland	FIN	Spain	SPA
France	FRA	Thailand	THA
Germany	GER	Turkey	TUR
<b>India</b>	<b>IND</b>	UK	UK
Indonesia	INS	United States	USA

**Table A2 Indicator List for CHIPS Absolute, Relative and Combined**

Indicator	Unit	Short Form	Data Source	CHIPS (Relative/Absolute)	Year of data	Notes
Price of mobile data and voice basket (HC)	PPP\$	Price of mobile data (HC)	ITU	Absolute	2023	
	% of monthly GNI			Relative		
Price of mobile data and voice basket (LC)	PPP\$	Price of mobile data (LC)	ITU	Absolute	2023	
	% of monthly GNI			Relative		
Price of cheapest smartphone	PPP\$	Price of cheapest smartphone	A4AI	Absolute	2021	
	% of monthly GNI			Relative		
Price of fixed broadband internet in USD	PPP\$	Price of fixed broadband internet	ITU	Absolute	2023	
	% of monthly GNI			Relative		
Median Mobile Download Speeds (Mbps)	Mbps	Mobile download speed	Speedtest	Absolute and Relative	As on September 2024	Same for Relative and Absolute
Median Fixed Broadband Download Speed (Mbps)	Mbps	Fixed broadband speed	Speedtest	Absolute and Relative	As on September 2024	Same for Relative and Absolute

Indicator	Unit	Short Form	Data Source	CHIPS (Relative/Absolute)	Year of data	Notes
Number of Internet Users	Absolute Numbers	Internet users	Apexx, Data reportal, Statista, World Bank, ITU, Eurostat, China Internet Overview	Absolute	2024 or latest	
	% of population			Relative	2024 or latest	
Mobile Cellular Subscriptions	Absolute numbers	Mobile cellular subscriptions	ITU	Absolute	2023	
	Subscriptions per 100 population			Relative		
Population covered by LTE	Absolute numbers	LTE coverage	ITU and World Bank	Absolute	2023	
	% of population			Relative		
Number of smartphone users	Absolute numbers	Smartphone users	Newzoo via Statista and Apexx for Brazil, Argentina, Australia, South Korea, Canada, Indonesia, Italy.	Absolute	2023 or latest	
	% of population			Relative		
Gender gap in number of women needing to connect to reach parity with male users	Absolute numbers	Digital gender gap	Calculated from ITU and 3i	Absolute	2023 or latest	To estimate - percentage point gender gap is multiplied by the number of women in the population to arrive at the additional number of women required to match the share of male internet users
Gender gap in percentage population using the internet	%	Digital gender gap	Calculated from ITU and 3i	Relative	2023 or latest	percentage point divided by population penetration rate
No. of internet users (16-64 years) using social media for work related activities	Absolute numbers % of internet users	Social media usage for work	Datareportal	Absolute	2024	
				Relative		
Number of users of digital food delivery platforms	Millions	Digital food delivery users	Statista	Absolute	2024	
	% of internet users			Relative		
Number of users of digital health applications	Millions	Digital health users	Statista	Absolute	2024	
	% of internet users			Relative		
Number of e-commerce users	Millions	E-commerce users	Statista	Absolute	2024	
	% of internet users			Relative		

Indicator	Unit	Short Form	Data Source	CHIPS (Relative/Absolute)	Year of data	Notes
Number of mobile app downloads	Billions	Mobile app downloads	Business of apps, Statista	Absolute	As of November 2024,	
	per internet users			Relative		
Number of video on demand users	Millions	Video-on-demand users	Statista	Absolute	2024	
	% of internet			Relative		
Fixed-broadband Internet traffic EBs	Exabytes	Fixed broadband	ITU	Absolute	2023	
	GBs per subscriber			Relative		
Mobile broadband internet traffic EBs	Exabytes	Mobile broadband	ITU	Absolute	2023	
	GBs per subscriber			Relative		
Value of digital payment transactions in billions of dollars	Billion USD	Digital payments value	Statista	Absolute	2024	
	PPP\$ per internet users			Relative		
Number of people who made or received a digital payment	Absolute numbers	Digital payment users	Findex	Absolute	2021	
	% of internet uses			Relative		
Number of people (age 15 +) who received private sector wages into an account	Absolute numbers	Digital private sector wages	Findex	Absolute	2021	
	% of population			Relative		
Value of neo banking transactions	Billion PPP\$	Neobanking transaction value	Statista	Absolute	2024	
	Billion PPP\$ per internet user			Relative		
Number of people who received public sector wages into an account (age 15 +)	Absolute numbers	Digital public sector wages	Findex	Absolute	2021	
	% of population			Relative		
Individuals who received government transfer or pension into an account (age 15 +)	Absolute numbers	Digital govt pension	Findex	Absolute	2021	
	% of government transfer or pension recipients, (age 15+)			Relative		
ICT Services Export	Million USD	ICT service exports	World Bank	Absolute	2023	
	% of service exports, BoP,			Relative		

Indicator	Unit	Short Form	Data Source	CHIPS (Relative/Absolute)	Year of data	Notes
ICT Market Capitalization	Absolute USD	ICT market cap	Wikipedia, MSCI	Absolute	2022	The country-wise MSCI sector weight for ICT was multiplied with the total stock market capitalisation to arrive at the ICT market capitalisation
MSCI ICT index sector weights %	Sector weights in %	ICT market cap	MSCI	Relative	2024	
ICT Value Added	USD	ICT Value Added	STAN, World Bank	G20 Absolute	2023	
	% of GDP			G20 Relative		
Research in AI (STEM, Model Research, Foundational AI research, Applied AI research, Educational institutions)	Index score	Research in AI	Tortoise Media	Absolute and Relative	2024	Part of The Global Artificial Intelligence report
Infrastructure for AI (Weighted avg of GPU, supercomputing, semiconductors)	Index score	Infrastructure for AI	Tortoise Media	Absolute and Relative	2024	
Venture Capital Investments in AI	Million of USD	VC investments in AI	OECD.AI	Absolute	2023	For denominators: FRED for US GFCF (Q3 2023 value). FRED for Japan GFCF. GFCF as a percent of GDP multiplied by GDP values, both taken from World Bank.
	Millions of USD as a % GFCF		OECD.AI, FRED	Relative		
Number of Startups	Absolute numbers	Startups	Startupranking.com	Absolute	As on November 2024	The listed company list for countries is from 2022
	Per listed company on the			Relative		
Valuation of Unicorns	Billions of USD	Unicorn valuation	CBinsights	Absolute	2023/2024	
	% of total stock market valuation			Relative		
Consumer IoT revenues	Billions PPP\$	Consumer IOT	Statista	Absolute	2024	
	per internet user			Relative		
AR/ VR revenues	Millions PPP\$	AR/VR	Statista	Absolute	2024	
	as a % of smartphone users			Relative		

Indicator	Unit	Short Form	Data Source	CHIPS (Relative/Absolute)	Year of data	Notes
Metaverse revenue	Billions PPP\$	Metaverse	Statista	Absolute	2024	
	per smartphone user			Relative		
DeFi revenue	Million PPP\$	Defi	Statista	Absolute	2024	
	per internet users			Relative		
Number of Secure servers	Absolute numbers	Secure servers	World Bank	Absolute	2023	
	Per million population			Relative		
Cybersecurity revenue	Billion USD	Cybersecurity revenue	Statista	Absolute	2024	
	as a % internet users			Relative		
Ransomware attacks 30-day average	30 day Average	Ransomware attacks	Kaspersky	Absolute	Averages taken in the months of November-December 2024	
	% of internet users			Relative		
Total number of email leaks (Quarterly average) (2021 Q3- 2024 Q3)	Absolute numbers	Email leaks	Surfshark	Absolute	2021 Q3-2024 Q3	
	per internet user			Relative		
% of respondents who are concerned about online privacy	% of survey respondents	Online privacy	IPSOS	G20 Absolute and Relative	2019	
% of respondents who say they trust the internet	% of survey respondents	Online Trust	IPSOS	G20 Absolute and Relative	2019	
Green Data Centre	USD million	Green data centres	Mordor	Absolute	2023	
	% of total data centre revenues			Relative		
EHS software	Million USD	EHS software	Mordor	Absolute	2023	
Market Size of Energy Management Software	Million USD	Energy management software	Mordor	Absolute	2023	
Market Size of Energy Management Software and EHS software % of total software revenues	% of total software revenues	-	Mordor	Relative	2023	In the relative index, EHS and EMS have been merged. Software revenues were taken from Statista
Share of digital startups in total energy startups	Share	Digital energy startups	IEA	G20 Relative	2022-2023	average of the two years

Indicator	Unit	Short Form	Data Source	CHIPS (Relative/Absolute)	Year of data	Notes
Sustainable Electronics	Million USD	Sustainable electronics	Mordor	Absolute	2023	The denominator is consumer electronics from Statista
	share of revenue from total electronics			Relative		
E-waste generated	in million kgs	E-waste generation	E-waste Monitor	Absolute	2022	
	kg per internet user			Relative		
Smart grid patents	Absolute numbers	Smart grid patents	IRENA	Absolute	2000-2023	Total patents was taken from WIPO
	% of total patents			Relative		
ICT in electromobility patents	Absolute numbers	ICT in electromobility patents	IRENA	Absolute	2000-2023	Total patents was taken from WIPO
	% of total patents filed			Relative		

## Annexure 2: CHIPS Framework and Methodology

The CHIP framework was conceptualised in 2023 with the forethought to analyse the state of digital economies and their transformation through varying approaches adopted by countries. The framework was organized around four pillars – Connect, Harness, Innovate and Protect – that capture key aspects of digital transformation, enabling comparison across countries and over time. The second iteration in 2024 expanded the framework to include a fifth pillar – sustainability. CHIP was transformed to CHIPS. The repository of indicators under each pillar has substantially expanded, enabling the computation of a composite index. In addition to the overall CHIPS score, disaggregated scores by pillar and sub-pillar allow for more modular and in-depth analysis. Like last year's report, this year's report also distinguishes between outcomes and inputs. So, while outcomes are quantitatively measured in the index, enablers are qualitatively discussed to explain the resulting outcomes. For instance, while measures of digital service adoption

are included in the index, measures of digital literacy which enable adoption have not been included.

In addition to presenting a 2025 index for the G20 countries based on the latest available data, this year's report expands the analysis to include more countries<sup>69</sup> bringing it to a total of 32. The list started with 60 countries (both Emerging and Developing Economies, and Advanced Economies) which was then narrowed down to 32 countries (G20 + 12 countries) based on following criteria: (1) population greater than 15 million (2) top 60 countries by GDP and (3) non-missing values for key indicators like smartphone users and internet users and data for at least 85 percent indicators. The 2025 G32 index is presented separately from the 2025 G20 index as it includes some new indicators that replaced old ones where data was either not available or we found an alternate that was more relevant and with a wider scope. (See Table A1 for a full list of indicators)

<sup>32</sup> Definition of Emerging and Developing and Advanced Economies have been taken from the IMF's WEO

## Calculations of index

We construct two versions of the index - the CHIPS (Economy) which captures outcomes at scale and the CHIPS (User) which captures outcomes for a representative user. Both versions of the index consist of similar indicators, but the latter is normalized by the relevant unit (e.g., population, number of internet users, GDP, etc.). A total of 47 indicators are grouped into 14 sub-pillars, which are then categorised under the 5 pillars of CHIPS.

In order to enable comparability and aggregation into an index, each indicator is standardised as follows:

$$\text{Standardised Value} = \frac{(\text{Value} - \text{Min})}{(\text{Max} - \text{Min})} \times 100$$

This standardized all values to a scale between 0 and 100, with 0 being assigned to the lowest value in the range for the G20 countries and 100 for the

## CHIPS 2024 (revised) and 2025

The CHIPS Economy and CHIPS User for G20 are based on 2024 indicators, but an updated value where available. This year a series called 2024 new was created as certain databases and sources were found to have either revised their numbers substantially or if the data had completely changed. This was necessary to allow for a comparison of 2024 and 2025 among G20 countries where the old framework with 16 sub pillars and 50 indicators has been used.

For the G32 index calculation, there are 14 pillars and 47 indicators that form the index- Trust pillar was dropped and Finance (private) and Finance (public) was merged to be called fintech. The indicator on

highest. For indicators where higher values indicate a less desirable outcome (e.g., cost, number of cyberattacks), the scale is inverted. In this case, the formula is as follows:

$$\text{Standardised Value} = \frac{(\text{Max} - \text{Value})}{(\text{Max} - \text{Min})} \times 100$$

A number of other methods of standardisation, including a z-score standardisation, were considered before arriving at this one. This current method was chosen over the z-score method to ensure the index is not overly dominated by values of outliers, reducing its ability to reflect variation within the remaining values. The other methods of standardisation, including the z-score one, were used to assess the sensitivity of the overall findings. The correlation between the values and indices calculated using the different methods were relatively high, serving as a robustness check for the final results.

cybersecurity patents was also dropped for G32 and the AI indicators for github and publications were replaced by composite scores on AI infrastructure and AI research from Tortoise Media's recent AI index. ICT value added was also replaced by IT market capitalisation.

The methodological calculation of the index is the same as G20 computation. The change in indicators does not drastically change India's ranking as most countries have moved more or less in the same direction. This iteration delineates these differences and the changes in India's ranking and scores are discussed in the main text.

## Weighting

The index is calculated as a weighted average of the indicators. The weighting of indicators has been designed carefully to ensure commensurate representation of each of the key aspects covered. Within each sub-pillar, weights are assigned equally to indicators such that they add up to 1. A few indicators for which new data was not available were assigned reduced weights in order to reflect their outdated nature and keep the index as current as possible. For example, the indicator “% of internet users who received private sector wages into an account” is based on older data from 2021. This indicator is part of the Fintech (private) sub-pillar which has a total of 4 indicators. The weights are then calculated as:

$$3X + \frac{X}{2} = 1$$

where x represents the weights for the 3 indicators with updated data and (x/2) represents the weight for the indicator with the older data. Please refer to Table A2-A4 for the weights of each indicator in the different indices. In the case that values for an indicator are missing for a country, the weights are readjusted only for that country such that the weights for the non-missing indicators in that sub-pillar add up to 1 (Refer to table A6 for a list of missing data for countries). Again, for the next level of aggregation from sub-pillar to pillar level, weights are assigned to each sub-pillar such that they add up to 1 for each pillar. The final level of aggregation

to the overall CHIPS score is then derived by assigning equal weights of 1/4 to each of the three pillars C, H and I and 1/8 to each of the two pillars P and S. The Protect and Sustain pillars are given lower representation in the index due to limitations in data availability and data quality, although we believe that both these pillars are equally important in ensuring a robust, resilient and inclusive digital economy. To summarize, the weighting scheme is therefore designed such that the three pillars of C, H and I are equally represented while the pillars of P and S are given half the representation as the other three. Each pillar is composed of a set of sub-pillars that contribute equally.

Aggregation from indicator to sub-pillar:

### Equation 1:

$$\sum_{i=1}^n (W_i \times V_{im}) \text{ such that } \sum W_i = 1$$

where i represents each indicator within the given sub-pillar, n represents the number of indicators within each sub-pillar and m represents each country.  $W_i$  is therefore the weight for indicator i and  $V_{im}$  the value of indicator i for each country m. The list of indicators and their weights in the sub-pillar are provided in the tables A2-A5 below.

## Calculation of the CHIPS Overall from the CHIPS (Economy) and CHIPS (User):

This year’s iteration also has an updated methodology to provide a holistic view of India’s Digital Economy. The CHIPS Economy and User indices have been combined to highlight and present unique challenges and successes in the developing nations. The combining of the CHIPS

Economy and CHIPS User indicators are done at the sub-pillar level. Each of the two versions of the relevant indicator is assigned half its original weight and then aggregated into the sub-pillar as shown above in Equation 1. This provides an overall score for each sub-pillar, with both the Economy

and User indicators contributing equally to the final computation. Subsequently, these CHIPS Combined sub-pillar scores are then aggregated to

get CHIPS Combined pillar scores, which are then finally aggregated into a final CHIPS Combined score.

**Table A3 Weighting for G20 CHIPS Economy, User and Combined**

Pillar	Sub -Pillar	Indicator	CHIPS Economy	CHIPS User	CHIPS Combined
CONNECT	Affordability	Price of mobile data and voice basket (HC)	2/7		2/14
		Price of mobile data and voice basket (HC) (% of GNI PC)		2/7	2/14
		Price of mobile data and voice basket (LC)	2/7		2/14
		Price of mobile data and voice basket (LC) (% of GNI PC)		2/7	2/14
		Price of cheapest smartphone in USD	1/7		1/14
		Price of cheapest smartphone (% of GNI per capita)		1/7	1/14
		Fixed (broadband) internet price, USD	2/7		2/14
		Price of fixed broadband internet (% of GNI)		2/7	2/14
	Quality	Median Mobile Download Speeds (Mbps)	1/2	1/2	1/2
		Median Fixed Broadband Download Speeds (Mbps)	1/2	1/2	1/2
	Access	Number of internet users	1/5		1/10
		Percent of population using the internet		1/5	1/10
		Mobile cellular subscriptions	1/5		1/10
		Mobile Cellular Subscriptions per 100 population		1/5	1/10
		Population covered by LTE	1/5		1/10
		Percent of Population covered by LTE		1/5	1/10
		Number of smartphone users	1/5		1/10
		Percent of population using smartphones		1/5	1/10
		Gender gap in population using the internet (percentage points)	1/5		1/10
Gender gap in percentage population using the internet (percent - percentage point divided by population percentage)			1/5	1/10	
HARNESS	App economy	Number (16-64 years) using social media for work related activities	1/6		1/12
		Percent of internet users (16-64 years) using social media for work related activities		1/6	1/12
		Number of users of digital food delivery platforms	1/6		1/12
		Percent of internet users using digital food delivery platforms		1/6	1/12
		Number of users of digital health applications	1/6		1/12

Pillar	Sub -Pillar	Indicator	CHIPS Economy	CHIPS User	CHIPS Combined
HARNESS	App economy	Percent of internet users using digital health applications		1/6	1/12
		E-commerce users	1/6		1/12
		Percent of internet users using e-commerce users		1/6	1/12
		Number of mobile of app downloads (in billions)	1/6		1/12
		Number of mobile app downloads per internet user		1/6	1/12
		Video On Demand Users	1/6		1/12
		Percent of internet users using video on demand users		1/6	1/12
	Data Intensity	Total monthly fixed broadband internet traffic (GB)	1/2		1/4
		Monthly Fixed-broadband Internet traffic per subscriber (EB)		1/2	1/4
		Total monthly mobile broadband internet traffic (GB)	1/2		1/4
		Monthly Mobile broadband Internet traffic per subscriber (EB)		1/2	1/4
	Fintech	Value of digital transactions in billion dollars	2/8		2/16
		Value of digital payment transactions (PPP\$ adjusted) per internet user		2/8	2/16
		Number of people who made or received a digital payment	1/8		1/16
		Percent of internet users who made or received a digital payment		1/8	1/16
		Number of people who received private sector wages: into an account (age 15+)	1/8		1/16
		Percent of population (age 15 +) who received private sector wages into an account		1/8	1/16
		Neo banking Transaction value (absolute)	2/8		2/16
		Value of neo banking transactions (USD PPP exchange rate adjusted) per internet user		2/8	2/16
		Number of people who received public sector wages: into an account (age 15+)	1/8		1/16
		Received public sector wages: into an account (% of public sector wage recipients, age 15+)		1/8	1/16
		Individuals who received government transfer or pension into an account (age 15 +)	1/8		1/16
		Received government transfer or pension: into an account (% of government transfer or pension recipients, age 15+)		1/8	1/16

Pillar	Sub -Pillar	Indicator	CHIPS Economy	CHIPS User	CHIPS Combined
HARNESS	Real Economy	ICT service exports (BOP current \$) in million USD	1/2		1/4
		ICT service exports (% of service exports, BoP)		1/2	1/4
		ICT Value added (absolute USD)	1/2		1/4
		ICT value Added as a Percent of GDP		1/2	1/4
INNOVATE	AI	AI Publications	1/3		1/6
		AI publications as a % of all publications		1/3	1/6
		Contributions to Global AI Projects (%)	1/3	1/3	2/6
		VC Investments in AI in Mn USD	1/3		1/6
		VC Investments in AI (millions of USD) as a percent of GFCF		1/3	1/6
	Investments and Startups	Number of start -ups	1/2		1/4
		Number of Startups per listed company		1/2	1/4
		Total Unicorn Valuation in billion USD	1/2		1/4
		Valuation of Unicorns as a share of total stock market valuation		1/2	1/4
	Other Emerging Technology	Consumer IOT Revenues in million USD	1/4		1/8
		Consumer IoT revenues (billions of USD PPP\$ adjusted) per internet user		1/4	1/8
		AR/VR Revenues in million USD	1/4		1/8
		AR/ VR revenues (PPP\$ adjusted) (in billion) per smartphone user		1/4	1/8
		Metaverse Revenues in billion USD	1/4		1/8
		Metaverse revenue (PPP\$ adjusted) per smartphone user		1/4	1/8
		DeFi Revenue in million USD	1/4		1/8
		DeFi revenue (millions of USD PPP\$ adjusted) per internet user		1/4	1/8
	PROTECT	Preparedness	Cybersecurity spending in million USD	2/5	
Cybersecurity spending in Million USD (PPP\$) as a % of internet users				2/5	2/10
Geography Wise Cybersecurity Patent Count (Cumulative from 2018 to 2022)			1/5		1/10
% of total patents that are cybersecurity related (2018-2022)				1/5	1/10
Number of Secure servers			2/5		2/10
Number of Secure servers per million population				2/5	2/10
Risk of Attack		Ransomware attacks 30 day average	1/2		1/4
		Ransomware attacks detected per month as a percent of internet users		1/2	1/4
		Total number of email leaks	1/2		1/4
		Total number of email leaks (Quarterly average) (2021 Q3- 2024 Q3) as a percent of internet users		1/2	1/4

Pillar	Sub -Pillar	Indicator	CHIPS Economy	CHIPS User	CHIPS Combined
PROTECT	Trust	Percent of respondents who are concerned about online privacy	1/2	1/2	1/2
		Percent of respondents who say they trust the internet	1/2	1/2	1/2
		Green data centres in million USD	1/5		4/40
SUSTAINABILITY	Commercialisation of Green Tech R&D	Green data centres market size as a percent of data centre revenues		1/5	4/40
		Environment, Health, and Safety (EHS) software including carbon footprint management	1/5		3/40
		Market Size of Energy Management Software and Environment, Health, and Safety (EHS) software including carbon footprint management as a percent of total software revenue		1/5	6/40
		Energy Management Software	1/5		3/40
		Share of digital startups in total energy startups		1/5	4/40
		Sustainable Electronics (Smartphones and PCs)	1/5		4/40
		Market revenue from sustainable electronics as share of revenue from total electronics		1/5	4/40
		E-waste generation in kilos	1/5		4/40
		E-waste generated (kg per internet user)		1/5	4/40
	R&D	Patents filed (2000-2021) in Smart Grids	1/2		1/4
		Patents filed (2000-2023) in Smart Grids as a percent of total patents filed		1/2	1/4
		Patents filed (2000-2021) in Information/ Communication Technologies for Electromobility	1/2		1/4
		Patents filed (2000-2021) in Information/ Communication Technologies for Electromobility		1/2	1/4

Table A4 Weighting for G32 CHIPS Economy, User and Combined

Pillar	Sub -Pillar	Indicator	Weight for		
			CHIPS Economy	CHIPS User	CHIPS Combined
CONNECT	Affordability	Price of mobile data and voice basket (HC) PPP	2/7		2/14
		Price of mobile data and voice basket (HC) (% of GNI PC)		2/7	2/14
		Price of mobile data and voice basket (LC) PPP	2/7		2/14
		Price of mobile data and voice basket (LC) (% of GNI PC)		2/7	2/14

Pillar	Sub -Pillar	Indicator	Weight for		
			CHIPS Economy	CHIPS User	CHIPS Combined
CONNECT	Affordability	Price of cheapest smartphone in USD PPP	1/7		1/14
		Price of cheapest smartphone (% of GNI per capita)		1/7	1/14
		Price of fixed broadband internet, USD PPP	2/7		2/14
		Price of fixed broadband internet (% of GNI)		2/7	2/14
	Quality	Median Mobile Download Speeds (Mbps)	1/2	1/2	1/2
		Median Fixed Broadband Download Speeds (Mbps)	1/2	1/2	1/2
	Access	Number of internet users	1/5		1/10
		Percent of population using the internet		1/5	1/10
		Mobile cellular subscriptions	1/5		1/10
		Mobile Cellular Subscriptions per 100 population		1/5	1/10
		Population covered by LTE	1/5		1/10
		Percent of Population covered by LTE		1/5	1/10
		Number of smartphone users	1/5		1/10
		Percent of population using smartphones users		1/5	1/10
		Gender gap in number of women needing to connect to reach parity with male users	1/5		1/10
		Gender gap in percentage population using the internet (percent - percentage point divided by population percentage)		1/5	1/10
HARNESS	App economy	Number (16-64 years) using social media for work related activities	1/6		1/12
		Percent of internet users (16-64 years) using social media for work related activities		1/6	1/12
		Number of users of digital food delivery platforms	1/6		1/12
		Percent of internet users using digital food delivery platforms		1/6	1/12
		Number of users of digital health applications	1/6		1/12
		Percent of internet users using digital health applications		1/6	1/12
		E-commerce users	1/6		1/12
		Percent of internet users using e-commerce users		1/6	1/12
		Number of mobile of app downloads (in billions)	1/6		1/12

Pillar	Sub -Pillar	Indicator	Weight for		
			CHIPS Economy	CHIPS User	CHIPS Combined
HARNESS	App economy	Number of mobile app downloads per internet user		1/6	1/12
		Video On Demand Users	1/6		1/12
		Percent of internet users using video on demand users		1/6	1/12
	Data Intensity	Total monthly fixed broadband internet traffic (GB)	1/2		1/4
		Monthly Fixed-broadband Internet traffic (GBs) per subscriber		1/2	1/4
		Total monthly mobile broadband internet traffic (GB)	1/2		1/4
		Monthly mobile-broadband Internet traffic (GBs) per subscriber		1/2	1/4
	Fintech	Value of digital transactions in billion dollars	1/4		2/16
		Value of digital payment transactions (USD PPP exchange rate) per internet user		1/4	2/16
		Number of people who made or received a digital payment	1/8		1/16
		Percent of internet users who made or received a digital payment		1/8	1/16
		Number of people who received private sector wages: into an account (age 15+)	1/8		1/16
		Percent of population (age 15 +) who received private sector wages into an account		1/8	1/16
		Neo banking Transaction value (absolute)	1/4		2/16
		Value of neo banking transactions (USD PPP exchange rate adjusted) per internet user		1/4	2/16
		Number of people who received public sector wages: into an account (age 15+)	1/8		1/16
		Received public sector wages: into an account (% of public sector wage recipients, age 15+)		1/8	1/16
		Individuals who received government transfer or pension into an account (age 15 +)	1/8		1/16
		Received government transfer or pension: into an account (% of government transfer or pension recipients, age 15+)		1/8	1/16

Pillar	Sub -Pillar	Indicator	Weight for		
			CHIPS Economy	CHIPS User	CHIPS Combined
HARNESS	Real Economy	ICT service exports (BOP current \$) in million \$	1/2		1/4
		ICT service exports (% of service exports, BoP)		1/2	1/4
		Market Valuation of listed IT and Communication Services Companies	1/2		1/4
		Share of IT stocks in total market valuation		1/2	1/4
INNOVATE	AI	Research in AI (Indexed Score)	1/3	1/3	2/6
		Infrastructure for AI (Indexed Score)	1/3	1/3	2/6
		VC Investments in AI in million USD	1/3		1/6
		Venture Capital Investments in AI (millions USD) as a % of GFCF		1/3	1/6
	Investments and Startups	Number of start -ups	1/2		1/4
		Number of Startups per listed company		1/2	1/4
		Total Unicorn Valuation in billion USD	1/2		1/4
		Valuation of Unicorns as a share of total stock market valuation		1/2	1/4
	Other Emerging Technology	Consumer IoT Revenues in MN USD	1/4		1/8
		Consumer IoT revenues (billions of USD PPP\$ adjusted) per internet user		1/4	1/8
		AR/VR Revenues in million USD	1/4		1/8
		AR/ VR revenues (PPP\$ adjusted) (in billion) per smartphone user		1/4	1/8
		Metaverse Revenues in billion USD	1/4		1/8
		Metaverse revenue (PPP\$ adjusted) per smartphone user		1/4	1/8
DeFi Revenue in million USD		1/4		1/8	
DeFi revenue (millions of USD PPP\$ adjusted) per internet user			1/4	1/8	
PROTECT	Preparedness	Cybersecurity Revenue in billion USD	1/2		1/4
		Cybersecurity revenue in million USD (PPP\$) as a % of internet users		1/2	1/4
		Number of Secure servers	1/2		1/4
		Number of Secure servers per million population		1/2	1/4
	Risk of Attack	Ransomware attacks 30 day average	1/2		1/4
		Ransomware attacks detected per month as a % of internet users		1/2	1/4
		Total number of email leaks	1/2		1/4
		Total number of email leaks (Quarterly average) (2021 Q3- 2024 Q3) as a percent of internet users		1/2	1/4

Pillar	Sub -Pillar	Indicator	Weight for		
			CHIPS Economy	CHIPS User	CHIPS Combined
SUSTAINABILITY	Commercialization of Green Tech	Green data centres in million USD	1/5		4/40
		Green data centres market size as a percent of data centre revenues		1/5	4/40
		Market revenue of Environment, Health, and Safety (EHS) software including carbon footprint management	1/5		3/40
		Market revenue of Energy Management Software	1/5		3/40
		Market Revenue of Energy Management Software and Environment, Health, and Safety (EHS) software including carbon footprint management as a % of total software revenue		1/5	6/40
		Share of digital startups in total energy startups		1/5	4/40
		Market revenue of Sustainable Electronics (Smartphones and PCs)	1/5		4/40
		Market revenue from sustainable electronics as share of revenue from total electronics		1/5	4/40
		E-waste generation in kilos	1/5		4/40
		E-waste generated (kg per internet user)		1/5	4/40
	R&D	Patents filed (2000-2021) in Smart Grids	1/2		1/4
		Patents filed (2000-2023) in Smart Grids as a percent of total patents filed		1/2	1/4
		Patents filed (2000-2021) in Information/Communication Technologies for Electromobility	1/2		1/4
		Patents filed (2000-2021) in Information/Communication Technologies for Electromobility		1/2	1/4

### Annexure 3: Indicators for which data is repeated from SIDE 2024

Some indicators in this year index have been repeated from last year's index because an update of these indicators is not available but form a crucial indicator that in measurement of the overall index and the pillar scores. Some of these for which

indicators have been repeated are as follows:

#### CONNECT:

- 1) Price of Cheapest smartphone (2022 or latest available)- Measures how devices in each

country are affordable. In this year's iteration, the only difference is the conversion to PPP\$

#### **HARNESS:**

In the harness pillar, 4 indicators have been repeated from Findex 2021. The same as been used in the relative index and has been normalised with population as the base.

- 1) Number of people who made or received a digital payment
- 2) Number of people who received private sector wages: into an account (age 15+)

3) Number of people who received public sector wages: into an account (age 15+)

4) Individuals who received government transfer or pension into an account (age 15 +)

#### **PROTECT:**

The following two indicators have been repeated for the G20 index:

- 1) Geography Wise Cybersecurity Patent Count (Cumulative from 2018 to 2022)
- 2) Percent of total patents that are cybersecurity related (2018-2022)

## **Annexure 4: Missing Data in G32 countries**

COUNTRY	CHIPS Economy 2024	CHIPS Economy 2025	CHIPS User 2024	CHIPS User 2025
<b>Argentina</b>	Fixed broadband internet traffic	Fixed broadband internet traffic	<ul style="list-style-type: none"> <li>• Fixed broadband internet traffic</li> <li>• Digital energy startups</li> </ul>	<ul style="list-style-type: none"> <li>• Fixed broadband internet traffic</li> <li>• Digital energy startups</li> </ul>
<b>Belgium</b>		Smartphone Users		<ul style="list-style-type: none"> <li>• Smartphone Users</li> <li>• AR/VR</li> <li>• Metaverse</li> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>Chile</b>				<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patent</li> </ul>
<b>China</b>	<ul style="list-style-type: none"> <li>• Public sector wages</li> <li>• DeFi revenue</li> </ul>	<ul style="list-style-type: none"> <li>• Public sector wages</li> <li>• DeFi revenue</li> </ul>	<ul style="list-style-type: none"> <li>• Public sector wages</li> <li>• DeFi revenue</li> </ul>	<ul style="list-style-type: none"> <li>• Public sector wages</li> <li>• VC investments in AI</li> <li>• DeFi revenue</li> </ul>
<b>Czechia</b>		VC investments in AI		<ul style="list-style-type: none"> <li>• VC investments in AI</li> <li>• Digital energy startups</li> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>Egypt</b>				<ul style="list-style-type: none"> <li>• VC investments in AI</li> <li>• Digital Energy Startups</li> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>Finland</b>		Internet users using social media for work related activities		<ul style="list-style-type: none"> <li>• Social Media for work</li> <li>• Startups</li> </ul>
<b>France</b>	Fixed broadband internet traffic	Fixed broadband internet traffic	Fixed broadband internet traffic	Fixed broadband internet traffic
<b>Ireland</b>				Startups

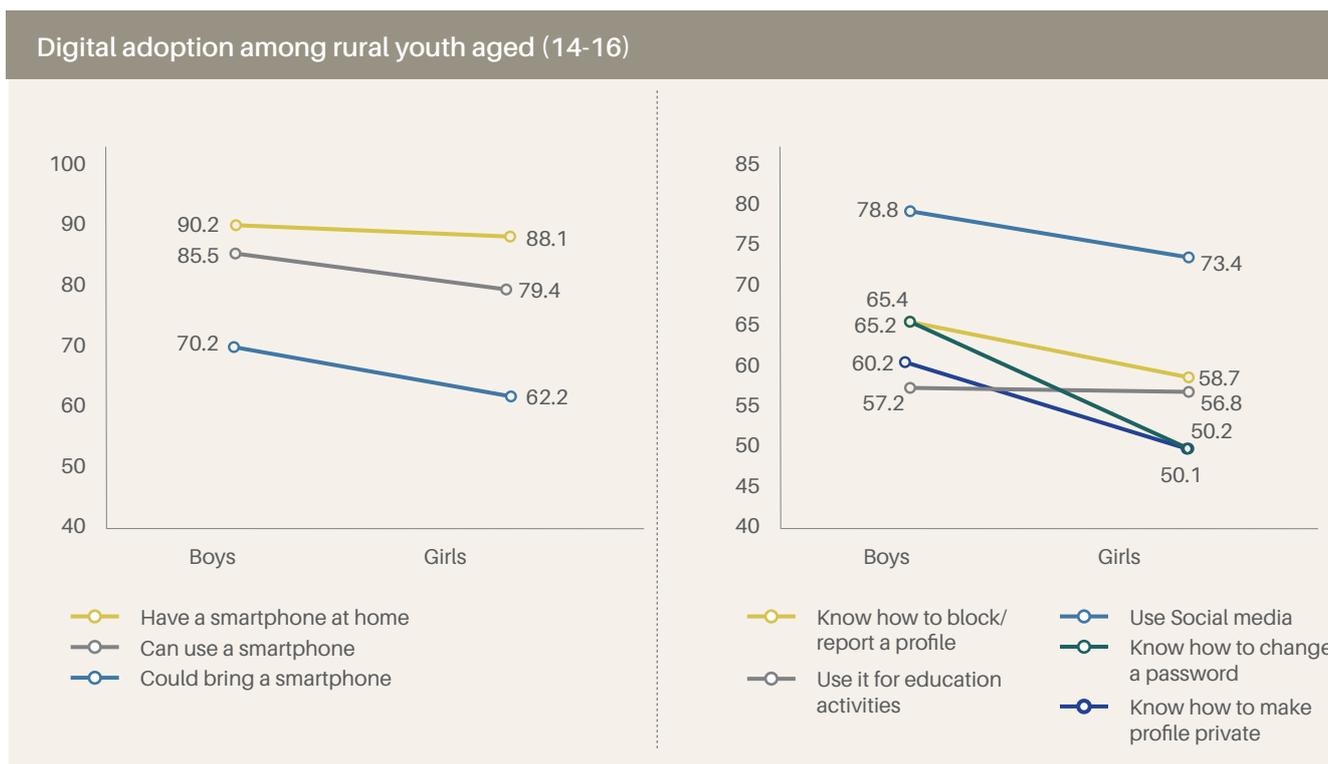
COUNTRY	CHIPS Economy 2024	CHIPS Economy 2025	CHIPS User 2024	CHIPS User 2025
<b>Mexico</b>			<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>	<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>Netherlands</b>		<ul style="list-style-type: none"> <li>• Fixed broadband internet traffic</li> <li>• Email Leaks</li> </ul>		<ul style="list-style-type: none"> <li>• Fixed broadband internet traffic</li> <li>• Email Leaks</li> <li>• Digital Energy Startups</li> </ul>
<b>Nigeria</b>		<ul style="list-style-type: none"> <li>• Digital government pension</li> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>		<ul style="list-style-type: none"> <li>• Digital government pension</li> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>Russia</b>	<ul style="list-style-type: none"> <li>• Startups</li> <li>• Unicorn Valuation</li> </ul>	Unicorn Valuation	<ul style="list-style-type: none"> <li>• Startups;</li> <li>• Unicorn Valuation</li> </ul>	<ul style="list-style-type: none"> <li>• Unicorn Valuation</li> <li>• Digital energy startups</li> </ul>
<b>Saudi Arabia</b>	Unicorn Valuation	Unicorn Valuation	Unicorn Valuation	Unicorn Valuation
<b>Singapore</b>		<ul style="list-style-type: none"> <li>• Mobile app downloads</li> <li>• Fixed Internet broadband traffic</li> </ul>		<ul style="list-style-type: none"> <li>• Mobile app downloads</li> <li>• Fixed broadband internet traffic</li> </ul>
<b>South Africa</b>			Digital energy startups	Digital Gender gap
<b>South Korea</b>			Digital energy startups	
<b>Thailand</b>		<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patent</li> </ul>		<ul style="list-style-type: none"> <li>• Digital Energy startups</li> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>Turkey</b>			<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>	<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>United Kingdom</b>			<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>	<ul style="list-style-type: none"> <li>• Smart grid patents</li> <li>• ICT in electromobility patents</li> </ul>
<b>United States</b>	Fixed broadband internet traffic	<ul style="list-style-type: none"> <li>• Fixed broadband internet traffic</li> <li>• Ransomware attacks</li> </ul>	Fixed broadband internet traffic	<ul style="list-style-type: none"> <li>• Fixed broadband internet traffic</li> <li>• Ransomware attacks</li> </ul>

## Annexure 5: Digital Adoption by India's Youth

The ASER (Annual Status of Education Report), a representative survey of rural districts of India, included a section on digital literacy in its recent 2024 survey. It found that teenagers' access to smartphones in rural areas is relatively high. Around 89% of rural children aged 14-16 had access to a smartphone at home, with around 82% knowing how to use it. There are, however, gender gaps girls' and boys' access and use of smartphones, and their knowledge of safety features (see Figures below). The gender gap in access to smartphones is lower than in ability to use it. Although the gender gap in access to a smartphone at home is relatively low, girls are less likely to be able to bring it with them for an activity during the day. So, for some girls, despite

having potential access to a smartphone at home, their ability to actually use it and have time with it is lower.

The survey also looks at what rural teenagers use smartphones for. Overall use of smartphone for education activities is relatively low, with only 57% of rural children aged 14-16 doing so, compared to 76% who use it for social media. Interestingly, amongst children who know how to use a smartphone, there is almost parity between boys and girls in its use for education related activities. There is however, a concerning gender gap in basic abilities for online safety such as knowing how to change a password.



Source: ASER 2024 survey



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